# Strategies, Approaches and Experiences:
## Towards building a South African Digital Health Innovation Ecosystem

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***Strategies, Approaches and Experiences: Towards building a South African Digital Health Innovation Ecosystem***

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# Strategies, Approaches and Experiences: Towards building a South African Digital Health Innovation Ecosystem

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# Foreword

The **digitalisation** of Healthcare Information Systems in South Africa could have an impact beyond mere access to and delivery of health services. The health landscape of South Africa offers unique challenges and for digital health to work, it has to address several major challenges pertaining to infrastructure and interoperability of all health systems. South African **investments in digital health, when conceived and managed as socially, technologically and economically sustainable innovation,** can have **implications beyond economic policy**, and may require new approaches in public management. Therefore, the **planning and building of a national infrastructure for digital health** should take stock of international experiences of building integrated systems. **Yet, substantial effort is required to plan and build a distinctly South African digital health culture that accommodates the country's diverse needs appropriately.** Success will require innovative solutions that are **sensitive to local economic, social, cultural and organisational factors**, and that are adapted to augment the broader **South African capabilities** in digital health. The **adoption and acceptance of digital health infrastructure and solutions by healthcare professionals, organisations and patients is challenging and critical for success.** A clear evaluation framework to monitor unsuccessful and successful adoption and acceptance of digital health solutions, as well as to trigger adaptive and corrective measures, must be designed from early on.

The **Digital Health Innovation Ecosystem (DHIE)** involves three interactive, complementary modules: **context,** the **innovation lifecycle** and the **users/stakeholders**. The context builds on the typology of Social, Technological, Economic, Environmental, Political and Value-based issues (STEEPV). **Stakeholders** should include, for example, patients, user communities, technology providers, payers, regulators and policymakers. **Technology** should cover **systemic views on elements** of interoperability, standards and integration of infrastructure. It should include privacy elements and big data, as well as focus on analytics and storage, and control of access. In a digital ecosystem, **users must sense or experience trust**. They must feel that they can control and increase their own access to a system. Their uptake and use are essential for such an ecosystem to work or to be regarded as a sustainable solution. For sustainability to work, the **value of a system has to be shared across groups** where there are partnerships, capacity building, good leadership and governance. **Reaching, engagement and empowerment** of low-income populations in urban and rural areas to deliver novel digital health services require **highly targeted measures**, which will require careful consideration of relatively **idiosyncratic conditions**.

The **build-up of digital health in South Africa** is not only about improving the availability, access and delivery of healthcare services, but essentially about **enhancing a**

**country's strategic capabilities to create, adapt and implement novel digital health solutions** within and by the **public and private** sectors. Platforms, technologies and solutions implemented must also be flexible enough to adjust to **future needs**. **Foresight methodologies** may propose a useful approach to construct a shared understanding of emerging possibilities. Including often-facilitated social processes, foresight methodologies propose a reforming platform for a **self-directed innovation ecosystem to emerge**. Innovation is considered to occur in an organic manner based on the **common interests of various stakeholders** and, consequently, it allows novel outcomes. In a local form these creative platforms can support the rise of an innovation-favourable culture, and help lower the barriers of local entrepreneurship.

# Preface

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.

The book provides a realistic overview of the current South African health situation in which ICT systems are involved and related issues have to be addressed if digital health systems are to be implemented to strengthen the health system in South Africa. Digitalisation of healthcare processes is one of the key requirements in global health, and as such constitutes an obvious central issue for every government concerned with the health and well-being of its citizens. National strategies, initiatives, funding, projects, as well as consultant briefs and academic literature on the topic are increasing rapidly. Practically no serious health policymaker or professional would have missed the call to digital health action due to "social and demographic changes, the rise of chronic diseases, and the need to improve efficiency and quality of healthcare delivery" (OECD 2013).

The Finnish Ministry for Foreign Affairs played a key role in making this collaboration a reality through its financial support. The collaboration focused on two key issues: Firstly, it broadened the Finnish and South African capabilities for strategic planning of digital health innovation ecosystems, and secondly, it undertook practical and targeted work to analyse, conceptualise and build a South African Digital Health Innovation Ecosystem (DHIE), in which foresight and road mapping were applied. The dialogue between South African and Finnish research experts in innovation and community work has been important for our ability to learn how technologies can be deployed to address society-wide challenges. It is also a testimony to the importance of two-way learning between Finland and South Africa.

The context and challenges experienced in health in South Africa are outlined in **Section A,** coupled with an analysis of what elements constitute the DHIE in general. **Section B** presents the methodology that was applied, as well as the underlying philosophy and methods that contributed to the development of this high-level ecosystem. The different phases of conceptualising and developing the DHIE for South Africa, together with a graphical representation that illustrates how the concepts relate to and support one another, are also provided in the final DHIE. **Section C** presents the next steps in implementing a Mobile Health and Wellness Innovation Ecosystem in South Africa with the lessons learnt, reflections and discussions.

All the chapters were reviewed by peers and the feedback from these reviewers has been incorporated.

# Chapter 7: Phase 3: Key findings from workshops in South Africa and Tanzania

*Marlien Herselman, Adèle Botha, Thomas Fogwill & Ronell Alberts*

## 7.1 Introduction

This part deals with the last phase of the DSRM process as depicted in Figure 7-1:

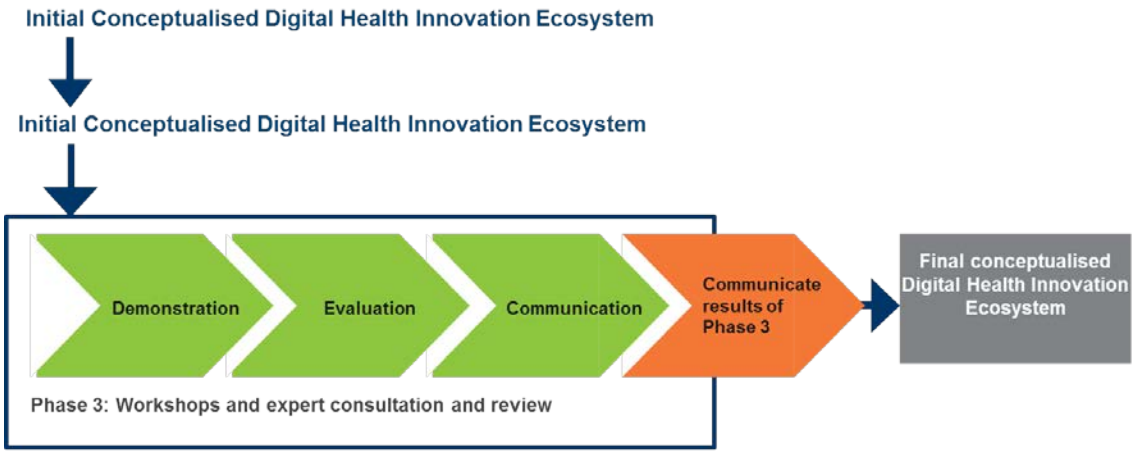


**Figure 7-1: DSRM process for Phase 3**

It is essential to understand the limitations of the transfer of Finnish or European experience and technical solutions to South Africa. The specification and definition of potential South African users and beneficiaries of digital health systems, or the adaptation of the cost structure of solutions would probably be the traditional focus areas when considering the value of European examples for South Africa. Indeed, failure to appreciate the local context and user needs is a typical problem when people attempt to transfer solutions from Europe to Africa. However, learning from other countries at the *system level* requires that attention be paid to how the emerging South African Digital Health System is adapted, integrated and coordinated with South Africa's national innovation system.

