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Supporting the formation and functioning of innovation platforms in healthcare value chains

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Abstract

Rising patient demands, a growing population, and resource limitations constrain the South African healthcare system. The integration of disparate interventions that are developed and implemented across various actors in healthcare value chains (VCs) remains a significant challenge. This calls for a multi-disciplinary approach to integrate the knowledge of communities, non-governmental organisations, private sector actors, frontline healthcare workers, and researchers in the development of sustainable, value-adding interventions. Multi-stakeholder engagement, in this article referred to as innovation platforms (IPs), is a mechanism through which interdependent VC actors could be organised and coordinated to develop sustainable innovations to strengthen the healthcare system. This article addresses the lack of guidance on how to develop and operate healthcare IPs in South Africa by presenting a framework for IP formation and functioning in healthcare VCs. A grounded theory approach, namely conceptual framework analysis, informed framework development within an exploratory qualitative study. The outcome of the study is an innovation management tool for improved policy development in a developing country context. It provides practical guidance to policy makers on how to: (1) Setup and develop an IP; (2) Implement interventions to improve IP functioning; and (3) Develop mechanisms to address commonly experienced challenges.

Key words: innovation platform; healthcare value chains; best practices management tool; formation; functioning

1. Introduction and problem statement

1.1 Background and the South African context

The healthcare system can be defined as all organisations, people, and actions whose primary intent is to promote, restore, or maintain health (World Health Organisation 2007). Healthcare systems are facing increasing pressures, with rising patient demands, growing populations, and limited infrastructure and resources. Present-day approaches to healthcare reform are reaching their limits. Prominent issues such as the adoption of new technology and digital healthcare, and resultant innovations in healthcare access, delivery models, and innovation-supporting policy and regulations are not effectively implemented (Grobbelaar and Uriona-Maldonado 2019). The processes through which these innovations are integrated into delivery systems are not necessarily inclusive, and marginalisation takes place where important stakeholder groups are excluded from systems improvement. This negatively influences the rate of adoption of innovations by those who need it most (Prahalad 2012; Heeks et al. 2014).

This is particularly problematic in South Africa (SA), where significant inequalities characterise the system. The two-tiered South African health system comprises private and public healthcare components, with the latter serving almost 90 per cent of the population but accounting for only 50 per cent of the total national healthcare expenditure (Coovadia et al. 2009; World Health Organisation 2017). Poor rural populations are most disadvantaged, as lacking infrastructure affects accessibility; also, hard-to-reach places render it difficult to provide a timeous and

quality service (Leon and Schneider 2012; South African National Department of Health 2015). Marginalisation of especially the rural poor requires new healthcare delivery approaches to overcome such problems.

1.2 Healthcare value chains and the need for improved coordination and cooperation

The term value chain (VC) was popularised by Porter (1985) and refers to the production process in its entirety, from the input of raw materials through to the final product output (Kahan and Testa 2008). Through this construct, each linkage in the process adds value as the product proceeds through the VC. VCs involve different groups of stakeholders with different backgrounds and perspectives (Porter 1980). The stakeholders that are generally considered along a VC include: suppliers, processors, producers, environmentalists, companies,[1] knowledge institutes,[2] government, healthcare providers, insurers, labour union representatives, financial organisations, intermediaries, non-profit organisations, and public sector players (Porter 1980; Fottler et al. 1989; Burns et al. 2002).

Burns et al. (2002) note that, in the context of healthcare, VCs have disparate sets of often poorly linked stakeholder groups, which fall victim to the lack of coordination and communication. Stakeholders are not all perceived as equal in terms of their power and concern regarding a matter, which means that some actors may be neglected or ignored while other dominate the agenda an outcomes due to power asymmetries (Fottler et al. 1989; Hoffman et al. 2010). An understanding of the presence, role, nature, capabilities, and competences of the actors within the healthcare VC is thus required to identify its major challenges. The knowledge of actors such as communities, non-governmental organisations, private sector entities, frontline healthcare workers (HCWs), and researchers should be harnessed and synergised for inclusive resolution of healthcare challenges and policy development.

In order for effective problem solving to be realised, there needs to be a collaboration across diverse stakeholder groups (South African National Department of Health 2019). This means engaging all actors in meaningful dialogue to establish a consensus on the values, goals, and overall intervention, its components and its implementation, to strengthen a part or whole of the healthcare system (World Health Organisation 2012).

One such example may be to develop innovations to support the work of Community Health Workers (CHWs) which means that such tools need to consider the very complex and diverse context-specific nature of the CHW's work environment (see case study in Section 5 for a more complete reflection). The CHW system interfaces with a range of healthcare VC actors such as the formal healthcare system, community systems which may include family structures, political structures, civic groups, and faith-based organisations and knowledge producers such as universities or science councils. Creating spaces and places for engagement is thus a way to bring these various actors together for an in-depth understanding of the healthcare domain and to influence the processes of technology adoption and use by CHWs (Ratshidi et al. 2020).

1.3 Study aim and objectives: innovation platforms as multi-stakeholder engagement approach

This study explores innovation platforms (IPs) as a multi-stakeholder engagement (MSE) approach (discussed in more depth in Section 3). IPs, rooted in the economic literature and an instantiation of multi-stakeholder approaches, are spaces for learning,

action, and change, where groups of individuals (or organisations) with different backgrounds, expertise, and interests engage to diagnose problems, identify opportunities, and find ways to achieve their goals. However, there is a lack of evidence of appropriate methods for the development and operation of healthcare IPs in developing country contexts. In this article, we aim to answer the following research questions:

- *What are the roles and activities played by the actors and how is the engagement and continued participation ensured on the platform? and*
- *What are the capabilities and processes required for the formation and functioning of successful IPs in healthcare?*

This article presents the development and evaluation of a framework to develop and manage IPs that aim to solve challenges within healthcare VCs. Based on a grounded theory process and structured literature review (SLR), key concepts related to IPs were identified and named through a coding process. The concepts were then synthesised into a coherent theoretical conceptualisation. The evaluation and refinement of the framework took place through three stages. Firstly, four qualitative semi-structured expert interviews were conducted to validate the concepts, suggest additions, and propose modifications, resulting in a refined framework. Secondly, ten experts were asked to rank the refined framework element's applicability, expected impact of concepts, and the effort required to apply the concept. Finally, a single qualitative case study was undertaken to test the framework's applicability in practice, and four supplementary case interviews were done to evaluate and validate the framework.

The final result of the framework that was developed in this research is presented as a tool to explore key implementation barriers, and ideas for good practice to overcome them. The major contribution of this article is a framework that provides taxonomy for researchers, policymakers, and HCWs to characterise key strategic features of evolving IPs. It provides, amongst others, a basis for assessing policy considerations.

The next section provides an overview of the methodology (Section 2), after which we present the outcome of the SLR of healthcare IPs literature (Section 3). Section 4 presents the theoretical framework, Section 5 describes its evaluation, and Section 6 summarises the evaluated framework. Section 7 concludes and outlines future work.

2. Methodology

A grounded theory-based approach, namely the conceptual framework analysis (CFA) proposed by Jabareen (2009) was followed (see Fig. 1). CFA was selected for its interpretive approach to social reality by building on data from multiple disciplines, and hence for its potential in reflecting MSE environments. The CFA method's eight phases of structured guidelines assist researchers in conducting qualitative research towards conceptualising new theories or populating frameworks (Corbin and Strauss 1990). In this article, the eight phases are applied in three distinct parts.

Part 1 of the study was focused on understanding the problem landscape, and included a systematic literature review (SLR) of IPs in the healthcare context; key concepts were identified and analysed through a coding process (SLR process described in or detail in Section 3.1).
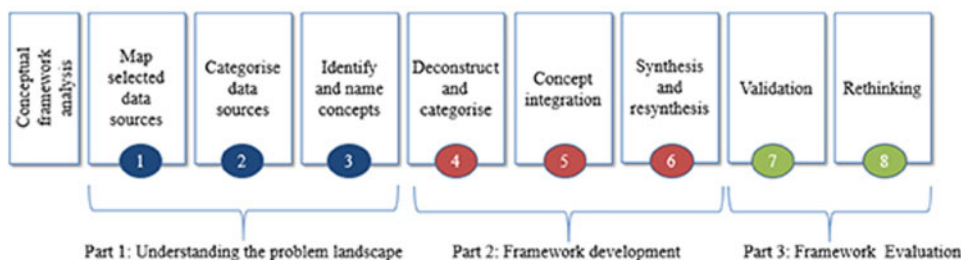
Figure 1. The CFA's eight phases, in three parts, for framework development.
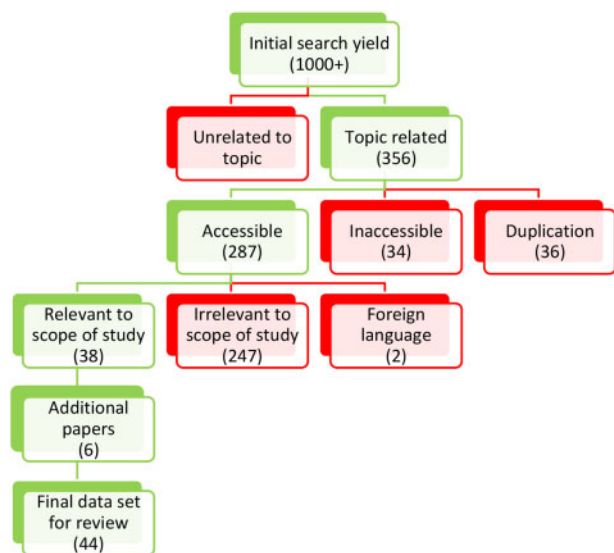

Figure 2. Data selection process.

Part 2 of the study focused on framework development; here, the concepts from the SLR were categorised and synthesised into a theoretical framework (Section 3.2).

