A FRAMEWORK FOR DECISION-MAKING IN ICT4D INTERVENTIONS TO ENABLE SUSTAINED BENEFIT IN RESOURCE-CONSTRAINED ENVIRONMENTS

by

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ABSTRACT

In the search to reduce the various divides between the developed and the developing world, Information and Communication Technology (ICT) is seen as an enabler in resource-constrained environments. However, the impact of ICT for Development (ICT4D) implementations is contested, and the ability to facilitate sustained change remains elusive.

Sustainability emerged as a key lesson from the failure of early ICT4D projects, and has served as a focal point in facilitating ICT4D success. However, interpretation of the concepts of sustainability and sustainable development seems to be multiple and disconnected from practice, and is rarely translated into a useful construct for guiding project-level actions.

The focus of international development is gradually shifting from donated aid towards capability and choice, empowerment, and per-poor initiatives. However, the reality remains that multiple organisations with varying levels of power, resources, and influence determine the outcomes and the sustainability of benefits from a development intervention.

This research investigates mechanisms to sustain benefit by exploring the interface between various role players through the lens of decision-making. It builds on the view that the value created by the virtual 'organisation' of stakeholders in an ICT4D implementation results from the sum of its decisions, and develops a framework for decision-making with a view on sustaining benefits.

The work follows a Design Science Research methodology, comprising an iterative process for the development, testing, and improvement of the framework based on three literature reviews, two case studies, and an expert review.

The research answers the primary research question, namely:

What are the elements of a framework that support strategic decision-making for the design and implementation of ICT4D interventions in resource-constrained environments, in support of sustained benefit?

The knowledge contribution is primarily at the concept and methodological level. In addition to framework development, the *decision problem in ICT4D* is defined, and the concept of *sustained benefit* is proposed as a means of operationalizing sustainability.

This research illustrates the role of decision concepts in structuring the complexity of ICT4D problems. It introduces an alternative perspective into the debate on sustainability in ICT4D, and provides a basis for the future development of theory.

Keywords:
ICT4D, Sustained Benefit, Sustainability, Decision Framework, Value Creation, Design Science, Decision Modelling, Project Process, Operationalization.

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PUBLICATIONS

The following publications resulted from the work done for this dissertation.

Peer-reviewed journal article

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Peer-reviewed book chapter

Meyer, I.A. and Marais, M.A. (2014). ***Sustainability and Value through Improved Decision-making***, in: *Designing and implementing an Information and Communication Technology for Rural Education Development (ICT4RED) initiative in a resource-constrained environment: Nciba school district, Eastern Cape, South Africa*, Herselman M E and Botha A (eds.), pp. 205-236, Edition: 1 published by CSIR, Pretoria. ISBN 978-0-7988-5618-8 (hbk).

Peer-reviewed conference proceedings

Meyer, I.A., Marais, M.A., Ford, M. and Dlamini, S. (2017). ***An exploration of the integration challenges inherent in adoption of ICT in an Education System***. Proceedings of the 14th IFIP WG 9.4 International Conference on the Social Implications of Computers in Developing Countries, ICT4D 2017, Yogjakarta, Indonesia, May 22–24, 2017.

Meyer, I.A. and Marais, M.A. (2014). ***Decision support to enable sustainability in development projects***. Proceedings of the 11th Prato CIRN Community Informatics Conference, Prato, Italy, October 13–15, 2014.

Meyer, I.A., Marais, M.A., Ford, M. and Dlamini, S. (2017). ***Systemic levers for change towards sustainable institutionalization of ICTs in schools.*** Proceedings of the IST Africa 2017 Conference, Windhoek, Namibia, May 31–June, 2017.

DECLARATION

I declare that **A FRAMEWORK FOR DECISION-MAKING IN ICT4D INTERVENTIONS TO ENABLE SUSTAINED BENEFIT IN RESOURCE-CONSTRAINED ENVIRONMENTS** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I have not previously submitted this work, or part of it, for examination at UNISA for another qualification or at any other higher education institution.