Before Phase 3, the conceptualisation of the DHIE consisted of the following insights gained, as illustrated in Figure 7-2:

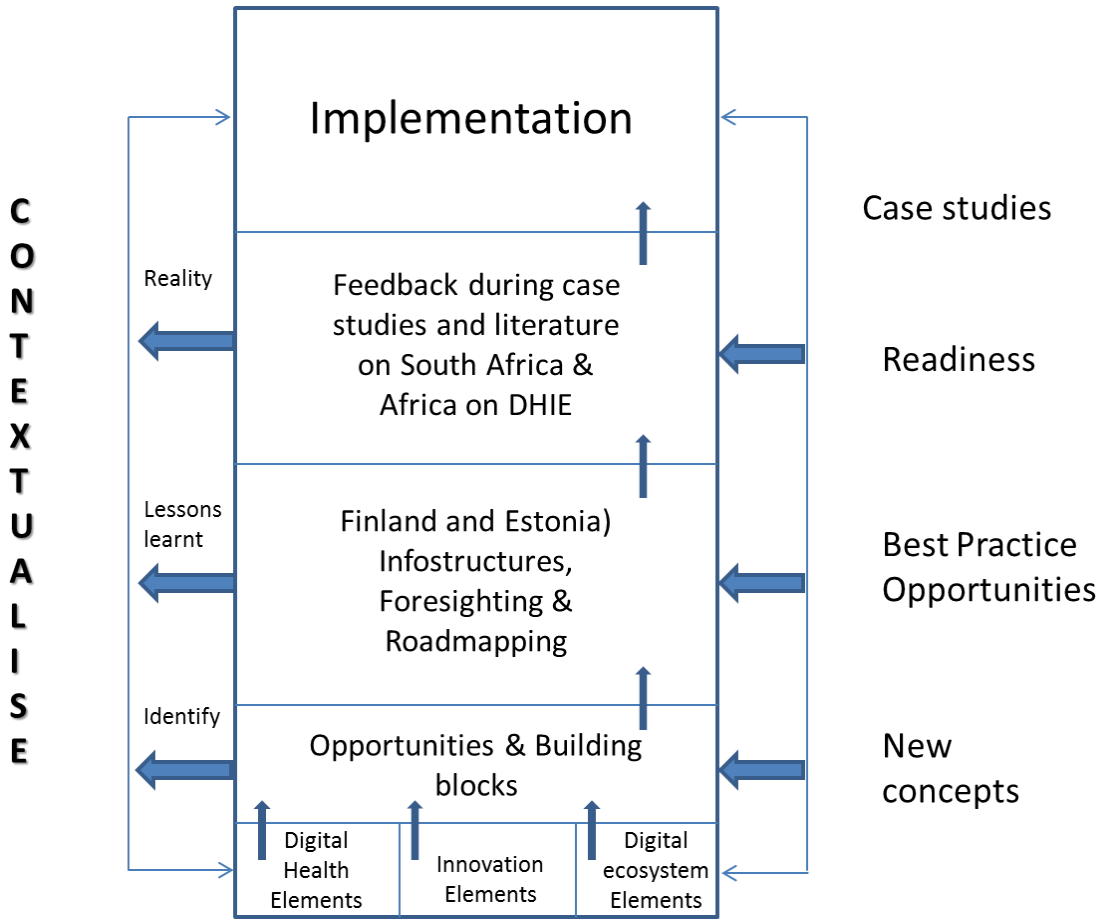


**Figure 7-2: Conceptual DHIE after Phase 2**

The above conceptualisation of the DHIE indicates that one needs to study the literature to identify the elements or concepts associated with the term DHIE. This helps to develop the building blocks which then assist in identifying new opportunities and concepts for the DHIE (for example using the Gartner hype cycle and transition management as mentioned in Chapter 5). The concepts were derived from evidence in the literature on South Africa's health situation in the current as well as future contexts, the information from Finland and Estonia that was deemed essential for such an ecosystem to exist, as well as the application of foresight and roadmapping as approaches to take a futuristic view of such an ecosystem. The lessons learnt from the Estonian and Finland infostructure allowed for developing best practices, which informed the workshops which were held in South Africa and in Africa. The reality of South Africa as a developing context allowed us to determine the reality of the most pertinent issues from the context through the application of STEEPV (Miles, 2015). In the end this provided insight into the most urgent need of South Africa – mHealth – and hence mHealth was identified as the element of digital health that will be implemented in a case study in Cape Town (see Section C).

## 7.2 Evidence from workshops

Two workshops were held, one in South Africa (August 2015) and one in Tanzania (November 2015), where health experts and researchers from all over the world provided inputs into the development of the DHIE.

The workshop attendees represented various stakeholders from different institutions and included academics from South Africa (Rhodes University, Unisa, North West University and the University of Cape Town); researchers from Germany, Namibia, Zimbabwe, Spain, Zambia and Tanzania, from the Innovation Centre at Groote Schuur Hospital in Cape Town, as well as from an NGO in Cape Town. This allowed for a unique combination of stakeholders who provided valuable feedback and inputs into the Digital Innovation Ecosystem for South Africa. Their feedback offered additional insights into the initial understanding and subsequently expanded the conceptualisation of a successful DHIE. The strategic change toward digital health should be a national priority, strongly supported by the government. To succeed, the implementation of digital health needs strong and visible advocates who provide leadership and build enthusiasm among stakeholders (something that was highlighted in Chapter 5 as well).

Before the findings from each workshop are provided, it is necessary to indicate how the participants were selected, as well as how data was collected, verified and analysed. It should be noted that this part of the methodology supports Phase 3 in the adapted Peffers et al. (2008) model as depicted earlier in Figure 7-1.

## 7.3 Data collection

To ensure data accuracy, a variety of sources were used, namely observations, interviews (both one-on-one and focus groups), audio-visual material (photographs, text and video recordings), as well as expert opinions. These sources were mentioned in Chapter 5 where the foresight diamond was discussed (Figure 5-4).

Expert opinion is a data collection technique that seeks the views of experts in functional areas of the outcome. Expert groups are used to evaluate the research outcome (artefact) through criticism of the presented material (Molich & Jeffries, 2003). Their comments and suggestions are subsequently incorporated into the final artefact.

Appropriate experts must be selected to ensure the appropriateness of their comments on the presented material. Experts selected for an expert review as part of a study should meet four criteria, namely knowledge and experience relevant to the research; capacity and willingness to participate; sufficient time to participate; and effective communication skills (Skulmoski, Hartman, & Krahn, 2007). For the current study the experts were tasked with offering comments on the various stages of developing the proposed ecosystem. (This was also indicated in paragraph 5.2 in Chapter 5 where the foresight diamond was applied to support technology roadmapping.

Apart from the primary data collected for the study, secondary sources of data were also examined to provide a theoretical basis for the study.