Part 3 comprised a three-stage process to iteratively refine and evaluate the framework. Four qualitative semi-structured expert interviews were conducted to validate the concepts in the framework, suggest additions, and propose modifications to each framework dimension. Thereafter, ten experts were asked to rank the applicability and expected impact of concepts, and the effort required to apply the concept. Finally, a single qualitative case study was undertaken to test the framework's applicability, with three supplementary case interviews to evaluate and validate the framework.

2.1 Part 1: understanding the problem landscape: SLR

The Scopus, Google Scholar, and ResearchGate databases were searched using keywords from the domains, namely, sector (healthcare, medicine, and medical) and innovation systems model (IP). Inclusion criteria were the article's: (1) empirical relevance to the theme; (2) relevance to scope (i.e. studies pertaining to IPs and not to innovative products or services that exist within healthcare); and (3) publication in the English language. Finally, the SLR review identified forty-four relevant publications (see Fig. 2).

ATLAS.ti, a qualitative data analysis and research software system, was used to extract data from the literature database. The aim of the SLR was to identify the core IP principles, processes, and concepts, as well as the different types of IPs and the dynamic processes

upon which they function. The outcome of the systematic review is discussed in Section 4 and is discussed in Part 2.

2.2 Part 2: framework development: the theoretical framework

The theoretical framework is based on the systematised literature review. Jabareen (2009) explains that the aim of the CFA's Phase 4 is to map each concept, along with a description including its main attributes, characteristics, assumptions, and role. Phase 5 iteratively integrates similar concepts into one higher-level concept (Jabareen 2009). Phase 6 of the framework synthesised the concepts into an integrated framework. We present the outcome of Phase 6 in Section 4.

2.3 Part 3: framework evaluation: methods for the interviews, framework ranking interviews, and case study

A limited number of experts were purposively sampled to contribute their in-depth knowledge through qualitative semi-structured interviews. Only experts knowledgeable on healthcare industry-related matters, healthcare VCs, and healthcare IPs were considered; participants embodied different roles and responsibilities within healthcare VCs.

The semi-structured expert interviews (during framework development) explored the novelty of IPs in the SA healthcare industry, and elicited proposals on the evolution of the identified concepts. Differences between the proposed theory and practical application were examined, and a strategy to decrease the gap between theory and practice was formulated. All the interviews complied to the requirements for the ethical clearance was obtained for this project from Research Development Division at Stellenbosch University. Interview recordings were analysed to identify prominent opinions, shortcomings, and useful recommendations for framework improvement.

The first stage of validation is achieved through expert feedback. Three face-to-face, semi-structured interviews were conducted over a time span of 1 month. An interview guideline was developed for conducting the interviews to ensure the coverage of the following themes: the need for a collaborative approach towards solving healthcare challenges, addressing the lack of a guiding tool towards the development of multi-stakeholder innovation processes in healthcare, and the validity of the concepts upon which the framework is developed. Beyond this, an open-ended question-oriented approach was adopted; the individual interviews lasted between one and 2 h. The data were coded to identify trends, to form a robust understanding of the underlying foundational IP concepts. Concepts' main attributes, assumptions, characteristics, and roles were identified by organising and categorising them according to their features and epistemological, ontological, and methodological roles.

For the ten framework-ranking interviews conducted, respondents were purposefully selected based on the criteria, and through

snowball sampling. The following criteria were considered in project selection: IPs in the healthcare industry that have the objective to directly impact healthcare; IPs operating within SA, with a focus on improvements in SA; IPs that can be classified within a specific life-cycle phase; and IPs for which the IP champion's contact details were available. For framework-ranking discussions (during framework evaluation), an introductory presentation was first completed to create context. Interviewees were then asked to rank concepts on a scale of 1–5 according to relevance, degree of impact, and the associated degree of effort required to address each concept.

The case study examined the collaboration between the Bertha Centre for Social Innovation and Entrepreneurship and Groote Schuur Hospital (GSH) for development and continued operation of the GSH Innovation Programme and the GSH Innovation Hub, which was included as Africa's first public services Healthcare Innovation Hub. Various literature sources were consulted, and project documents were reviewed to understand the Hub's context and the initial motivation for its development. The case study findings were supplemented by three site visits and four focused interviews.

3. Mapping the problem landscape (Part 1)

The outcomes of Part 1 of the CFA (understanding the problem landscape) are reflected by the literature review results; Part 1 culminated in the identification of the core concepts.

3.1 Conceptual review of IPs

A rich body of literature exists on IPs as multi-stakeholder platforms, which have been applied in a wide range of areas such as global governance, agriculture, disaster risk science, and health (Adekunle and Fatunbi 2012; Victor et al. 2013; Cullen et al. 2014; Dondofema and Grobbelaar 2019). As interest in multi-stakeholder approaches have been rising rapidly over the past 10 years, a range of terms has been used to refer to such structures. IPs' application areas are vast (Nambisan, et al. 2018). They can operate in almost any field that requires multi-stakeholder approaches for innovative solutions. The application of most studies on IPs have been in the agricultural sector, where a lot has been written in the area of Agricultural IP Systems with the focus on achieving institutional transformations (e.g. agricultural education, women participation, policy, markets, and stakeholder engagements) or new technology development (e.g. development of new pesticides, new breeds of animals, new seeds, and new production techniques) (Klerkx et al. 2010; Nederlof et al. 2011).

As shown in Fig. 3, the systematised exploration of the literature identified twenty-four different names for multi-stakeholder partnerships within the healthcare context. Examples include innovation intermediaries, communities of practice, convergent IPs, technology platforms, open health platforms, living labs, collaborative research networks, and traditional IPs. The IP's purpose influences its building blocks; for example, the initiation of a living lab is very different from a technology platform (Schut et al. 2016; Schut et al., 2018). While some of their fundamental practices are the same, the way in which objectives are achieved, and the combination of IP concepts upon which they draw, differ greatly.

Although we show that there are many different types of IPs (again with reference to Fig. 3), the terms 'innovations platform' and 'multi-stakeholder partnership' refer to a similar idea in this study; we thus adopt the term 'innovation platform' in the remainder of this article. Homann-Kee Tui et al. (2013) define an IP as a

forum for shared learning, collaborative planning, scalable action, and change (Cullen et al. 2014; Swaans et al. 2014). The idea is to create a learning environment where stakeholder groups with different interests can collaborate to define and redefine problems (Dalziel 2010; Homann-Kee Tui et al. 2013).

Researchers have adopted several perspectives when investigating IPs. The innovation systems perspective (especially the agricultural innovation system) (Adjei-Nsiah and Klerkx 2016; Jiggins et al. 2016; Adu-Acheampong et al. 2017), the VC perspective in healthcare (Marais et al. 2017, 2018; Marais 2018), and the innovation ecosystem perspective (Dondofema and Grobbelaar 2018, 2019; Grobbelaar 2018; Ngongoni et al. 2018).

The use of platform approaches in healthcare is starting to gain traction, as it provides a mechanism through which to stimulate growth by drawing on the knowledge of stakeholders across the VC (Boogaard et al. 2013a).

Ultimately, the core benefits of IPs is to provide a foundation to streamline development as it creates opportunities for demand-driven research, the identification of critical issues, and the dissemination of research outputs (Grobbelaar et al. 2017). By placing resources into the hands of stakeholders, they are able to steer the R&D agendas and to implement activities that cannot be supported by other projects or businesses. Victor et al. (2013) highlights that, with improved innovation capacity, one is able to better embrace changes whilst simultaneously discovering innovative solutions. This is achieved by exposing members to new people and novel ideas. Constant interaction amongst members ensures that interventions are appropriate to the situation. Members are also more likely to adopt solutions that they understand and helped to conceive (Burton et al. 2008; Homann-Kee Tui et al. 2013). IPs can have benefits such as collaborative and interactive ideation, network development, acquisition of external expertise from strategic assets, idea generation and support for innovation development, and rewards for idea implementation (Frey et al., 2011). Therefore, IP adoption requires integration at several levels in the organisation and for numerous platform design decisions, for example, user activities and user engagement mechanisms, idea management decisions, and user participation rules (Antikainen, Mäkipää, et al. 2010).

Several criticisms and risks of IPs, also associated with participatory approaches, are apparent (Reed 2008; Luyet et al. 2012; Haddaway et al. 2017). IPs may reinforce existing privileges, and minority perspectives may be neglected (Boogaard et al. 2013b). Tokenism and poorly managed IPs may break down trust and relationships and result in delaying the implementation of interventions. Knowing who to engage at what point in time is not obvious and ensuring the right representation and securing the right expertise for the IP remains a challenge. IPs are resource-intensive and require careful assessment of the institutional context within which they function. While IPs have the proven ability to support innovation, the process behind their development and functioning still requires investigation (Heeks et al. 2014; Swaans et al. 2014; Herman et al. 2018).