10 November 2017

SIGNATURE DATE

I A Meyer

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LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Explanation
AHP	Analytical Hierarchical Process
DANIDA	Danish International Development Agency
DBE	Department of Basic Education
DD	Digital Doorway
DI	Development Informatics
DFID	Department for International Development
DRDLR	Department of Rural Development and Land Reform
DS	Design Science
DSR	Design Science Research
DSRP	Design Science Research Process
DST	Department of Science and Technology
ECDoE	Eastern Cape Department of Education
EJIDSC	Electronic Journal of Information Systems in Developing Countries
FEDS	Framework for Evaluation in Design Science Research
H-Index	Harzing's search index
HSRC	Human Sciences Research Council
ICT	Information and Communications Technology
ICT4D	Information and Communications Technology for Development
ICT4RED	Information and Communications Technology for Rural Education
ICTD	Information and Communications Technology and Development
IDRC	International Development Research Centre
IFIP	International Federation for Information Processing
IFPRI	International Food Policy Research Institute
ISDC	Information Systems in Developing Communities
IT	Information Technology
JOCI	Journal of Community Informatics
LED	Local Economic Development
M&E	Monitoring and Evaluation
MCDM	Multi-criteria Decision Making
NARYSEC	National Rural Youth Service Corps
OECD	Organisation for Economic Co-operation and Development
OECD/DAC	Development Assistance Committee of the Organisation for Economic Co-operation and Development
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
SJR	Scimago Journal Rank
SLA	Service-level Agreement
TCO	Total cost of ownership
TPD	Teacher Professional Development
TECH4RED	Technology for Rural Education
UPS	Uninterrupted Power Supply
WCED	World Commission on Environment and Development