### 7.4 Sampling

The participants in the interviews conducted in Phase 2 and Phase 3 were selected by means of purposive and snowball sampling. In the case of purposive sampling the researcher uses her/his judgment to select specific participants who can contribute to an understanding of the research problem and phenomena central to the investigation to fulfil the purpose of the research (Creswell, Plano & Clark, 2011; Oates, 2006). Snowball sampling identifies research participants through a chain reaction as a result of word-of-mouth publicity. Researchers find one person who comes from the target group and then ask him/her to recommend additional participants who can contribute to the study. Having gathered data from these participants, the researchers then ask them to recommend additional participants (Creswell, Plano & Clark, 2011; Oates, 2006).

### 7.5 Data verification

To further ensure data accuracy, corroborate the findings and enhance their validity, various types of triangulation were used (Oates, 2006):

- Data triangulation involves the use of a variety of data sources in a study. In this study the sources included participants (digital health developers in Finland and Estonia and digital health experts in South Africa and Finland), existing documentation relevant to the study and external experts in the Information and Communications Technologies for Development (ICT4D), technology and health domains.
- Theory triangulation used multiple theoretical perspectives – critical and design – to interpret the data collected.
- Method triangulation entailed the use of multiple data-generation methods, namely ethnographic reports, observations, interviews, photographs, and anecdotal stories.

### 7.6 Data analysis techniques

As interpretivism is the philosophy that has been applied during the different workshops (Phase 3 of the DSRM process of Peffers et al., 2008), the hermeneutic analysis technique was applied. Hermeneutics is based on the interpretative paradigm (Walsham, 1995). According to Gadamer (1998, p. 196) the hermeneutic analysis is “logically a circular argument in so far as the whole, in terms of which parts…” or otherwise put “we must understand the whole in terms of the detail and the detail in terms of the whole” (Gadamer, 1998). Hermeneutics therefore analyses the various sections of the text while considering the complete picture. It also analyses the complete picture while looking at the different separate texts that contributed to the whole picture. This is done by way of the hermeneutic circle.

**Hermeneutic circle**

The analysis of this research was based on the following four stages that make up the hermeneutic circle:

- Stages 1 and 2: Study of the literature review based on the hermeneutic circle to produce initial artefacts.
- Stages 3 and 4: Conducting of multiple case studies that included an investigation of the Finland and Estonia health systems, and workshops in South Africa and Africa.

Klein and Myers (1999) proposed a set of principles to conduct and evaluate interpretive case research, which are based on the philosophical perspective of hermeneutics and apply mostly to studies of this nature. Table 7-1 lists these principles and indicates how they guided the research study as a whole.

**Table 7-1: Principles for conducting and evaluating interpretive research**

| **Fundamental principle for conducting and evaluating interpretive studies** | **How and where applied in this study** |
|---|---|
| 1. The Fundamental Principle of the Hermeneutic Circle: This principle suggests that all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they form. This principle of human understanding is fundamental to all the other principles. | Data analysis using Creswell's (2007, p. 75) within-case, cross-case and holistic-case analysis template. Triangulation. |
| 2. The Principle of Contextualisation: Requires critical reflection on the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged. | Applied when highlighting the setting of South Africa's public health system. |
| 3. The Principle of Interaction between the Researchers and the Subjects: Requires critical reflection on how the research material (or 'data') was socially constructed through interaction between the researchers and participants. | The role of the researchers and digital health experts during the interviews and workshop is evidence of this. |
| 4. The Principle of Abstraction and Generalisation: Requires relating the idiographic details revealed by the data interpretation through the application of principles 1 and 2 to theoretical, general concepts that describe the nature of human understanding and social action. | It is envisaged that the resulting ecosystem will be able to be replicated and applied in other provinces in South Africa or other developing countries; thus generalisation will be possible if the context specifics are taken into consideration. |
| 5. The Principle of Dialogical Reasoning: Requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings (*the story which the* | The data was interpreted in the light of the literature and visiting and interviewing the Finnish and Estonia health system developers and experts. |

| | |
|---|---|
| *data tell*s) with subsequent cycles of revision. | |
| 6. The Principle of Multiple Interpretations: Requires sensitivity to possible differences in interpretations among the participants as are typically expressed in multiple narratives or stories of the same sequence of events under study. Similar to multiple witness accounts, even if all tell it as they saw it. | Interpretations from the researchers from both South Africa and Finland were useful to ensure that differences are addressed. |
| 7. The Principle of Suspicion: Requires sensitivity to possible *biases* and systematic *distortions* in the narratives collected from the participants. | Data collected from participants was done anonymously. Multiple sources and measures for data collection were employed. |

The principle of the hermeneutics circle and multiple interpretations require the researcher to understand and examine situations not only in parts, but also as a whole, and to assign explanations to them.

In summary, the following was applied to guide the development of the artefacts:

- *Philosophy:* Although the philosophy chosen for the study was mainly pragmatism to guide the design and development of the artefact known as the DHIE, interpretivism was also applied to the results from the phases, case studies and workshops, which were part of the phase iterations of the design science cycle.
- *Methodology:* The methodology used was DSR, which was informed by qualitative multiple case study methodology as well as foresight and roadmapping.
- *Approach:* The data was analysed through both inductive and deductive means.
- *Research strategy:* The strategy used in the study was the multiple case study approach.
- *Data collection techniques used:* The data collection techniques used included primary data in the form of the validations from the experts, and secondary data sought from literature reviews.
- *Data analysis:* The data was analysed by employing hermeneutics and descriptive statistics techniques to render meaningful the examination of the collected data as well as to conduct within-case, cross-case and holistic-case analysis. Triangulation of results was therefore applied.

The methodology section explained how the DHIE was designs and how it was improved based on the application of the Design Science Research Methodology process. The next section explains in detail each workshop and how it informed the conceptualisation of the DHIE.

## 7.7 Workshop 1 (South Africa) – Goals and feedback

The main goal of the first workshop was to provide an overview of the current eHealth or mHealth research projects and to provide feedback on a proposed DHIE from the user's perspective.

Each of the workshop participants had to provide an overview of their specific research focus and indicate what they do in the digital health research space in which they are situated. They also had to

- share lessons learnt with one another on operational issues in different settings/environments;
- share challenges on digital health from their specific perspectives; and
- indicate what they considered to be the most important elements and components in a DHIE for South Africa.

This allowed for valuable inputs and insights into the landscape of digital health, especially from a developing country's perspective. At the end of the workshop it was agreed that the following factors supported the development of an innovative digital health ecosystem for a developing context like South Africa:

- Resources (allocation, management, availability)
- Governance (invest in infrastructure, rigorous decision making, and systematic risk assessment)
- Democracy
- Allow for a flexible system
- Strategy and leadership
- Organisational culture of innovation
- People
- Technology
- Partners
- Clustering (foster interactions)

Thus, if one wants to invent an innovative digital health innovation ecosystem for South Africa, cognisance must be taken of the above factors' influence on the already established health system.

It was soon realised that if technological foresighting and roadmapping were applied as was done previously in Finland (refer to Chapter 5), and if technologies were to work in a digital health space, these technologies and people would have to be able to adapt to changes and to focus on a mind-set where capabilities are important to transition catalysts.