3.2 Concepts from SLR

The outcome of the SLR concept identification process is presented in this section. The identified concepts are summarised in Fig. 4. Consideration of the context of emergence is evidently of critical importance in this field of study, as thirty-four of the forty-four publications in our database addressed this concept. This is followed by knowledge management and capacity development, addressed by thirty-two publications each.
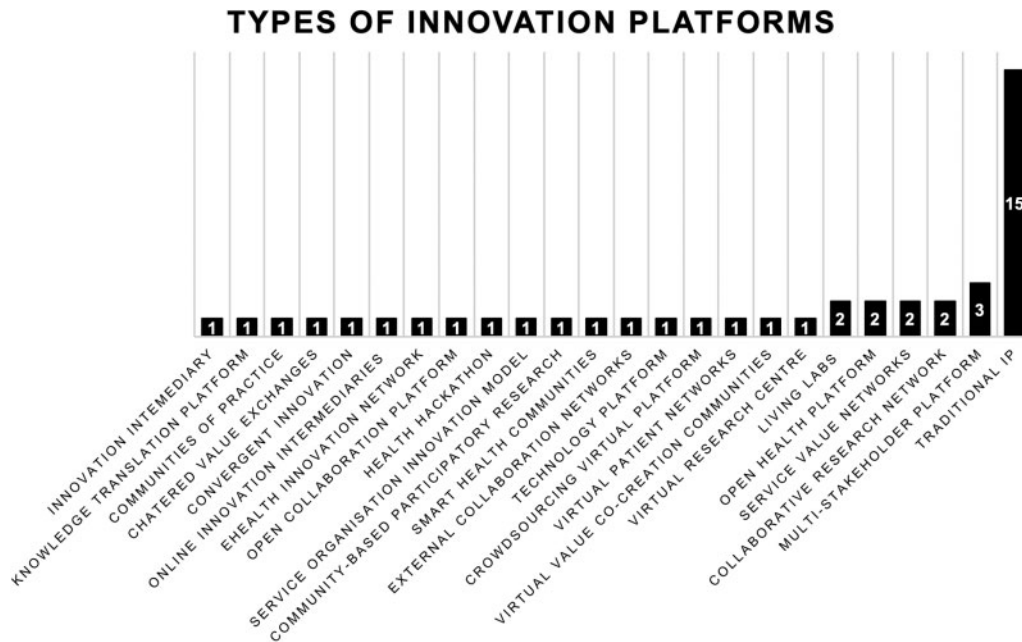
Figure 3. Count of different types of IPs identified in the SLR.
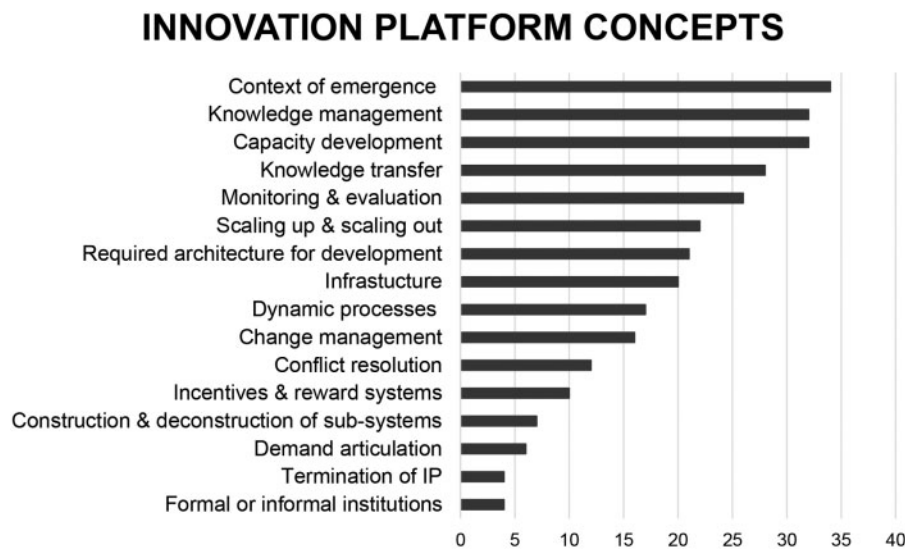
Figure 4. IP concepts, as identified from the literature review.

These concepts form the foundation of the system infrastructure that comprise IPs, and the factors that allow for effective operations of IP in the face of stakeholder interdependencies (Dubé, Jha, et al. 2014). Table 1 categorises the concepts and describes each category.

The literature indicates that IPs can operationalise inclusive innovation by facilitating interaction and learning amongst different actors, thus leading to increased innovation capacity and enabling the reshaping of institutions within a specific infrastructure. This interpretation guided the definition of seven core *dimensions*, namely, engagement/participation, knowledge management, capacity development, innovation, actors, institutions, and infrastructure. These dimensions form the core principles upon which IPs function (Marais et al. 2018).

In addition to identifying concepts and concept categories, the review showed that IPs move through life-cycles. While many IP life-cycles are identified in the literature, this study adopts Swaans

et al.'s (2014) phases, namely, *Formation* and *Functioning*. The phases of IP development are iterative, non-linear, and characterised by joint learning, reflection, experimentation, and adaptation. As such, phases are repeated over time and can even occur simultaneously. However, the focus on activities is usually different for different stages of IP development.

Examples of such decisions and capacity development phases include the following (Varma et al. 2009; Adekunle et al. 2010; Tenywa et al. 2011; Nederlof and Pyburn 2012; Homann-Kee Tui et al. 2013; Makini et al. 2013; Swaans et al. 2014): (1) decide on the IP's level of functioning (local, sub-national, national, or international); (2) define the IP's objectives and focus areas, and the members' areas of interest; (3) gain perspectives from multiple partners to serve participants' needs, which will, in turn, drive engagement and ensure IP effectivity; (4) build the life cycle phases on a

Table 1. Categorised concepts identified through review (with core references).

Concept category	Concepts	Description
Approaches to change management (Cullen et al. 2013)	Evolving roles and responsibilities	IPs constantly need to change their functioning, membership roles, and landscape of operation. Resistance to change should be addressed.
Approaches to knowledge management (De Almeide and De Moreas 2015)	Knowledge transfer, learning, and diffusion Drawing on existing capacity and developing new ones Collaboration Information exchange and communication Establish knowledge sharing platforms and machinery	Create a sense of ownership that leads to increased buy-in. Joint learning and encouraged cooperation amidst diverse actors facilitate capacity development. Enable actors to develop solutions that would be infeasible for an individual actor to achieve
Capacity development (Sanyang et al. 2016)	Drawing on existing capacity and developing new ones Inclusiveness; Bottom-up processes Supporting entrepreneurial activity	Innovation capacity is the invisible glue that ties successful IPs together; enhancement thereof provides a fresh perspective on challenges Innovation capacity is developed through training and learning opportunities
Conflict resolution and dealing with power dynamics	Power relations amongst stakeholders Stakeholder analysis Mediation processes	Potential challenges pertaining to member power relations should be established at the project's outset and addressed as required. Conflict may arise when members promote personal agendas that do not align with the platform's objective
Context of emergence	Cultural context Motivation behind IP Addressing physical, socioeconomic, andand political factors	The IPs context of emergence can be viewed as a driver for innovation, as well as the foundation for its development. It provides information regarding the problem landscape to be addressed
Demand articulation	Mobilising resources Guiding search Strategy vision development Visioning and planning Driving participation, commitment, and ownership	Demand articulation supports collaboration by ensuring that members understand the project's vision at the outset
Dynamic processes, engagement, and facilitation	Continued guidance of search activities Facilitation, management, and interaction Open communication Monitoring and Evaluation	IPs operate in dynamic environments, rendering it necessary for stakeholders to adapt rapidly to change. The role of a facilitator is multifaceted and is pivotal to ensuring engagement
Incentives and reward systems	Monetary incentive programmes Introduction to new markets	Incentives are needed to involve diverse stakeholders and motivate them to stay engaged in platform activities
Infrastructure	Access to resources and facilities Focus level of IP Access to resources and facilities Supporting development of technology services Policy-making Legitimacy: resources, and commitment Construction and deconstruction of subsystems Formal and informal institutions	Spaces for engagement, communication, and creation of common vision. Available resources need to be identified and missing resources acquired. Hard and soft infrastructure impacts the extent to which IPs can operate and influence policy-making
Scaling up and scaling out	Celebrate successful idea execution Supporting access to markets	Facilitates communication amongst different levels of operation within a sector. Aims to overcome the traditional boundaries amongst stakeholders
Stakeholder participation	Inclusion and representation Focus tasks and roles Seek opportunities for participation Explore knowledge, skills, and interests	IPs are founded on their inclusive approach to stakeholder participation. Stakeholder roles and responsibilities need to be clearly defined and communicated
Termination of IP	Evolving membership IP dismantling	Once an IP has resolved its targeted problem, it should not be kept alive artificially

strong infrastructure that improves access to data and knowledge; and (5) develop contingency plans when addressing the entire scope of a life cycle; these are required for the development of procedures to monitor critical infrastructure threats.

Figure 5 presents the IP concepts as a taxonomy. The IP framework addresses complex multi-dimensional healthcare problems from a VC perspective. The VC in which the problem is embedded, is investigated, and elements that support or constrain innovation across the VC are identified. Two strategic categories were outlined from the identified trends and themes: (1) core capabilities and (2) structural components.

The taxonomy provides a simplified lexicon for characterising key strategic features of evolving IPs. It also provides the basis for the IP framework for future inquiry regarding the relationships between organisational strategy, structure, and performance, and for assessing policy issues.
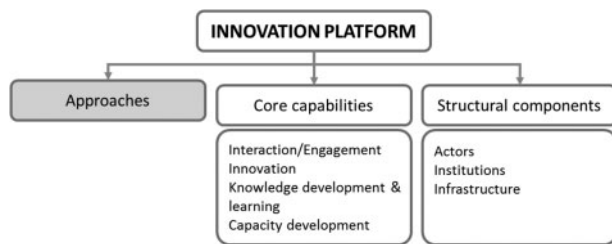
Figure 5. Concept taxonomy.

4. Theoretical IP framework (Part 2)

The innovation concepts in Section 4.1 were categorised within Swaans et al.'s (2014) two proposed platform phases of *Formation* and *Functioning*. The concepts were strategically positioned through an iterative process, in accordance with the framework design criteria of quality of interactions, organising governance mechanisms, and supportive conditions (adapted from Kuhlmann 2015). The inductively developed theoretical IP framework is outlined in Table 2.

The framework integrates the identified innovation concepts, focusing on fostering the development of growth pathways. It reflects the core dimensions identified during the literature review, which reflect the principles of IP functioning, namely, Interaction/Engagement-concertation ; Knowledge development and learning; Capacity development; and Innovation, and the structural components of Actors, Institutions, and Infrastructure.