CHAPTER 1. INTRODUCTION

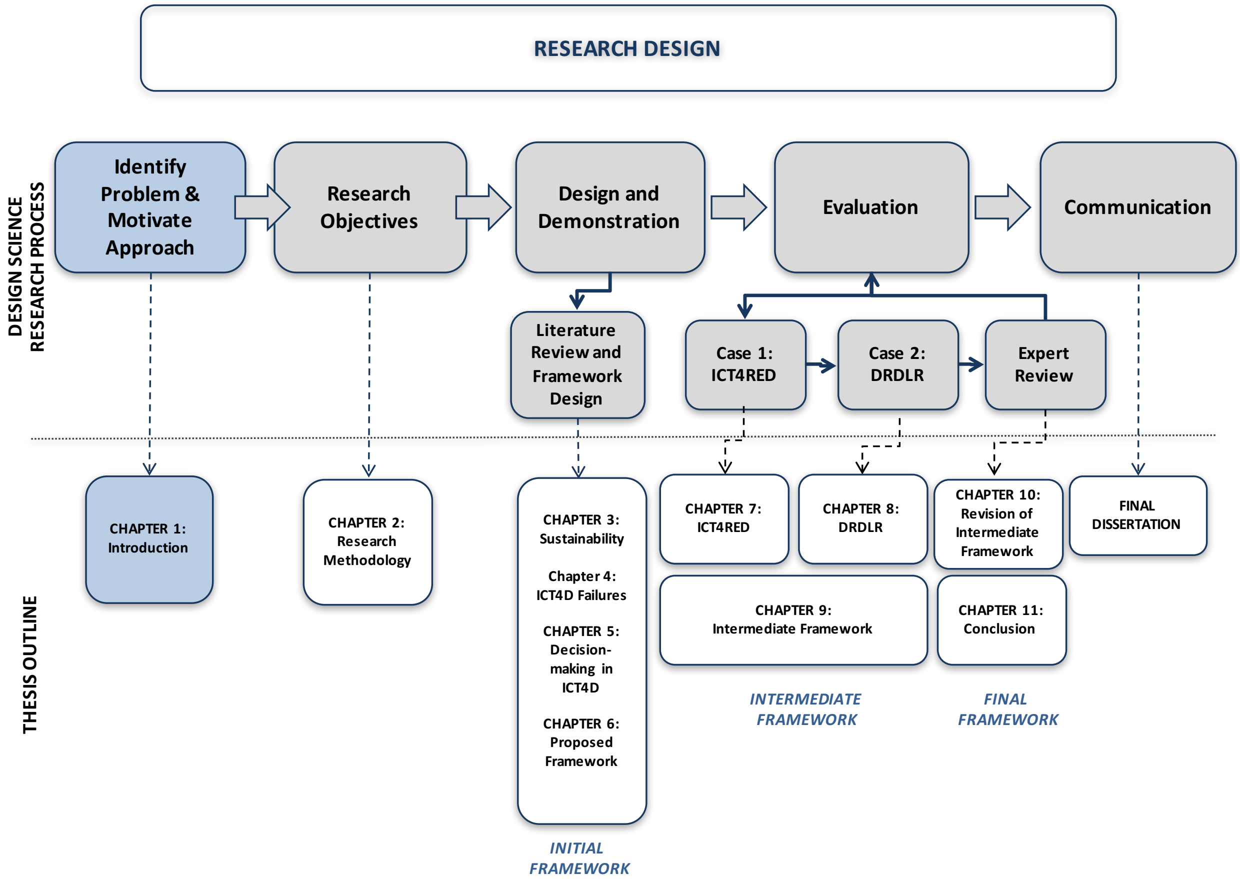

Figure 1.1 Research process and thesis outline: Chapter 1

1.1. MOTIVATION

Global socio-economic inequality is significant and increasing (OECD, 2015); while development goals are continuously set and revised (United Nations, 2008, 2015), significant progress towards sustained development is lacking. The latter is reflected in the preamble to the Sustainable Development Goals, which aims to 'build upon the achievements of the Millennium Development Goals and seek to address their unfinished business' (United Nations, 2015:3). However, it is similarly perceived that the Sustainable Development Goals 'will do little to reduce poverty, will continue to propagate a world system based on inequality' (Unwin, 2015:1).

The strong correlation between the use of Information and Communication Technologies (ICTs) and the development status of different countries serves to support the high expectations from Development Informatics (DI) and related fields to contribute to development (Johanson, 2011), and Information and Communications Technology for Development (ICT4D) is often seen as a catalyst for sustainable rural development (Nayak, 2013; Vandeyar, 2013; Zeleneka & Pearce, 2013). However, its success remains limited and disputed (Heeks, 2002, 2010b; Toyama, 2010).

Traditionally, a significant portion of development interventions originates from development agencies that allocate funds with a specific agenda, to achieve a specific goal. This approach has lead to a focus on efficiency, effectiveness, and return on investment by agencies (OECD, n.d.); a 'top-down' or 'outside-in' view on development and change (Langmia, 2013); and power imbalances between the 'provider' and the 'recipient' of development aid (Brown & Morton, 2008; Girvan, 2007).

While the focus is gradually shifting towards capability and choice (Kleine, 2010; Sen, 1992), empowerment (e.g., Grunfeld, 2011; Valls, 2014), and per-poor initiatives (Heeks, 2008), the reality remains that multiple organisations with varying levels of power, resources, and influence pre-determine the outcome of a development intervention, as well as the sustainability of the change and benefits that are effected in the community through the intervention.

This research investigates mechanisms to sustain benefit from development interventions by exploring the interfaces between the various role players in an intervention through the lens of decision-making. It builds on the view that 'the value that an organisation creates is ultimately no more or no less than the sum of the decisions that it makes and executes' (Blenko, Mankins, & Rogers, 2010:5), and proceeds to develop a framework within which decisions can be made with a view on sustaining the benefits that an intervention aims to create.

This chapter provides a conceptual overview of the work described in this document. First, it provides background to the study (Section 1.2), followed by background and a definition of the research problem (Sections 1.3, 1.4). The significance and contribution of the study, as well as its limitations (Sections 1.5, 1.6), are then described. Finally, a thesis outline is provided (Section 1.7), and the chapter is summarized (Section 1.8).