Regulation comes after innovation and in innovation the focus has to be on technology, sustainability and the user, in order to streamline a digital ecosystem. Users must feel or experience trust, be prepared to change behaviour, and feel that they can control and increase their own access to a system. Their uptake and use are essential for such an ecosystem to work. Technology should include elements of interoperability, standards, integrated

infrastructure, privacy issues, big data, focus on analytics and storage, and controlled access. For sustainability to work, the value of a system has to be shared across groups where there are partnerships, capacity building, leadership and governance, and where measurement can play a role. With foresight in mind, workshop participants were allowed to apply the following layered view of specific considerations in developing essential components of the DHIE for South Africa:

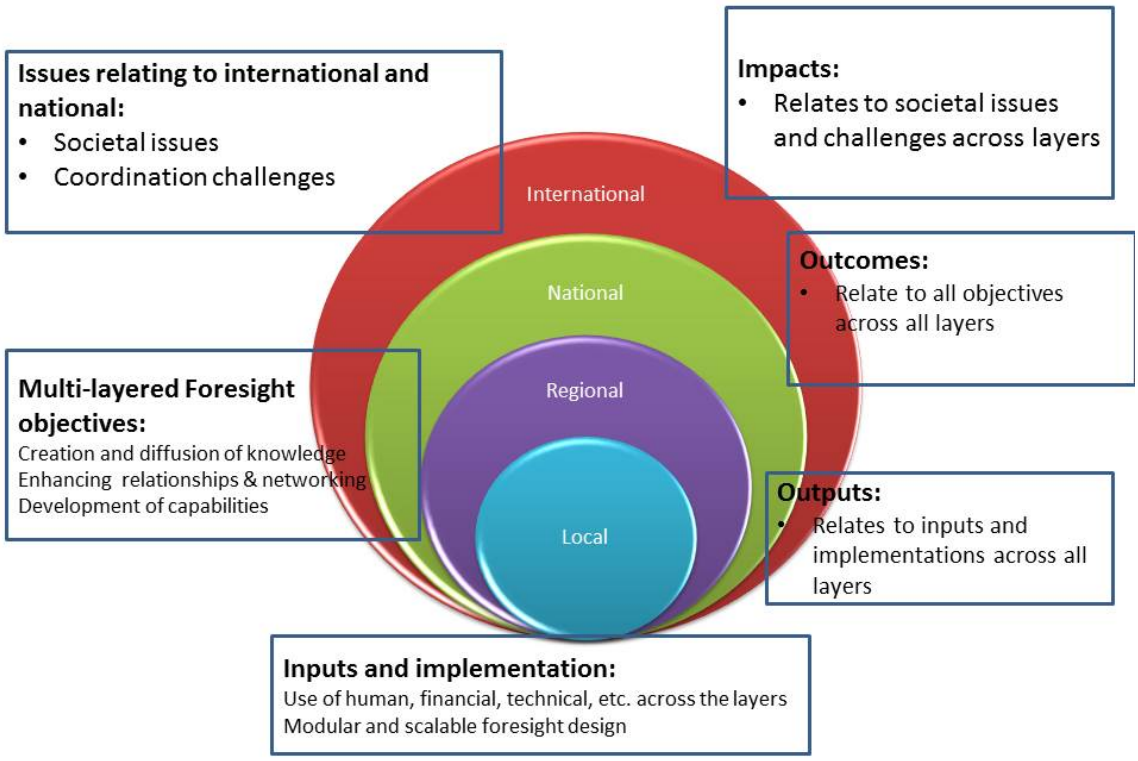


**Figure 7-3: Multiple layers in innovation ecosystems and applying foresight principles (Adapted from Pombo-Juárez et al., 2016)**

Figure 7-3 illustrates the four layers (local, regional, national and international) where specific issues should be regarded. At the international level, issues relating to society and coordination challenges have to be considered together with impacts. At the local, regional and national level, foresight objectives that consider the creation and diffusion of knowledge, enhance relationships and networks and develop capabilities, have to be considered to allow for opportunities and new concepts to be derived. At the local level, it is also important to focus on the inputs and implementation realities and to use the outputs and outcomes from these to provide renewed innovation of an ecosystem.

After Workshop 1, and all three the previous phases (1-3), various components emerged as essential when conceptualising a Digital Health Innovative Ecosystem (DHIE). They support the conceptual DHIE (see Figure 7-2. The role of the local, regional, national and

international levels where innovation takes place, as well as the importance of the stakeholder and user/consumer, emerged as important components that were not that evident in Figure 7-2.

In Figure 7-4 it is evident that a DHIE should comprise specific components and these components have important aspects that are unique to them and that need to be considered. Next to each component there are also issues that support them in a unique way and that relate to the aspects that encompass the component.

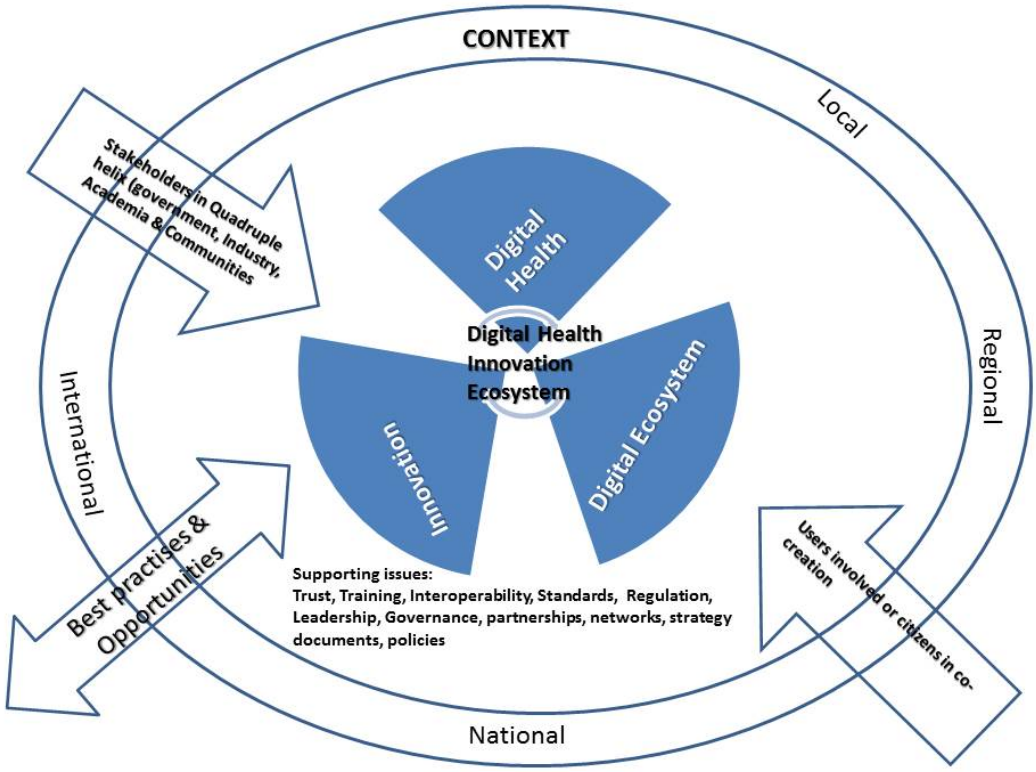


**Figure 7-4: Initial and intermediate components for the DHIE for South Africa**

The important components that emerged – technology, context, stakeholders and users – allowed for an improvement of the previous conceptualisation of the DHIE after Phase 2 (Figure 7-2). The table below explains the aspects of each component, as well as the issues that support them.