5. IP framework evaluation (Part 3)

The framework evaluation is aimed at assessing how well the framework supports the ability of potential users to enhance their ability to innovate. Innovation is pivotal in value co-creation through the use of new ideas and knowledge across social, commercial, and organisational boundaries (Porter and Kramer 2011), and the framework should be assessed for its ability to facilitate such co-creation. The evaluation results are based on semi-structured expert interviews, framework ranking interviews, and a case study investigation during the framework development phase (Part 2) of the CFA.

Table 2. Theoretical framework.

Categories	Dimensions	Formation Concepts	Functioning Concepts
Core capabilities	Interaction/ Engagement— Concertation	Visioning and planning	Driving participation, commitment, ownership
		Incentives and reward systems	Facilitation and management of interactions within IP
		Facilitation and coordination	Termination of IP/members
		Conflict resolution and dealing with power dynamics	
	Knowledge development and learning	Knowledge, skills, and interests exploration	Knowledge transfer and type of learning
		Monitoring and evaluation	Consideration of various knowledge management approaches
			Knowledge dissemination and diffusion
			Continuous monitoring and evaluation
	Capacity building	Focus on inclusivity within process	Drawing on existing, and developing new, capacity
		Designed for scalability (Scaling up/out)	Celebrating successful idea execution
		Consideration of dynamic processes	Approaches to change management
		Dealing with resistance to change	Addressing physical, socio-economic, and political factors
	Innovation	Search guidance	Supporting development of technology services
		Shift in focus level of IP	Supporting entrepreneurial activity
			Continued guidance of search activities
Structural components	Actors	Inclusion and representation of all stakeholders	Seeking opportunities for participation
		Stakeholder-representative demand articulation	Evolving roles and responsibilities with new idea introduction
	Institutions	Setting up formal and informal institutions	Maintaining and strengthening formal and informal institutions
		Construction and deconstruction of sub-systems	Supporting and influencing policy-making
	Infrastructure	Consideration of context of emergence	Overcoming barriers to functioning
		Level of access to resources and facilities	Establishing knowledge-sharing platforms
		Required setup foundation	Mobilising resources

Table 3. Evaluation: semi-structured interview results.

Dimension	Validation	Additions	Modifications
Interaction/ Engagement— concertation	Context-specific incentives ensure active engagement of members Address conflict head-on by creating a neutral space for interaction Create an engaged platform based on mutual respect Visioning and brainstorming are essential tools	Clarification of members' roles and responsibility Engaging with people takes time Platform facilitator requires experience in negotiation and dealing with diverse stakeholder desires	For-profit companies are not always ready to share information or collaborate Patients' living conditions are critical in determining appropriate interventions
Knowledge development and learning	Promote education and knowledge sharing amongst actors Knowledge translation should transpire across different levels of education and multiple cultural backgrounds	Data security is important in the healthcare context M&E is difficult to track Knowledge management processes should be customised to suit the IP environment	Wide-spread dissemination of results is required for awareness across geographical and disciplinary boundaries Inter-operability functions need to be considered during data storage facility design to optimise data usability A definite link between policy-makers and IPs is required for access by policy-makers to the latest research findings
Capacity development	Local solution ownership is vital to implementation and long-term acceptance Create trust amongst platform members through transparency	Design for scalability is important Input should be invited from across the VC	Elaboration of the consideration of capacity versus capability development is required. M&E indicators are required to track capacity development.
Innovation	Expertise and continued improvement is required Acknowledging each actor's input stimulates innovation amongst members	Consider intellectual property rights with respect to the development of unique, commercialisable innovations Mind-set and culture change amongst actors are needed	Limited resources, accountability, and transparency of finances are important
Actors	Distribute as much information as possible amongst all stakeholders Create a united perspective by including multiple stakeholder groups	The approach should not purely be bottom-up, but should consider both ends of the spectrum	Embedding the human element in any design within healthcare is essential
Institutions	Inspection of cultural norms in which the IP is embedded, is required Consider the institution that owns the IP and the consequences thereof prior to commencement of platform activities	Lack of communication amongst VC actors often impedes the implementation of plausible ideas A contractual agreement amongst IP members is required.	Collaboration amongst national-level institutions is required to spur on cooperation amongst regional and local institutions
Infrastructure	Neutral meeting space is required to provide members with a fresh perspective; it resembles equality amongst members Identify the projects that can and cannot be supported in terms of resource availability	Funding plays a major role during the platform's lifetime and is an important determinant of success With the creation of an entirely new set of producers, some quality control issues may arise; platforms should include robust quality control mechanisms	Business models are a major challenge, as they do not allow for inter-operability and integration

5.1 Results: semi-structured interviews

[Table 3](#) presents the framework evaluation results of experts, who commented on the differences between theory and the practical application thereof. Participants' responses are categorised into validations, additions, and proposed modifications to each framework dimension.

In addition to the specific validations and additions, the following themes were identified:

- all interviewees agreed that a collaborative approach towards addressing healthcare challenges is desperately needed;
- there is overwhelming agreement that the VC analytical lens is an appropriate perspective to adopt, and that it would provide

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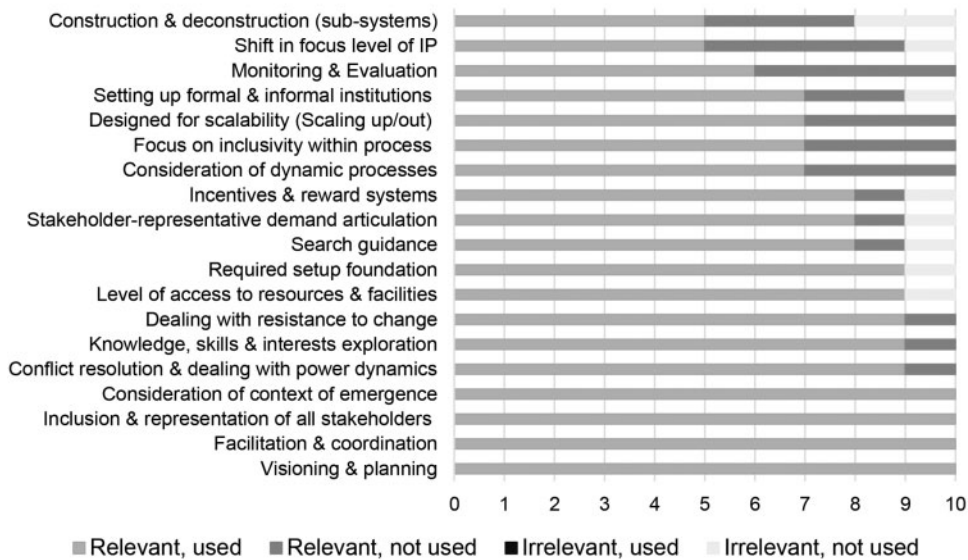
Figure 6. Relevance of concepts to IP formation.

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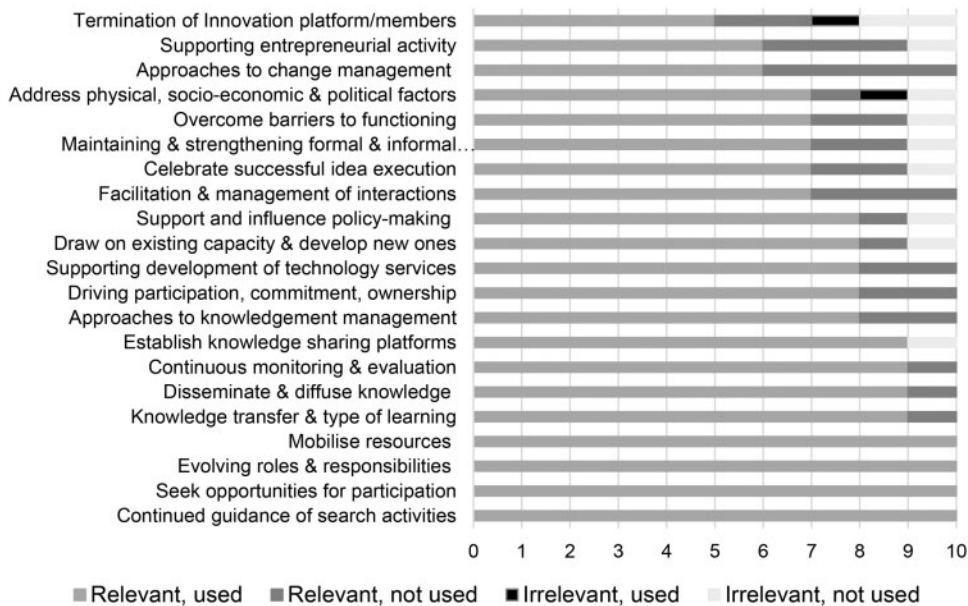
Figure 7. Relevance of concepts to IP functioning.

useful insights for all members involved in the innovation process and

- all interviewees expressed a keen interest in the final outcome of the framework, as they observed the need for a documented approach towards IP development. Participants evidently use processes to run their respective platforms, but none of them explicitly use a framework or tool.

These themes are in support of the view that an IP is a means of fostering collaboration across the VC. It provides an infrastructure to stimulate innovation and stakeholder interaction towards the development of sustainable solutions to common problems, with emphasis on developing solutions that are realistic, timely, and context appropriate (Dwivedi, 2015). This is achieved through the inclusion of multiple perspectives across the VC. Collaboration during innovation projects results in the co-production of knowledge and

Figure 8. Impact and implementation effort of core concepts.