1.2. BACKGROUND TO THE STUDY

The concept of ICT4D emerged in the 1990s and early 2000s, when ICTs was hailed as a means of having a potentially significant impact on development (Kleine & Unwin, 2009). It refers to the use of ICT in development contexts and arose, according to Heeks (2008:27), from the intersection between ‘the digital technologies of the 1990s [which] … supplied a new tool in search of a purpose; development goals were new targets in search of a delivery mechanism’. This view is echoed by Burrel and Toyama (2009:84), who define ICT4D research as ‘involving both studies of the interaction between people and technology as it exists or evolves, as well as intervention work’. At the same time, the role of technology in development needs to be contextualised appropriately, with information technology as just one of a number of measures of development (Johanson, 2011).

Heeks (2014a) differentiates DI as the sub-discipline that studies ICT4D policy and practice, at the intersection of Development Studies and Informatics Studies. He further describes the development of DI research through four waves, from wave one in the 1960s to the mid-1980s (where the first links between ICT and development were made), to the fourth wave (mid-2000s to mid-2010s), where work has focused on the impact of ICTs in development, and where intellectual consolidation has been taking place across different conceptualisations.

In earlier work, Heeks (2008) highlighted that ICT4D has progressed from *ICT4D1.0* – a phase that was largely focused on establishing telecentres in rural communities – to *ICT4D2.0*, in which the field has been confronted with the challenge of delivering internet technology to the five billion people without access. ICT4D2.0 reflects the evolution of ICT4D from dissemination of technology to an agent of innovation, by stressing its transformative role as a platform for innovation by the poor themselves – expressed in a shift from pro-poor to para-poor and per-poor innovation (Heeks, 2008).

Contrary to the earlier expectations of significant impact (Kleine & Unwin, 2009), ICT4D interventions[1] often have high failure rates. Earlier work to understand failures focused on the lack of sustainability, scalability, and inadequate impact evaluation methods (Heeks, 2008). The work proposed here focuses on the concept of *sustainability*, which is often seen as a means of focusing on failure reduction (Howard, 2008). The multiple but often high-level and impracticable definitions of sustainability (Nayak, 2013) calls for an examination of the concept, and the development of new approaches to the long-term delivery of benefit from ICT4D interventions.

The implementation of ICT4D interventions constitutes, from many perspectives, a 'messy' problem (Herselman & Botha, 2015; Hevner, March, & Park, 2004). The latter is characterised by 'a large degree of uncertainty as to how the problem should be approached and how to establish and evaluate the set of alternative solutions' (Pries-Heje & Baskerville, 2008:731). In ICT4D interventions, these characteristics manifest in the many role players with different views on the definition of the problem to be solved, objectives that are often not clear or agreed upon, budgets that are not adequately allocated and understood upfront, implementation environments that hold many uncertainties, and resources that are constrained. In addition, conflicting decisions by many role players could undermine the benefit from the intervention.

The premise of this work is that the long-term impact of an intervention, and the benefit that can be delivered, can be influenced through the development and use of a structured framework for decision-making with respect to the design and implementation of ICT4D interventions. It is proposed that a framework be developed to focus decision-making towards sustained benefit.

Hassan (2014) differentiates between conceptual, research, and theoretical frameworks. He positions a framework as a product of theorising, which can ultimately be used to inform model development, and guide the generation of further research questions. In this work, the interest is in developing a conceptual framework of the

[1] In this context, an ICT4D intervention is seen to represent any mechanism aimed at implementing or facilitating the use of ICT for development, including a project, programme, or any similar arrangement. The manner in which the intervention is structured is not dictated. In this research, the term ICT4D intervention is mostly used, but interchanged with related terms (e.g., project or implementation), as appropriate.

concepts and structures that can be used to guide the planning of ICT4D work towards sustained benefit. The definition of Miles and Huberman (1994:30) is relevant: 'the researcher's map of territory being studied, which consists of the map of main concepts, constructs and their related positions'.