**Table 7-2: Components, aspects and issues supporting each component**

| Components | Aspects | Issues that support each component |
|---|---|---|
| Digital health, innovation and digital ecosystem elements | All the elements that were previously provided and that have to be considered for the DHIE to operate within its context. They | Interoperability, integration and standards to prevent fragmentation. Building the infostructure which was provided in Chapter 1 |

| Components | Aspects | Issues that support each component |
|---|---|---|
| | can include platforms, devices, data security, auditing, privacy, processes, access, storage, infrastructure, connectivity and fragmentation reduction. | |
| Context | In health, a context comprises a public and private domain. It can be a developed or a developing context, and government strategy documents (Green Papers, White Papers) have to be considered in this context.<br>The context also involves local, regional, national and international multi-layers. | Regulation, leadership and governance. Strategy documents at national level |
| Stakeholders | Partnerships should be formed by stakeholders where their networks can collaborate and where there is trust among them. They should also understand the importance of change management, especially if a disruptive technology like digital health is involved. Stakeholders should involve the quadruple helix. | Involve and inform them on a regular basis to use their feedback and to co-create with them. Cognisance is also taken of stakeholder issues. |
| Users | Users can be stakeholders (patients, industry people, universities, councils and NGOs), they can be involved in usability testing and need security in using digital devices or wearables. They also value trust as important when collaborating. | Trust, capacity, training and skills; clarity of benefits |

Workshop 1 also made it evident that a specific type of innovation model should be considered to play a role in stimulating co-creation and collaboration in order for users and stakeholders to create opportunities for the use of digital health in this ecosystem.

The workshop was a success both in terms of networking and outcomes, since the objectives of awareness creation between the different participants were obvious. Delegates also used the opportunity to meet key players from different countries and to share experiences of great value. They agreed to strengthen the collaboration between participants

from the different countries and indicated that having a network is an opportunity that needs to be utilised fully for the benefit of everyone.

### 7.8 Workshop 2 (Tanzania) – Goals and feedback

The participants in this second workshop represented different categories of groups of people (stakeholders). They were from all over the world and mostly represented Africa – not just South Africa.

The main goal of the workshop was to provide an overview of the current status of the DHIE of South Africa (conceptualised during the literature overview and further refined during Workshop 1 – see Figure 7-2) with its different facets or components. Apart from sharing the overview of this DHIE for South Africa, Workshop 2 focused mainly on applying foresight principles to identify drivers, trends and inhibitors for the following STEEPV areas: Social, Technological, Economic, Environmental, Political and Value-based issues. STEEPV will be explained below as one of the tools one can be applied to refine the context in foresight. The feedback can inform the proposed DHIE, especially from a stakeholder and user perspective, through focusing on finer elements of the context, both on a local, regional, national or international level.

Foresight is a capability to assess future possibilities in such a way as to confront them. It is a study of the future, especially of a future transformed through the use of new technologies (Georghiou, 2008). When applying foresight, participants can learn through a process, and they can be interactive as well as future- and action-oriented. In Workshop 2, the STEEPV (similar to PESTLE and TEEPSE) tool was applied (Miles, 2015), especially to consider the context (Figure 7-4) and to involve all relevant stakeholders.

According to Pombo-Juárez (2016), foresight processes help to identify weaknesses in innovation ecosystems by bridging certain gaps in innovation networks through interaction between stakeholders in participative and inclusive processes. While a number of large-scale foresight activities are concerned with national innovation systems (Georghiou et al., 2008; Könnölä et al. 2009; Havas et al. 2010), there are those that focus on regional and local level (as explained in Figure 7-3) and consider context as important for development (Dufva et al., 2015; Gavigan et al., 2001; Keller et al., 2015). These were also applied in this workshop.

Foresight contributes to the governance of innovation ecosystems through its emphasis on the exploration of long-term developments (which often transcend immediate differences in point of view), and on the formulation of common visions, which indicate joint actions across multiple layers of innovation ecosystems (Pombo-Juárez, 2016). This allows for the exchange of understandings among stakeholders as they suggest topics of foresight. Foresight can also create new knowledge (see Eerola & Miles, 2011; Miles, 2010; Loikkanen et al., 2006), mainly because people can participate and collaborate during a foresight workshop, as was evident in Tanzania.

Three foresight objectives were also applied during this workshop in Tanzania (Salo et al., 2004), namely improved systems understanding, enhanced networking and strengthened innovation activities. From these objectives and the premises of knowledge creation, Dufva et al. (2015) derived three general dimensions of foresight contributions, known as "*facets of foresight"*, namely knowledge, relations and capabilities.

**Table 7-3: Facets of foresighting (adapted from Dufva et al., 2015)**

| **Facet** | **Definition** | **Examples of how it was used in the workshop 2** |
|---|---|---|
| Knowledge | The production of new knowledge and insights about possible future developments and the consequences of present actions that help stakeholders to re-position themselves in the innovation system | Forecasts, scenarios, roadmaps |
| Relations | The creation of new connections between different stakeholders and across sectors, and the restructuring and enhancing of existing networks | Bring stakeholders together from all sectors into joint envisioning and create enhanced networks |
| Capabilities | The learning of new capabilities that contribute to the future-orientation of an organisation and the system at large | Learning new skills, habits and mind-sets that strengthen foresight and innovation capabilities |

From Workshop 2 it was evident that all these facets were addressed. Participants indicated that they had gained more knowledge, improved relations and built new networks. They also improved their own capabilities to think about the future and learnt how digital health can be addressed in their own countries from a context and stakeholder perspective.

The following procedure was followed during this workshop:

- An overview was provided of the elements and components of a Digital Health Innovation Ecosystem for South Africa as depicted in Figure 7-4.
- A focus was placed on worldwide challenges facing digital health, and finally on Gartner's Hype Cycle for digital health as future technological opportunities for digital health.
- Workshop participants identified themselves, their institutions and their focus in the eHealth space.
- Break-out groups (3-5 people) for STEEPV brainstorming were formed. The scope was to predict the short-, medium- and long-term drivers, trends and inhibitors for each STEEPV category that will influence digital health. Participants were asked to identify factors and issues under the headings: social, technological, economic, environmental, political and values-based (STEEPV). These form part of the aide-memoire for classifying relevant trends or drivers and inhibitors influencing the topic that was considered (DHIE).

- After these were identified, the groups of 3-5 people had to come up with the 3-5 most important opportunities.
- All these opportunities were finally ranked with red stickers that identified the three most important opportunities to be considered when developing or implementing the DHIE.

Valuable inputs and insights into the landscape of digital health were found, especially from a developing country perspective.

The feedback from this allowed everyone to agree on what definitions should be applied for digital health and for an innovation ecosystem.

The following elements were regarded and explained:

- Trends (tendency, course of events or the general direction in which digital health innovation is moving)
- Drivers (issues, including trends, that drive innovation in digital health)
- Inhibitors: Issues or problems (including trends) that inhibit innovation in digital health
- Participants had to think of trends (T), drivers (D) and inhibitors (I) for each of the categories below.