C1 Visioning and planning
C2 Incentives and reward systems
C3 Facilitation and coordination
C4 Knowledge, skills, and interests exploration
C5 Monitoring and evaluation
C6 Focus on inclusivity within process
C7 Designed for scalability (scaling up/out)
C8 Dealing with resistance to change
C9 Search guidance
C10 Shift in focus level of IP
C11 Inclusion and representation of all stakeholders
C12 Stakeholder–representative demand articulation

C13 Setting up formal and informal institutions
C14 Construction and de-construction (sub-systems)
C15 Consideration of context of emergence
C16 Required setup foundation
C17 Facilitation and management within IP
C18 Knowledge transfer and type of learning
C19 Consideration of various approaches to knowledge management
C20 Disseminate & diffuse knowledge
C21 Draw on existing capacity & develop new ones
C22 Approaches to change management
C23 Continuous monitoring and evaluation
C24 Driving participation, commitment, ownership

C25 Celebrate successful idea execution
C26 Address physical, socio-economic & political factors
C27 Supporting development of technology services
C28 Supporting entrepreneurial activity
C29 Continued guidance of search activities
C30 Seek opportunities for participation
C31 Evolving roles & responsibilities with introduction of new ideas
C32 Maintaining & strengthening formal & informal institutions
C33 Support and influence policy-making
C34 Overcome barriers to functioning
C35 Establish knowledge-sharing platforms
C36 Mobilise resources

Table 4. Long hanging fruit and strategic projects in IP development.

Concept code	Low hanging fruit Import and low effort to implement		Strategic projects Important but difficult to implement
C25	Celebrate successful idea execution	C7	Designed for scalability (scaling up/out)
C28	Supporting entrepreneurial activity	C5	Monitoring and Evaluation
C21	Draw on existing capacity and develop new ones	C15	Consideration of context of emergence
C4	Knowledge, skills, and interests exploration	C20	Disseminate and diffuse knowledge
C29	Continued guidance of search activities	C34	Overcome barriers to functioning
C32	Maintaining and strengthening formal and informal institutions	C6	Focus on inclusivity within process
C16	Required setup foundation	C35	Establish knowledge-sharing platforms
C22	Approaches to change management	C36	Mobilise resources
		C27	Supporting development of technology services
		C24	Driving participation, commitment, ownership
		C23	Continuous monitoring and evaluation

increased capabilities, which may address both the economic as well as the societal challenges.

5.2 Results: outcome of framework-ranking interviews

Figure 6 summarises experts' ranking of the relevance of framework concepts in supporting IP development. The concepts are ranked in terms of their ability to support either the formation or the functioning of the framework. Respondents indicated if they found the concept relevant, and if the concept was used in their specific contexts.

For IP formation, the majority of the concepts was deemed relevant and was used by the experts (Fig. 5). Thirteen concepts were identified by at least one respondent as relevant, but not currently used. Respondents indicated that the implementation of these concepts was constrained by a lack of knowledge and insufficient resources.

The concepts that are deemed most relevant relate to inclusiveness, coordination, and visioning and planning. These collaborative approaches are considered well suited to the modern interconnected innovation environment (Brant and Lohse, 2014).

Figure 7 highlights the relevance of concepts for IP functioning. Here, the majority of the concepts were ranked as relevant and used, while sixteen concepts were highlighted as relevant but not used. Nine concepts were ranked as irrelevant and not used, with two concepts ranked as irrelevant and used.

The ten respondents were also asked to rank the relative effort to use each concept, as well as its importance. Figure 8 maps each concept related to the average rankings. An impact rating of five

Table 5. Further recommendations for improvement.

Facilitation and coordination (C3)	The framework requires an explicit process for platform facilitator selection. Additionally, a checklist with basic requirements may be useful for facilitator identification
Facilitation and coordination (C3), Visioning and planning C(1)	Starting out is a challenge. Members should see the platform's potential value at the outset. However, members should not initially be placed under too much pressure
Facilitation and management (C17)	Create a central driving force to identify, analyse, promote, and track relationships, partnerships, outcomes, and outputs over time
Incentives and reward systems (C2)	Promote platform sustainability by preventing a rapid decline in membership after sign-up. Use context-appropriate incentives to ensure that engagement is constantly pursued by the platform
Inclusion and representation of all stakeholders (C11)	Multiple stakeholder involvement and maintaining neutrality are pivotal to platform success. Tools to assist in this process may be needed
Knowledge transfer and type of learning (C18)	There is a need for a clear understanding of intellectual property protection
	Local and indigenous knowledge should be considered to ensure that temporary solutions are not proposed for major problems. How to introduce indigenous knowledge into the IP should be considered

indicates a high positive impact, while a degree of effort rating of five indicates that a high degree of effort is required to address the concept. The results can be used to see where significant impact can be achieved and assessed versus implementation difficulty.

Factors that have been ranked high on both accounts for the formation phase are Designed for scalability (C7), M&E (C5), and Inclusion and representation of all stakeholders (C11). Figure 7 supports their selection, as all three concepts are ranked as relevant and used; or relevant, not used. The relatively high ranking of M&E is appropriate, since literature has shown that the field of IPs is confined by vague definitions, a lack of practical implementation models as well as limited M&E mechanisms (Frey et al. 2011; Meersman et al., 2012; Cullen et al. 2014).

Furthermore, respondents identified Mobilise resources (C36), Facilitation and management (C17), Knowledge transfer and type of learning (C18), Continuous M&E (C23), and Supporting development of technology services (C27) as the highest-ranked concepts during IP functioning. The focus on knowledge and learning (C18) supports the overarching theme in literature of the importance of knowledge as a resource towards innovation, while learning is classified as the most fundamental process (Lundvall 2007; Wieczorek and Hekkert 2012). Figure 8 also indicates that not all concepts that have a major impact, require a high degree of implementation effort. Such concepts provide a good basis from which an IP can be developed.

The correlation between the impact of a core concept and the degree of implementation effort required is revealing, as it highlights the areas of IPs that require further in-depth discussion during development. Auxiliary tools that address the identified concepts were investigated to provide assistance in resolving specific challenges.

The analysis in Fig. 8 enables practitioners to identify where to spend their IP development efforts. Table 4 summarises projects that can be classified as low hanging fruit (important and requiring low implementation effort), as well as strategic projects (important, but difficult to implement). Some of these are particularly difficult to implement, such as Design for scalability (during both the formation and functioning phases); Mobilising resources; Monitoring and evaluation; Inclusion and representation of all stakeholders; and Knowledge transfer and type of learning.

In their overall impression of the framework concepts and their validity, participants rated the potential benefits of healthcare IPs as superior to their implementation and maintenance difficulties. They generally perceived the framework concepts as useful for considering issues relevant to the functioning of their healthcare platforms.

Participants' feedback informed relevant and helpful recommendations for framework improvement, as outlined below.

5.2.1 For strategic projects
For *Context of emergence* (C15), participants recommended the consideration of measures to prevent extrapolation of solutions between conflicting contexts. For *Driving participation, commitment, and ownership* (C24), it is recommended that collaboration tools are incorporated as part of the project, and for *Monitoring and evaluation* (C5), participants recommended the use of a platform/process for innovation, continuous interaction of practice, implementation, design, documentation, and learning. Benefits would include the visibility of ongoing projects.

5.2.2 For low-hanging fruit
Participants recommended that a greater focus on data interoperability and the creation of back-end communication is established when *Maintaining & strengthening formal & informal institutions* (C32). However, this would require that the lack of available standards for platforms is addressed.

5.2.3 Other
Participants made recommendations for IP concepts that are not reflected in Fig. 7. These are summarised in Table 5.

5.3 Results: case study
The GSH Innovation Hub is the first public services Healthcare Innovation Hub in Africa. It is supported by a partnership between the Bertha Centre for Social Innovation and Entrepreneurship, the University of Cape Town's Faculty of Health Sciences, GSH, the GSH Facilities Board, and the Western Cape Provincial Department of Health. The Hub is located within GSH and was opened in March 2015. GSH is an academic hospital that is characterised by its innovative nature, whilst Bertha Centre is focused on uncovering, pioneering, and connecting innovators and entrepreneurs to generate inclusive opportunities and to advance social justice in Africa. The hub was developed to create a space from which to catalyse innovation by harnessing the potential of frontline HCWs. This was motivated by the Innovation Programme that commenced in 2014,

and the 2017 Innovation Programme that was launched to celebrate GSH's 80th anniversary in 2018.

The inaugural GSH Innovation Programme focused on identifying and collaboratively addressing challenges experienced by frontline HCWs within the hospital. The aim was to develop a culture of innovation to facilitate creative thinking among all levels of staff in identification of opportunities for improvement. The focus is on person-centred healthcare that creates a better patient experience and a superior working environment for staff. The vision was to inculcate feeling of an inclusive space that would allow for teamwork amongst diverse members of the healthcare system.

The Innovation Hub runs separately from, but simultaneously with, the GSH Innovation Programme, with events and workshops curated for the benefit of the Western Cape healthcare community as a whole, rather than for the sole use of GSH Innovation Programme participants. The Hub was designed to achieve three objectives: (1) understanding the needs; (2) developing new solutions; and (3) connecting with the community. It is a space that allows for HCWs, innovators, students, policy makers, and community members to gain a deeper understanding of the real challenges within the system, encourages practical learning and skills development in innovation, and allows for the co-creation of solutions and creates a pathway from ideas to implementation. The Hub serves as a connector between the Public Healthsystem (PHS) and the broader community, as well as between healthcare innovators and policy makers.

Through the case study, the enhanced framework and its associated tools were applied practically. To foreground, the relevancy of the framework on the case study, a stepwise analysis of the case was completed. The collaboration project was used to reflect on what has been done, and the processes and principles that were employed during the formation and functioning of the Innovation Hub. These processes were mapped against the framework to determine the framework's utility and practical application.

The case analysis investigated the formation and functioning of the Innovation Hub for each of the dimensions outlined in Table 3. Recommendations were then identified for the disparities that have been identified between the proposed innovation framework and the functioning of the GSH Innovation Hub. The case observations are summarised here.

5.3.1 Interaction/engagement—concertation
The Innovation Programme commenced by identifying persistent challenges that obstruct the delivery of healthcare at GSH. These included improvements in programme protocol, delivery processes, events, and interventions that focus on improving patient outcomes further. GSH staffs were asked to respond to these challenges with proposals, and a series of workshops and events were run in the hospital to stimulate staff to think differently. A facilitator was engaged to perfect proposed approaches and implement them timeously, so as to enhance the chances of success. Participants were incentivised through recognition of participation, and a preventative approach to conflict was adopted.