Bordage (2009:312) defines a conceptual framework as representing 'ways of thinking about a problem or a study, or ways of representing how complex things work'. The decision framework would provide structure within the messy environment of delivering benefit from ICT4D interventions. It would serve as a guideline to enable decision-makers to consider the key elements that affect the delivery of sustained benefit, and manage their decisions accordingly. The nature of the process within which development interventions take place is critical to the ability to deliver sustained benefit. The framework would therefore be contextualised against an appropriate process.

This chapter introduces research that is aimed at developing a *framework* for decision-making that will enhance the ability of ICT4D teams (i.e., implementers, participants, and all other stakeholders) to deliver sustained benefit in *resource-constrained* environments. The inclusion of the concept of 'resource-constrained' in this definition primarily serves to emphasize the development context within which the research takes place, but also serves to highlight the necessity for making trade-offs in environments where resources are not abundant. Intuitively, one could define such environments as lacking sufficient resources to implement, adopt, and support ICT4D solutions. In the context of ICT4D, and education specifically, Herselman and Botha (2014) define a resource-constrained school environment as one that is characterised by intermittent (or lack of) access to enablers such as electricity, internet and communications infrastructure, as well as limited (or lack of) access to water, sanitation, and sufficient schooling facilities (including teachers).

Two ICT4D interventions in rural, resource-constrained environments are used as primary cases to inform the development of the decision framework. These also serve as cases for the interrogation of an appropriate project process.

A Design Science (DS) research approach is proposed for development of the framework. Its appropriateness for this work lies in the ability to create both knowledge and solutions (Van Aken, 2005), to cross the boundaries of people, organisations, and systems (Hevner & Chatterjee, 2010), and to provide a structured mechanism within which iterative design cycles can be executed (Drechsler & Hevner, 2016; Peffers *et al*., 2006).

1.3. BACKGROUND TO THE RESEARCH PROBLEM

1.3.1. Sustainability and sustained benefit

Sustainability is a concept that is used in various contexts, including that of ICT4D interventions. It emerged as one of three key lessons or watchwords from the failure of early ICT4D projects (Heeks, 2008). However, the concept is not clearly defined, and is rarely translated into a construct that could be used to influence and guide actions comprehensively at project level. It is seen as 'a difficult aspiration to operationalise' (Sanner, 2017:498). Heeks (2014b:15) echoes this sentiment by stating 'sustainable development is an empty slogan: continuously invoked but never examined'. Sustainability is seen as a key element of the post-2015 development agenda, but is the most underrepresented theme in ICT4D literature; this implies that 'ICT4D policy and practice needs to pay far more attention to sustainability' (Heeks, 2014b:15).

The interpretation of the concepts of sustainability and sustainable development seems to be multiple and disconnected from practice, in the sense that limited or inappropriate focus is given to translating a high-level ideal into something that exerts influence at the practical level. For example, Sanner and Saebo (2014) highlight how efforts to facilitate 'sustainability' of ICT4D interventions by *per diem* payments to project participants in effect undermine the long-term capacity building and sustainability of such interventions.

The 1987 Brundtland report contains the most well known definition of sustainable development, defining it as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987:54). This definition could be interpreted as a long-term statement about the ***system*** that needs to be sustained. However, method or approach is not implied.

Another ***systems*** level definition is that of the sustainable livelihoods framework of Ashley and Carney (1999), in which sustainable systems are considered as accumulating stocks of assets over time, while unsustainable systems deplete assets. This definition describes the desired characteristics of a sustainable system; it does not define how to facilitate change.

The Organisation for Economic Cooperation and Development (OECD) criteria for evaluation of development assistance reduces the concept to a ***project level*** definition:

'To what extent did the benefits of a programme or project continue after donor funding ceased?'

(OECD, n.d:2)

While this is a critical question in terms of the long-term impact of interventions or projects, it does not provide a means of engaging with (and facilitating) sustainability. In addition, the question is often asked retrospectively, depending on the nature of the monitoring and evaluation (M&E) approach that is taken. As such, it misses the opportunity to influence long-term delivery of value and benefit by the intervention. Sanner and Saebo (2014:33) provide a similarly intuitive definition of sustainability:

'Simply put, sustainability refers to an ICT4D intervention's ability to work in practice, over time, in a given setting.'