**Table 7-4: Applying STEEPV components during Workshop 2**

| Foresight STEEPV components | **Short term** | **Medium term** | **Long term** |
|---|---|---|---|
| Technology | • Cloud computing<br>• Mobile adoption connectivity (T, D)<br>• Challenges in respect of data collection (I)<br>• Use of mobile phones for all 911 health calls (D)<br>• Telemedicine (T)<br>• Data confidentiality (I, D)<br>• Data as an asset (D)<br>• Personal health and wellness<br>• Social media<br>• Personal ownership of health data | • Big data<br>• Wearable technology<br>• Communication | • Bioinformatics<br>• Bio Engineering<br>• 3D Bio printing<br>• Personalised medicine |
| Economy | • Existing eHealth technology adoption in the public sector is lower than eHealth | • Lack of governance in eHealth development<br>• Increased cost of healthcare | • Unemployment results in lower tax income and less funding to develop eHealth |

| Foresight STEEPV components | **Short term** | **Medium term** | **Long term** |
|---|---|---|---|
| | adoption in private sector<br>• Financial ability of people affected by health (D) | | • Minimise the cost of eHealth research in developing countriesh<br>• Sustainability<br>• Growth of healthcare (T) |
| Environment | • Hospital<br>• Digital procurement process | • Resources not available Driver = expectations of patient and staff<br>• I = Centralised procurement<br>• Hospital folder management<br>• Trend = treatment delays and patient care centralised by government (I) (top down) | • NHI = close gap (T)<br>• Drivers = low life expectancy if no quality healthcare<br>• Inhibitor = financial implications and needs of stakeholders |
| Political | • Political will to make it happen<br>• Partnerships<br>• Opportunities of mHealth<br>• Regulation (D, I) | • IP<br>• Lack of policy regarding mHealth<br>• Priorities of who is in charge (Global) | • Adoption and implementation of mHealth standards<br>• Social media usage<br>• Infrastructure<br>• Business opportunity (D) |
| Social | • Trend = Social driver & social media – driver if influence policy | • Global trend of eHealth adoption<br>• Better service delivery<br>• Cultural influence<br>• Language<br>• Data privacy<br>• Inhibitor is social media as people can lie | • Cultural differences |
| Value-based | • Sophisticated technology accessible to disabled and elderly<br>• Can potentially exclude a whole group (opportunity)<br>• Family wants family to be healthy<br>• More elderly people stay with children<br>• Driver = people treated with respect | • Increasingly unhealthy society | • How to make complicated things easy |

| Foresight STEEPV components | **Short term** | **Medium term** | **Long term** |
|---|---|---|---|
| | (technology can be invasive)<br>• Trend = community service for patients and users<br>• Personalised care – my health is my responsibility – increased concern from family to look after yourself | | |

From the results above it is evident that governments have to play a bigger role in focusing on economic means to support the less fortunate. However, cultural differences need to be addressed in the context, as well as the political will and incentives for people to take ownership of and responsibility for their own health. Values of families and communities are also important factors to consider.

The photos in the figures below depict what happened during the different workshops:

**Photo 7-1: STEEPV Workshop 2**

**Photo 7-2: STEEPV Workshop 2**

After all the trends, drivers and inhibitors had been identified (see photo in Figure 7-8) the same groups had to identify the most important opportunities or opportunities that would have the biggest impact on digital health.

The groups also had to indicate the top short-term and medium-term aspects and these are reflected in Table 7-6:

**Table 7-5: Short and medium-term components**

| Foresight STEEPV components | Short term | Medium term |
|---|---|---|
| Technology | • Cloud computing<br>• Mobile adoption connectivity<br>• Challenges in respect of data collection<br>• Use of mobile phones for all 911 health calls<br>• Telemedicine<br>• Data confidentiality<br>• Data as an asset<br>• Personal health and wellness<br>• Social media<br>• Personal ownership of health data<br>• | • Big data<br>• Wearable technology<br>• Communication |
| Economy | • Source of health data and who captures this<br>• Availability of info to healthcare provider and improvement of resource healthcare management. | • Personal responsibility for health<br>• Co-create mHealth applications with rural populations<br>• Empower healthcare professionals<br>• Patient-doctor ratio – link doctors |

| Foresight STEEPV components | Short term | Medium term |
|---|---|---|
| | • Link different fragmented systems<br>• Telemedicine for remote areas to cut costs. Must be innovative to make it more affordable<br>• Digital health decision support system (NHI)<br>• Value of data capturing in rural areas<br>• Health informatics course to train healthcare workers<br>• Financial ability of people affected by health | from rural areas with city doctors to share knowledge<br>• Communicate advantages of mHealth to population<br>• Risks (digital divide, ownership of health registers (NDoH))<br>• Public and private disconnectedness in service delivery<br>• Cost (device, infrastructure, data, sustainability)<br>• Policies that drive usage<br>• Disconnectedness between stakeholders (programming and health, different perspectives). This make it more difficult for one system to assist.<br>• Lack of governance in eHealth development<br>• Increased cost of healthcare |
| Environment | • Individual's environment, group and open environment<br>• Individual's– vulnerability to crime<br>• Cultural influences<br>• Privacy and confidentiality<br>• Incomplete data capturing<br>• Local materials that are bio-gradable<br>• Involve local entrepreneurs<br>• Design for different literacy groups<br>• Governance and policy directions influence environment<br>• International environment of unstable markets and how the market influence can become an opportunity<br>• Hospital<br>• Digital procurement process | • Disposed processes and products – revamp and customise these<br>• Ownership and cultural acceptance<br>• Customise systems to be adaptable<br>• Customise existing guidelines, adapt them to country and contexts and use feedback of users to improve a product.<br>• Start from the point of view of end-users (those who provide the service, e.g. caregivers, doctors)<br>• Fit for purpose in order for it to be used.<br>• Climate change and influence on mHealth<br>• Context relevant solutions can drive small companies<br>• Flow of data over distances and through referrals<br>• Developmental and transferable goals – if we want to innovate it has to have a positive influence on people.<br>• Electronic waves and influence on |

| Foresight STEEPV components | Short term | Medium term |
|---|---|---|
| | | individuals<br>• Technology health influence<br>• Resources not available<br>• Driver = expectations of patient and staff<br>• I = Centralised procurement<br>• Hospital folder management<br>• Trend = treatment delays and patient care centralised by government (I) (top down) |
| Political | • Policy review issues around PoPI Act<br>• Private partnerships – needed along with legislation – what kind of info should be shared? Agreement between private and public sector (patients' main stakeholder). Boundaries and security and standards of agreements. What can be used from this partnership?<br>• Political will to make it happen<br>• Partnerships<br>• Opportunities for mHealth<br>• Regulation | • Need government 4.0 – need to leapfrog (need incentives) win-win situation for big companies to accept new entrance and share information<br>• Incentives of use – how to intensify use – for sustainability<br>• Quality assurance where there is certification of products, so that small entrepreneurs can meet requirements (IP).<br>• Service quality and evaluation<br>• Lack of policy regarding mHealth<br>• Priorities of who is in charge (Global) |
| Social | • Research to empower stakeholders<br>• Awareness and capacity building<br>• Trend = Social driver & social media – driver if influence policy | • Continuous quality assurance<br>• Incentives, healthy lifestyles.<br>• Continuous improvement<br>• Global trend of ehealth adoption<br>• Better service delivery<br>• Cultural influence<br>• Language<br>• Data privacy<br>• Inhibitor = social media |
| Value-based | • Privacy and security of health data<br>• Health insurance to mine data<br>• Informed consent without benefits – adhere to ethical rules<br>• Adherence to regulator<br>• HPCSA – Healthcare Professions Council of South Africa should be consulted<br>• Sophisticated technology accessible to disabled and elderly<br>• Can potentially exclude a whole group | • If short-term components can be addressed, it will influence cost effectiveness in the long run<br>• Improve the health of the population in the long term<br>• Improve life expectancy of nation<br>• Improve infant mortality rate<br>• mHealth users are often from rural areas and design for their needs through the use of multimedia should be considered |

| Foresight STEEPV components | Short term | Medium term |
|---|---|---|
| | (opportunity)<br>• Family wants family members to be healthy<br>• More elderly people stay with children<br>• Driver = people treated with respect (technology can be invasive)<br>• Trend = community service for patients and users<br>• Personalised care – my health is my responsibility – increased concern from family to look after yourself | • Increasingly unhealthy society |