A key finding from the case: As found in the IP literature (van Rooyen et al. 2013; Swaans et al. 2014), the nurturing of socialised informal relations to foster innovation are key to interaction and engagement; here, knowledge brokers can assist in fostering new relationships (Ellen et al. 2011). A facilitator is required to create a link between daily operations and the executive management team, and to promote bottom-up development. Finally, incentives should be

employed to ensure a demand-driven and contextualised innovation process.

5.3.2 Knowledge development
Due to the vast number of stakeholders involved in the Hub, knowledge differs greatly across Hub members. Members have also been trying to create a unique, non-traditional M&E system that speaks to their specific context, but with limited success. The need for an improved knowledge management system is evident from the case study. The steering committee requires this information to make better and more informed decisions. Further, it is sometimes difficult to get the desired buy-in from hospital staff into the innovation programme. A proposed intervention that is owned and implemented by frontline workers, rather than imposed by management, is more likely that peers and colleagues will buy into the innovation process.

A key finding from the case: This dimension can be enhanced by on-going project evaluation to assess programme impact, and reflexive learning when challenging critical constraints. Knowledge translation should easily occur across levels (van Rooyen et al. 2013; Swaans et al. 2014).

5.3.3 Capacity development
It is clear that the Hub serves a vital role in contributing to and strengthening the innovation ecosystem in the hospital. However, there is a need for external parties that hold specific knowledge to be included, so as to introduce new, but extremely valuable knowledge. It is often difficult when different mind sets from external actors do not understand the GSH context.

A key finding from the case: The innovation process should contribute to capacity development by catalysing new thought processes, and an IP should create the opportunity for participants to learn from each other.

5.3.4 Innovation
During 2016, the Hub was run by GSH staff. While it was still utilised for different workshops and other functions, it was not used optimally. At the time, the Hub primarily partnered with UCT to complete a few innovation projects. During this period the Hub grew slowly, but nevertheless gained more traction and involved an increasing number of staff members. The Innovation Hub illustrates that innovation does not take place in an institutional vacuum, but that it requires facilitation towards the interaction of different actors. In June 2017, GSH permanently employed two staff members to run the Innovation Hub. The availability of funds for an innovation drive to celebrate GSH's 80th anniversary led to the launch of a second Innovation Programme. Numerous project suggestions were received and, for the first time, input was received from across the VC. The Hub was not equipped at the time to deal with the development of commercially viable innovations. The necessary entrepreneurial support is not available to deal with intellectual property matters or the appropriation of viable business models within this space.

A key finding from the case: Project timelines need to be adaptable. While defined start and end dates are appropriate for an Innovation Programme, it is also important not to impose artificial timelines on individual project implementations. Capacity also needs to be developed to deal with intellectual property and to realise business cases for innovations (van der Merwe et al. 2020).

5.3.5 Actors

The Innovation Hub was planned to serve as a site for moulding a community of like-minded innovators, in which membership is fluid and people from various strands of life and work are welcome. The inclusion of all actors is extremely difficult because people work in pockets across the hospital, and all have different agendas. The inclusion of all parties from the onset of the project is crucial, as the initial scoping feedback provides a foundation from which to address challenges. For the successful implementation of solutions, the context requires attention. Unless the purpose and value of the intervention are clear to IP members and stakeholders, long-term acceptance is impeded.

The Bertha Centre was very explicit about the role they wanted to play, and that the initial facilitator would withdraw to ensure the sustainability of the Hub. At the end of 2015, the Bertha Centre stepped away from their hands-on role in supporting the various project teams. This led to the creation of a space in which there were no dedicated resources to coordinate the innovation initiatives. Further, the first innovation run highlighted the need to support single-person project teams as they are unable to carry the totality of the Innovation Programme burden. These members find it difficult to stick to project timelines and to attend meetings that lead to a time-delay in the implementation of their innovation.

A key finding from the case: The following should be addressed to enable actors to play an appropriate role:

- social organisation of producers is important for learning and demand articulation;
- intermediaries play a critical role to ensure representation of different types of VC actors;
- rules and regulations should be adapted to include marginalised populations;
- diversity among main beneficiaries should be considered when deciding on the project's main focus; and
- creating and fostering effective coalitions among actors is often hindered by incomplete information regarding potential members' contributions.

5.3.6 Institutions

The Innovation Hub has a set of house rules to ensure that the space is utilised optimally. These rules include standard operating procedures regarding the Hub's keys, the cleanliness of the Hub as well as booking the space for an event. This creates the necessary structure to ensure that the Hub functions optimally and to reduce misunderstandings amongst Hub members. Additionally, Hub members adopt a democratic approach towards constructing and deconstructing sub-systems. The importance of the Innovation Hub in public sector organisations is emphasised, as such spaces are not typically conducive to innovation. Attempts towards innovation are often hindered through a lack of knowledge sharing amongst these organisations as well as internal politics.

A key finding from the case: Formal institutions (and the change thereof) are important to support the innovation process. Informal institutions such as trust, norms, and values are important for people's behaviour, and may require specific methods to address them. Finally, projects must be embedded within a specific context to ensure sustainability (Hekkert et al. 2007).

5.3.7 Infrastructure

The Innovation Programme is based in the GSH Innovation Hub, a physical space that allows programme participants to interact with various partners[3] across the Western Cape. The importance of creating an open space in which to interact is highlighted through this case study. This is due to the fact that the geographic concentration of people aids in creating social networks, which promotes inter-personal relationships and inter-organisation relations; further, it creates a platform through which knowledge can more easily be shared across organisational boundaries. Efforts to overcome many barriers to effective communication, cooperation, and ultimately innovation are central to sustainability within the Hub's infrastructure. Open communication amongst members allows for colleagues from different departments to work together to identify bottlenecks that affect everyone. To ensure the programme's sustainability, an active resource is required to streamline the Hub's and the Innovation Programme's implementation. This creates accountability regarding the use of resources and allows for the identification required resources. The support from the facility board is necessary to ensure sustainability.

A key finding from the case: Infrastructure-related problems should be resolved by specifically looking beyond symptoms, considering the root cause of problems, and identifying the requirements to address challenges.

5.3.8 In summary

Evidence from the GSH Innovation Hub case suggests that the framework satisfies its design goals by:

- providing guidance towards the development of an IP;
- providing support towards the operation of an IP; and
- identifying interventions to support the development and continued functioning of more inclusive IPs.

The interviewees believe that the framework, if implemented, will aid IPs in promoting a culture of innovation that leads to an increase in collaborative efforts to address healthcare challenges. The lessons learned from the case application of the framework were incorporated into the management tool design and provide recommendations for future studies.

6. Conclusion

6.1 Evaluated framework

The evaluated framework, based on validation during Part 3 of the CFA, is summarised in Table 6. For each dimension, the concepts that relate to formation and functioning are summarised, as are the policy insights that can be deduced from implementation challenges and best practices.

The framework combines two often contradictory mindsets: expansive thinking that explores long-term possibilities, and pragmatic implementation activities that lead to shorter-term impacts. Each IP originates from within a different context and has a different set of resources and infrastructure at its disposal. The framework guides IPs to optimise the formation of synergies amongst VC actors to solve the specific problems in their environment. It provides high-level phases with requirements; it is not rigid in nature, as there is no formula to ensure the success of an IP.

The high degree of flexibility within the predetermined boundaries of the platform allows for numerous combinations of the identified concepts, all of which lead to different outcomes and growth

Table 6. The IP framework.

Dimensions	Concepts	Policy insights
Interaction/ Engagement – Concertation	Formation: visioning and planning; incentives and reward systems; facilitation and coordination; conflict resolution and dealing with power dynamics Functioning: driving participation, commitment, ownership; facilitation and management of interactions within IP; termination of IP/members	What is difficult about implementing this? Engaging and keeping external parties engaged, fostering a feeling of solution ownership What is good practice, for consideration in policy development? Platform facilitation requires a dedicated person with skills and experience in negotiations and dealing with diverse stakeholder desires Entice participation by explaining the value of being part of the platform Undertake visioning and planning activities to engage with and gather information from participants—this will help to understand how they see value. Create collaborative partnerships between parties, based on mutual respect and transparency, to develop trust Platform sustainability depends on appropriate, context-relevant incentives to drive engagement Neutral spaces for interaction between participants may reduce conflict Accept that engagement will take time and will be influenced by participants' expectations and roles Develop processes and mechanisms to keep track of the relationships, partnerships, outcomes, and outputs that these generate over time
Knowledge development and learning	Formation: knowledge, skills, and interest exploration; and monitoring and evaluation Functioning: knowledge transfer and type of learning; consideration of various approaches to knowledge management; disseminate and diffuse knowledge; andcontinuous monitoring and evaluation	What is difficult about implementing this? Facilitating knowledge sharing between individuals with varying levels of education Facilitating a process where participants accept and implement solutions Managing intellectual property concerns Dealing with sensitive data and information Implementing solid M&E systems Scaling solutions, especially under limited engagement. What is good practice, for consideration in policy development? The platform should facilitate knowledge sharing between participants Knowledge translation should transpire across diverse levels of education and cultural backgrounds The implementation and acceptability of ideas depend on buy-in and ownership through co-creation of solutions Knowledge management processes should be created to ensure appropriate treatment of sensitive information, and to decide how intellectual property will be handled Knowledge development processes should incorporate local knowledge to ensure appropriate solution development Knowledge dissemination is important to share learning; it should be designed to cross disciplinary and geographical boundaries Monitoring and Evaluation pose challenges, as impacts may be difficult to track; it is important to build momentum, share success stories, and know what is not working well Feedback and learning in platforms need to be better monitored
Capacity building	Formation: focus on process inclusivity; design for scalability (Scaling up/out); consideration of dynamic processes; dealing with resistance to change Functioning: draw on existing capacity and develop new ones; celebrate successful idea execution; approaches to change management; andaddress physical, socio-economic, and political factors	What is difficult about implementing this? Tracking and managing capacity building that needs to take place at different levels and locations Measurement and evaluation of capacity developments are difficult to quantify What is good practice, for consideration in policy development? Platforms should implement principles of continuous improvement –how to do things better and how to ensure capacity development The platform should develop strong linkages with policy makers for access to relevant and current research—specifically to build policy-making capacity M&E indicators are required to track capacity development Participants should be encouraged to learn from each other, rather than compete through the measurement process; the latter may induce stress, tension, and fear of not living up to expectations
Innovation	Formation: search guidance; andshift in IP's focus level Functioning: supporting technology service development; supporting entrepreneurial activity; andcontinued guidance of search activities	What is difficult about implementing this? Driving innovation in resource-poor environments Ensuring buy-in for solutions and its implementation What is good practice, for consideration in policy development? Expertise and continued improvement are critical to intervention success