The most important **technological** aspects identified during the workshops were to develop, support and focus on uHealth (Ubiquitous Healthcare) and wearables. **Economic** aspects focused on planning for the increased cost of health in future, as well as policies to support users and stakeholders and governance. In the **environment** the most important issues related to localisation and customisation of systems; climate change and its influence on health; international unstable markets; and the availability of resources coupled with a centralised system of patient care. **Political** aspects related mostly to policy awareness (PoPI Act) as well as partnerships, quality assurance mechanisms and regulations. **Social issues** pertinent to digital health ecosystems were found to be continuous quality assurance; incentives for people to take part; healthy lifestyles; better service delivery; cultural influence; respect; trust; language diversity; data privacy.

The most pertinent **value-based** issues were privacy and security of health data; the role of health councils; respect for an older generation; and the use of mHealth as a platform to encourage personalised healthcare.

The following were mentioned when participants were asked to rate the three most important opportunities for digital health ecosystems:

- Industry supports health research
- Big data can lead to better medicine
- Health tax reduction for healthier people
- Education resources to be used for development, sharing and collaboration
- Data visualisation and analysis to improve health delivery, management and governance
- Dissemination of health information to areas less likely to get access to this information

The workshops allowed for valuable contributions and added depth to the context-specific component that previously consisted only of four multi-layers (local, regional,

national and international). This component now also includes the STEEPV aspects with opportunities, which were summarised above. This improved the DHIE even further to result in the final ecosystem (Figure 7-5). Feedback from the participants indicated that the STEEPV tool allowed them to think ahead and also to do some of their own foresighting to identify the priorities of their own countries regarding future digital health research. They also indicated that they would like to apply the same methodology (STEEPV) in their future workshops as it was quite interactive and informative. It also offered an opportunity to understand how stakeholders from other countries value the future of digital health.

In the article by Dufva et al. (2015) on the foresight exercise, it was also noted that there are different layers to focus on when addressing innovation systems, namely the landscape or context; the stakeholders; the users or individuals; and finally the type of innovation system. This is important especially since Open Innovation 2.0 was indicated as relevant and appropriate in Chapter 2.

Interconnections and interactions within and across different innovation systems should be reflected at the design and implementation phase of a foresight exercise, as well as in the recommendations (as was the case in Workshop 2). The impact of foresight exercises will increase if activities in multiple layers are examined and engaged, and if strategies are designed (as far as possible) in a concerted way, as the strategic implications of a foresight exercise range across different layers of innovation ecosystems. This was particularly important as this method or focus was regarded as crucial to apply in developing the DHIE for South Africa. During the second workshop the scope was wider and involved many facets and layers of foresighting to ensure that all inputs are used to develop this ecosystem. In the end, after Workshop 2, the following can be regarded as the most important components of constituting the DHIE for South Africa:

**Context:**

Digital health solutions that are sensitive to social, technological, economic, environmental and value-based (STEEPV) aspects at all layers (local, regional, national and international) should consider the following:

- uHealth and wearables will be the future focus in digital health from a technological perspective.
- ICT policies and government programmes should be aligned to and linked with telecommunications regulations and develop a framework for data protection and privacy.
- Inappropriate and unaffordable systems will not work. Socio-technical requirements should be considered where appropriate technologies sensitive to resource constrained environments (context, culture, politics) and environmental constraints (low literacy, older technologies) are chosen. There should also be a focus on poor user techniques and the proposed solutions should capitalise on available technological capabilities (mobile phones) to facilitate equitable access

to information services. There should also be a focus on contextualised and appropriate content in solutions that support all cultures.

- Digital health solutions that are adapted to augment the broader localised capabilities in digital health.
- Data security and building coalitions that might include government, other health implementers, technology providers, mobile network operators and other relevant stakeholders.
- Alignment with interoperability standards for mobile health, based on the recent mobile health strategy and reflection on the South African Department of Health's eHealth strategy. These strategies should be updated regularly to accommodate trends and future digital health realities.
- Governance (invest in infrastructure, rigorous decision making, facilitated by data timing, systematic risk assessment where there is strategy and leadership.
- Technical requirements for scalability and taking cognisance of client device neutrality. Data privacy and security have to be guaranteed for uptake and use of digital health systems.
- Allowing for access technology, agnostic support for information and service delivery, and media convergence so that digital content and services are accessible and delivered to end-users, regardless of the type of technologies that they use.

**Innovation Lifecycle**

- Digital health solutions should be developed locally.
- Innovation opportunities and their uptake are not always organic and the latter is often a facilitated process.
- Applying foresight methodologies proposes a useful approach towards constructing a shared understanding of future possibilities.
- Local competencies and skills are essential and should be developed, incorporated and supported. Continuous training and updating of skills to use systems are essential.
- Economic sustainability requirements have to be considered for sustainability.
- Creative engagement platforms can help lower the barriers of entrepreneurship.
- Open Innovation embraces a number of new and different ways of working that require skill sets that are not normally seen as critical in healthcare generally and R&D in particular. These include excellent communication and dissemination skills, project leadership and coordination, and excellence in collaboration and teamwork. These will be required alongside the more traditional, technical, commercial and policy roles. In addition, creating a framework that facilitates the hiring and career progression of 'non-traditional' employees will also be important.
- An innovation ecosystem should be self-directed.
- Allowing innovation to take place in an organic manner based on the common interests of various stakeholders can allow for novel outcomes and create new opportunities.

- ‘Bridgers’ and curators help shape the ecosystem. Salmelin (2015) describes curators as focusing on sustaining and enriching the quality of the innovation for reuse or adaption by ‘bridgers’ to other disciplines. He describes ‘bridgers’ as socially well-connected stakeholders, with a broad knowledge base, who are able to link various aspects of the innovation in spontaneous and unusual ways with other stakeholders or innovations.