(continued)

Table (continued)

Dimensions	Concepts	Policy insights
		Innovation is stimulated amongst members by acknowledging the distinct input of each actor
		Intellectual property rights with respect to the development of unique, commercialisable innovations should be considered
		A mindset and culture change amongst actors should be considered
		Regardless of how good the idea may be, actors need to be engaged to make the initiative a success
		Project management activities should be flexible to ensure that artificial constraints are not imposed on the programme
		Solutions need to look past symptoms to find root causes, and then identify the requirements to address challenges
Actors	Formation: inclusion and representation of all stakeholders and stakeholder-representative demand articulation Functioning seek opportunities for participation and evolving roles and responsibilities with new idea introduction	What is difficult about engaging actors? Involving various stakeholders, creating a neutral environment for engagement, and limiting conflict Creating and fostering effective coalitions among actors is often hindered by incomplete information on what potential members can offer What is good practice, for consideration in policy development? Early definition of clear roles and responsibilities Actors need to realise their mutual dependence through the engagement process, which is facilitated by knowledge sharing Weak linkages in the VC can be overcome through intermediaries; knowledge brokering activities often play an important role to facilitate knowledge sharing Diversity among main beneficiaries should be considered when deciding on the main focus of project
Institutions	Formation: setting up formal and informal institutions and construction and deconstruction of sub-systems Functioning: maintaining and strengthening formal and informal institutions and support and influence policy-making	What is difficult about engaging actors? The development of an environment where a culture of collaboration and trust is ensured. The lack of available standards for IP platforms that involve healthcare data initiatives. A lack of communication amongst VC actors may impede the implementation of plausible ideas What is good practice, for consideration in policy development? Formal institutions (and the change thereof) are important to support the innovation process Informal institutions such as trust, norms, and values are important for people's behaviour; specific methods may be required to address them In the face of limited resources, accountability and transparency are important to facilitate trust
Infrastructure	Formation: consideration of context of emergence; level of access to resources and facilities and required setup foundation Functioning: overcome barriers to functioning; establish knowledge-sharing platforms; and mobilise resources	What is difficult about engaging actors? Consideration of measures to prevent extrapolation of solutions between conflicting contexts Consideration of appropriate business models that allow for inter-operability and integration across contexts What is good practice, for consideration in policy development? Active processes and engagement mechanisms should be developed to include marginalised groups Knowledge sharing infrastructure Identification of the most appropriate funding strategy Incorporation of robust quality control mechanisms Dynamism and unpredictability of innovation require adaptive platforms

pathways. The interface design offers a modular structure that is easy to interpret and adapt to the platform's specific context.

7. Concluding remarks

IPs are mechanisms through which such MSE may be facilitated to include stakeholders from a broad range of backgrounds. This is required to ensure that technological advancements improve healthcare service delivery and increase the potential reach of healthcare workers more equitably.

The framework developed in this study provides a guideline for policy makers on how best to approach the formation and functioning of IPs. By making use of the framework, policy makers may be better positioned to address the question of how to implement VC interventions while integrating and considering opinions of all VC actors during the process of designing and developing interventions.

The fieldwork presented insight into the practical world of IPs, and the feedback informed iterative framework improvements. This rigorous approach ensured a robust final 'best practice framework' (see Table 6).

This research paves the way for future empirical studies to successfully deploy IPs through the implementation of the framework. This study indicates that IPs are complex in nature, with various factors that influence their success and effectiveness. While the framework evaluation results indicate a positive response, further study is required to track the framework's usefulness through its implementation and critical consideration of results. The study identified twenty-four types of IPs. The authors suggest that these different types of platforms are further investigated and the major differences between the platform life cycles of each type of IP are established. The development of a risk mitigation strategy for each phase in the IP life cycle will be extremely beneficial to IP development and operation.

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References

Adekunle, A. A., and Fatunbi, A. O. (2012) 'Approaches for Setting-Up Multi-Stakeholder Platforms for Agricultural Research and Development', *World Applied Sciences Journal*, 16/7: 981–8.

———, ———, and Jones, M. P. (2010) *How to Set up an Innovation Platform: A Concept Guide for the Sub-Saharan African Challenge Programme (SSA CP)*. Accra, Ghana. Forum for Agricultural Research in Africa.

Adjei-Nsiah, S., and Klerkx, L. (2016) 'Innovation Platforms and Institutional Change: The Case of Small-Scale Palm Oil Processing in Ghana', *Cahiers Agricultures*, 25/6: 9.

Adu-Acheampong, R., Jiggins, J., Tei Quartey, E. et al. (2017) 'An innovation Platform for Institutional Change in Ghana's Cocoa Sector', *Cahiers Agricultures*, 26/3: 7.

De Almeide, D., and Moreas, A. C. (2015) 'Designing a Technology and Innovation Platform for Oncological Drugs: An Integrated Foresight, Framework'. Published in proceedings of *International Association for Management of Technology IAMOT 2015*, pp.1990–2010. Hawaii, USA.

Boogaard, B., Schut, ,2M., Klerkx, L. et al. (2013a) 'Critical Issues for Reflection When Designing and Implementing Research for Development in Innovation Platforms.' Report for the *CGIAR Research Program on Integrated Systems for the Humid Tropics. Knowledge, Technology & Innovation Group (KTI)*. Wageningen University & Research centre, The Netherlands, pp. 42.

———, Dror, IAdekunle, A. et al. (2013b) 'Developing Innovation Capacity Through Innovation Platforms'. *Innovation Platforms Practice Brief 8. ILRI, Nairobi, Kenya. hdl.handle.net/10568/34162*, pp. 1–4.

Brant, J. and Lohse, S., 2014. *The open innovation model*. ICC (International Chamber of Commerce) Innovation and Intellectual Property Research Paper, (2).

Burns, L. R., Wharton School Colleagues, et al. (2002) 'The Wharton School Study of the Health Care Value Chain'. *The Health Care Value Chain: Producers, Purchasers, and Providers*, pp. 3–26. San Francisco, CA: Jossey-Bass.

Burton, H., Adams,2M, Bunton, R. et al. (2008) 'Developing Stakeholder Involvement for Introducing Public Health Genomics into Public Policy', *Public Health Genomics*, 12/1: 11–9.

Coovadia, H., Jewkes, R.Barron, P. et al. (2009) 'The Health and Health System of South Africa: Historical Roots of Current Public Health Challenges', *The Lancet*, 374: 817–34.

Corbin, J., and Strauss, A. (1990) 'Grounded Theory Research: Procedures, Canon and Evaluative Criteria', Qualitative Sociology, 13/1, doi: 10.1007/BF00988593.

Cullen, B., Tucker, J.Snyder, K. et al. (2014) 'An Analysis of Power Dynamics Within Innovation Platforms for Natural Resource Management', *Innovation and Development*, 4/2: 259–75.

———, ———, and Homann-Kee Tui, S. (2013) 'Power Dynamics and Representation in Innovation Platforms'. *Innovation Platforms Practice Brief*, Vol. 4, pp. 1–4.

Dalziel, M. (2010) 'Why do Innovation Intermediaries Exist?' *DRUID Summer Conference*, Vol. 2010, pp. 24. Imperial College London Business School, London.

Dondofema, R. A., and Grobbelaar, S. S. (2018) 'A Methodology for Case Study Research to Analyse Innovation Platforms in South African Healthcare Sector'. Published in *Proceedings of the International Conference on Industrial Engineering and Operations Management*. Johannesburg, South Africa, October 29 – November 1, 2018.

———, and Grobbelaar, S. S. S. (2019) 'Conceptualising Innovation Platforms Through Innovation Ecosystems Ierspective'. *2019 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)*, pp. 1–10. IEEE.

Dwivedi, P. K. (2015) 'Improvised model for BOP healthcare in India: Lessons from NRHM', International Journal of Pharmaceutical and Healthcare Marketing, 9/3: 259doidoi10.1108/IJPHM-08-2014-0047

Ellen, M. E., Lavis,2J. N,2Ouimet,2M. et al. (2011) 'Determining Research Knowledge Infrastructure for Healthcare Systems: A Qualitative Study', *Implementation Science*, 6: 60.

Fottler, M. D., Blair,2J. D,2Whitehead,2C. J. et al. (1989) 'Assessing Key Stakeholders: Who Matters to Hospitals and Why', *Hospital & Health Services Administration*, 34/4: 525

Frey, K., Lüthje, C., and Haag, S. (2011) 'Whom should firms attract to open innovation platforms? The role of knowledge diversity and motivation. Long Range Planning', 44/5: 397-420, doi : 10.1016/j.lrp.2011.09.006.

Grobbelaar, S. S. (2018) 'Developing a Local Innovation Ecosystem Through a University Coordinated Innovation Platform: The University of Fort Hare', *Development Southern Africa*, 35/5: 657–72.

———, and Uriona-Maldonado, M. (2019) 'Using Technology to Improve Access to Healthcare: The Case of the Mom Connect Programme in South Africa', *Local Economy: The Journal of the Local Economy Policy Unit*, 34: 838–52.

Grobbelaar, S., Tijssen, R., and Dijksterhuis, M. (2017) 'University-Driven Inclusive Innovations in the Western Cape of South Africa: Towards a Research Framework of Innovation Regimes', *African Journal of Science, Technology, Innovation and Development*, 9/1: 7–19.

Haddaway, N. R., Kohl,2C, Rebelo da Silva, N. et al. (2017) 'A Framework for Stakeholder Engagement During Systematic Reviews and Maps in Environmental Management', *Environmental Evidence*, 6/1: 11.

Heeks, R., Foster, C., and Nugroho, Y. (2014) 'New Models of Inclusive Innovation for Development', *Innovation and Development*, 4/2: 175–85.

Hekkert, M. P., Suursa,2R.A.A, Negro, S. O. et al. (2007) 'Functions of Innovation Systems: A New Approach for Analysing Technological Change', *Technological Forecasting and Social Change*, 74/4: 413–32.

Herman, H., Grobbelaar, S. S., and Pistorius, C. W. I. (2018) 'Towards a Conceptual Framework for the Design, Development and Implementation of Technology Platforms from a Platform Owner's Perspective'. *Towards Sustainable Technologies and Innovation - Proceedings of the 27th Annual Conference of the International Association for Management of Technology, IAMOT 2018*.

Hoffman, A., Montgomery, R., Aubry, W. et al. (2010) 'How Best to Engage Patients, Doctors, and Other Stakeholders in Designing Comparative Effectiveness Studies', *Health Affairs*, 29/10: 1834–41.

Homann-Kee Tui, S., Adekunle,2A, Lundy, M. et al. (2013). Innovation Platforms Practice Brief 1. ILRI, Nairobi, Kenya. hdl.handle.net/10568/34157.

Jabareen, Y. (2009) 'Building a Conceptual Framework: Philosophy, Definitions, and Procedure', *International Journal of Qualitative Methods*, 8/4: 49–62.

Jiggins, J., Hounkonnou, D.Sakyi-Dawson, O. et al. (2016) 'Innovation Platforms and Projects to Support Smallholder Development- Experiences from Sub-Saharan Africa', *Cahiers Agricultures*, 25/6: 8.

Kahan, S., and Testa, W. A. (2008) *The Value Chain Case for Health Care Reform—a Conference Summary*. *Chicago Fed Letter*, (248), p.1.

Klerkx, L., Aarts, N., and Leeuwis, C. (2010) 'Adaptive Management in Agricultural Innovation Systems: The Interactions Between Innovation Networks and their Environment', *Agricultural Systems*, 103/6: 390–400.

Leon, N., and Schneider, H. (2012) *MHealth4CBS in South Africa a Review of the Role of Mobile Phone Technology for Monitoring and Evaluation of Community Based Health Services*. Cape Town: Medical Research Council and University of Western Cape.

Lundvall, B. Å. (2007) 'National innovation systems—analytical concept and development tool', Industry and Innovation, 14/1: 95, 10.1080/13662710601130863

Luyet, V., Schlaepfer, R., Parlange, M. B. et al. (2012) 'A Framework to Implement Stakeholder Participation in Environmental Projects', *Journal of Environmental Management*, 111: 213–9.

Makini, F., Kamau,2G, Makelo, M. et al. (2013) In: M., Mwariri, and K. T., Mukundi (eds.) *Operational Field Guide for Developing and Managing Local Agricultural Innovation Platforms*. Nairobi, Kenya: KARI and ACIAR.

Marais, A. (2018) *A Management Tool Towards the Development of Healthcare Innovation Platforms*. Stellenbosch: Stellenbosch University.

——, Grobbelaar, S. S., and Kennon, D. (2017) 'A Conceptual Framework Towards the Development of Innovation Platforms that Facilitate the Integration of Technology in Healthcare Value Chains'. *Proceedings of IAMOT 2017 Conference*. Vienna, Austria.

——, —— and —— (2018) 'A Conceptual Framework for Managing Healthcare Innovation Platforms: A Value Chain Perspective'. *Towards Sustainable Technologies and Innovation - Proceedings of the 27th Annual Conference of the International Association for Management of Technology, IAMOT 2018*.

Meersman, D. and De Leenheer, P.(2012) 'Open Innovation in Health Service Value Networks: A Methodology for the Innovation of Ambient Assisted Living Platforms and Services' in W., Abramowicz, J., Domingue, and K., Wœcel (eds) *Business Information Systems Workshops: BIS* 2012. Springer Berlin Heidelberg, pp 25. doi 10.1007/978-642-34228-8_3

van der Merwe, E., Grobbelaar, S., and Bam, W. (2020) 'Exploring the Functional Dynamics of Innovation for Inclusive Development Innovation Systems: A Case Study of a Large Scale Maternal mHealth Project in South Africa', *Innovation and Development*, 10: 117–38.

Nederlof, E. S., and Pyburn, R. (2012) *One Finger Cannot Lift a Rock: Facilitating Innovation Platforms to Trigger Institutional Change in West Africa*. Amsterdam, The Netherlands: Royal Tropical Institute (KIT). http://hdl.handle.net/10919/70157

Nederlof, S., Wongtschowski, M., and Van Der Lee, F. (2011) *Putting Heads Together: Agricultural Innovation Platforms in Practice, Development, Policy & Practice*. Amsterdam: Royal Tropical Institute (KIT) pp. 1- 192.

Ngongoni, C. N., Grobbelaar, S. S. and Schutte, C. (2018) 'Platforms in the Healthcare Innovation Ecosystems: The Lens of an Innovation Intermediary'. *Proceedings of the 3rd IEEE S.A. Biomedical Engineering Conference*. Spier, Stellenbosch.

Porter, M. E. (1980) *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: NY: Free Press.

Porter, M.E. and Kramer, M.R., (2011). The Big Idea: Creating Shared Value. How to reinvent capitalism—and unleash a wave of innovation and growth. Harvard Business Review, 89(1–2).

Porter, M. E. (1985) *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: NY: The Free Press.

Prahalad, C. K. (2012) 'Bottom of the Pyramid as a Source of Breakthrough Innovations', *Journal of Product Innovation Management*, 29/1: 6–12.

Ratshidi, L., Grobbelaar, S., and Botha, A. (2020) *Categorization of Factors Influencing Community Health Workers from a Socio-Technical Systems Perspective*. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), pp. 84–95. doi: 10.1007/978-3-030-45002-1_8.

Reed, M. S. (2008) 'Stakeholder Participation for Environmental Management: A Literature Review', *Biological Conservation*, 141: 2417–31.

van Rooyen, A., Swaans, K., Cullen, B. et al. (2013). *Facilitating Innovation platforms, Innovation Platforms Practice Brief 10*. ILRI, Nairobi, Kenya. hdl. handle.net/10568/34164.

Sanyang, S., Taonda, S. B., Kuiseu, J. et al. (2016) 'A Paradigm Shift in African Agricultural Research for Development: The Role of Innovation Platforms', *International Journal of Agricultural Sustainability*, 14: 187–213.

Schut, M., Klerkx, L.W.A., Kamanda, J., Sartas, M. and Leeuwis, C., 2018. Innovation platforms: synopsis of innovation platforms in agricultural research and development. In *Reference Module in Food Science*, Elsevier.

——, Klerkx,2L, Sartas, M. et al. (2016) 'Innovation Platforms: Experieces with their Institutional Embedding in Agricultural Research for Development', *Experimental Agriculture*, 52/04: 537–61.

South African National Department of Health. (2015) National Health Insurance for South Africa. Pretoria, South Africa. Available at: www. health.gov.za accessed October Nambisan, S., Siegel, D. and Kenney, M. (2018) 'On open innovation, platforms, and entrepreneurship', Strategic Entrepreneurship Journal. John Wiley & Sons, Ltd, 12(3), pp. 354–368. doi: 10.1002/sej.1300.2020

——. (2019) *National Digital Health Strategy for South Africa 2019–2024*. Pretoria, South Africa. Available at https://www.bhfglobal.com/2019/10/25/national-digital-health-strategy-for-south-africa-2019-2024/ Accessed on 12 October 2020.

Swaans, K., Boogaard,2B, Bendapudi, R. et al. (2014) 'Operationalizing Inclusive Innovation: Lessons from Innovation Platforms in Livestock Value Chains in India and Mozambique', *Innovation and Development*, 4: 239–57.

Tenywa, M. M., Rao,2K. P. C, Tukahirwa, J. B. et al. (2011) 'Agricultural Innovation Platform as a Tool for Development Oriented Research: Lessons and Challenges in the Formation and Operationalization', *Learning Publics Journal of Agriculture and Environmental Studies*, 2/1: 118–46.

Varma, S., Evans,2A, Wells, C. S. et al. (2009) 'Attitudes and Actions of Participants in Multi-Stakeholder Processes and Platforms', *Knowledge Management for Development Journal*, 5/3: 201–14.

Victor, M., Ballantyne,2P. G, Le Borgne, E. et al. (2013) '*Communication in Innovation Platforms*', *Innovation Platforms Practice Brief*, pp. 1–4. Nairobi: CGIAR.

World Health Organization. (2007) *Everybody's Business: Strengthening Health Systems to Improve Health Outcomes: WHO's Framework for Action*. Geneva.

——. (2012) *National Health Policies, Strategies and Plans*, WHO. <https://www.who.int/nationalpolicies/processes/stakeholders/en/>, accessed on 12 October 2020

——. (2017) World Health Statistics 2017: Monitoring Health for the Sustainable Development Goals. Geneva: World Health Organization.

Wieczorek, A. J., and Hekkert, M. P. (2012) 'Systemic Instruments for Systemic Innovation Problems: A Framework for Policy Makers and Innovation Scholars', *Science and Public Policy*, 39/1: 74–87.