**Users/Stakeholders**

- An innovation ecosystem should be based on the common interest of all actors in a quadruple helix (Salmelin, 2015) (government, industry, users or community and universities).
- Resources (allocation, management and availability), people, partners and technology need to work in a flexible system where there is a culture of innovation and support for entrepreneurship possibilities.
- For solutions to work in a digital health space, the technologies and people must be able to adapt to changes and focus on a mind-set where capabilities are important to think differently and opportunities exist for co-creation.
- The components above can be visualised in the final DHIE for South Africa as illustrated in Figure 7-5:

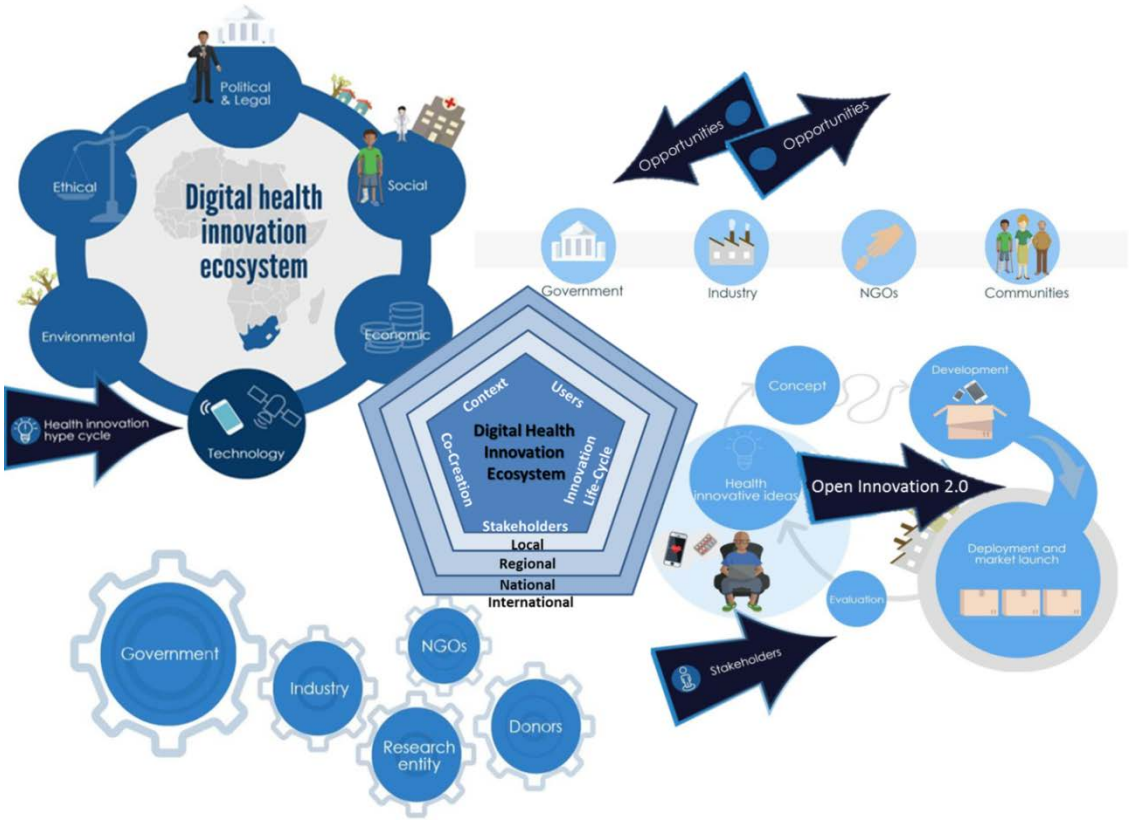


**Figure 7-5: Final DHIE for South Africa**

This graphical presentation of the DHIE for South Africa provides the essence of all the elements of digital health, innovation and digital ecosystem which are reflected in the context (technology) as well as in the innovation lifecycle. It indicates the importance of the involvement of both stakeholders and users to co-create new innovations within their specific context, whether this occurs at a local, regional, national or international level. It allows for new opportunities and creates new building blocks to improve healthcare in South Africa as foresighting tools and roadmapping approaches can assist to take a futuristic perspective on new possibilities. The context also encapsulates the STEEPV dimensions of social, technological, economic, environment as well as value-based ethics, as depicted in the different layers of local, regional, national and international dimensions evident in an innovation ecosystem (Dufva et al., 2015). Under innovation, the importance of applying a specific innovation process (especially Open Innovation 2.0) is evident where stakeholders and users are involved to co-create and stimulate the National System of Innovation in South Africa. The role of users and stakeholders is very prominent as it was indicated in the last workshop to be the essence of customising or localising digital health innovations to fit the needs of the consumer or patient. The users are therefore all the stakeholders that represent the quadruple helix components of government, industry, NGOs and communities. The greatest challenge and opportunity for preventive health innovation lies in closing the gap between what we know and what we do. This includes attitude and behavioural changes by many different stakeholder groups (e.g. healthcare professionals and providers, private companies, politicians, industry, policy makers and the public), as well as by individuals who are targeted to apply the preventive health solution.

Open Innovation in health should have education as an overarching strategy for all involved in the chain – from researchers to end-users and their support. It will require the development of new mind-sets and the capabilities to access and use the new tools and technologies that are available globally. However, in an Open Innovation environment, consideration should be given to Intellectual Property (IP). The right balance between sharing information and creating competition is essential in Open Innovation strategies. It is critically important that all stakeholders not only have a mind-set that sees IP as important for value creation, but that also attaches appropriate value to it. Overvaluation of IP at an early stage by any party could hamper innovation; on the other hand, a closed approach to IP can also become a blocker to innovation.

Challenges to the innovation commercialisation that need to be tackled head-on include excessive regulations, price constraints, limited access to markets and the overall value of commercial markets. The cultural change required especially in some academic and government institutions, as well as in business, will be enormous if the true potential of Open Innovation is to be realised. Regulation comes after innovation and in innovation the focus has to be on technology, sustainability and the user to streamline a digital ecosystem. Users must feel or experience trust, they have to change their behaviour, and they must feel that they can control and increase their own access to a system. Their uptake and use are essential

for such an ecosystem to work or to be regarded as a sustainable solution. Technology should include elements of interoperability; standards; integration of infrastructure; privacy elements; big data; and a focus on analytics, storage and control of access. For sustainability to work, the value of a system has to be shared across groups where there are partnerships, capacity building, leadership and governance, and where measurement can refine the true value.

For digital health to contribute towards improved health equality in the South African context, the specific challenges of implementing eHealth solutions need to be addressed. Reaching, engaging with and empowering low-income populations in urban and rural areas to deliver novel digital health services require highly targeted measures, which will require careful consideration of relatively idiosyncratic conditions. Simple transfer of off-the-shelf technology or solutions will not work, but lead to high failure rates. Success will require local (South African) development of innovative solutions that are sensitive to (local) economic, social, cultural and organisational factors, and that are adapted to augment the broader South African capabilities in digital health.

Other important considerations are that healthcare providers and suppliers need to ensure that a range of solutions are explored, including some that are not so reliant on technology to engage with community groups and include them in the Open Innovation team. The problem lies in their adoption of the system and a major factor that contributes to this problem is failure to implement and sustain the recommended behaviour changes.

It is for this reason that we are arguing for the notion of an *Innovation Ecosystem*. The build-up of digital health in South Africa is not only about improving the availability, access and delivery of healthcare services, but essentially about enhancing a country's strategic capabilities to create, adapt and implement novel digital health solutions within and by the public and private sector. This can furthermore enhance the country's overall innovation capacity. In this context, it is about processing a shared understanding of future possibilities in a systematic way. Platforms, technologies and solutions implemented today should remain aware of and be open to the needs of tomorrow.

## 7.9 Conclusion

Digital health solutions should be aligned with ICT policy and government programmes, which should be linked with telecommunications regulations and develop a framework for data protection and privacy. Cost should be considered and systems that are contextualised will best support local, regional and national needs of users. A DHIE for South Africa would function in support of the ICT RDI Implementation Roadmap which supports further innovation. This implies that new public policies, governance structures, IT infrastructure, practices and approaches should be aligned to not only strengthen the implementation framework, but also to actively encourage and enable new digital innovations.

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