Some authors have explored the elements of sustainability in ICT4D projects, and have as such allowed for multiple perspectives on sustainability in ICT4D projects to be considered. These include economic, environmental, social, and institutional components (Marais, 2014), as well as political and technological dimensions (Ali & Bailur, 2007; Kumar & Best, 2006; Pade, Mallison, & Sewry, 2011).

The first three elements considered by Marais (2014) are based on Batchelor *et al*.'s (2003) definitions of the various elements of sustainability. These authors use the sustainable livelihoods definition as point of departure, and define that economic sustainability is achieved when a given level of expenditure can be maintained over time; social sustainability is achieved when social exclusion is minimised and social equity maximised; and institutional sustainability is achieved when prevailing structures and processes have the capacity to perform their functions over the long term (Talyarkhan, 2004). These definitions provide a means of taking multiple concurrent perspectives on sustainability, and could serve as a bridge between the high-level definitions that describe sustainability, and the project-level mechanisms that are required to enable *design for sustainability*.

Pade-Khene, Mallison, & Sewry (2011) provide a means of making the concepts of sustainability useful at project level by examining critical success factors in ICT4D projects, and by aligning them with the project process. As such, this approach could be used to assess whether the project has been designed to address various aspects of sustainability.

In this research, it is proposed that the concept of *sustained benefit* rather than *sustainability* be adopted as a statement pertaining to the long-term value that a development intervention delivers. The intention is to differentiate the concept from the usual connotations associated with sustainability, and to focus on the structural or fundamental change that needs to be effected in the system, rather than on short-term, transient improvements. For this purpose, it is proposed that sustained benefit is considered as something 'that will result when the relationships that support sustained change in the system of participants have been enabled to the extent that benefits will continue to be generated in the long run' (Marais & Meyer, 2015:1). In some implementations, sustaining benefits may not be relevant, for example in experimental work that is aimed at understanding and testing, rather than deploying and maintaining. The duration of benefit is therefore goal and context-specific, and needs to be defined for different interventions.

This research develops a framework that will ***focus decision-makers towards attaining sustained benefit***. As such, it is proposed that the following definition of sustained benefit is adopted: 'the benefits that this project will initiate in the system over various time scales (short, medium and long term) and at different levels of influence (strategic, tactical and operational) for participants as well as for funders. It is proposed that this perspective will provide the opportunity to operationalise the concept of sustainability. Furthermore, it places the focus on the level at which the project is making a contribution by informing decisions for long term sustained benefit' (Meyer & Marais, 2014:218). This definition, or a similar one, combined with the elements of sustainability as outlined in this section, could provide a useful basis in terms of which the goal of sustained benefit can be defined and the framework can be constructed. The relevant definition is derived in Chapter 3, based on a review of the literature of sustainability.

1.3.2. The failure of ICT4D interventions

Much has been written about the failure of ICT4D interventions, and a variety of reasons have been proposed for the low success rate. These range from a mismatch between what designers offer and what users need (i.e., the *design-actuality gap;* Heeks, 2002), to the external nature of a 'project' and the discontinuity of funding when the 'project' comes to an end (Unwin, 2009). Other explanations include that technology in itself rarely has an impact (Toyama, 2011), even though it is often seen as a solution to a development problem. Some solutions have been offered for improved sustainability, such as a focus on partnerships (Hosman & Fife, 2008), or engaging with institutionalisation (Madon *et al*., 2007).

This research develops a decision framework that is aimed at addressing some of the drivers of failure at the conceptualisation, design, and implementation level. The intent is to apply the framework also at the project or programme level. It is therefore useful to understand the different levels at which ICT4D interventions fail. An appropriate classification allows the researcher to develop a framework that considers classes of decisions that are taken at different organisational levels and different spheres of influence, and that relate to different categories of failure. For example, differentiation of failure into strategic, tactical, and operational aspects allows the researcher to identify classes of decisions that need to be influenced at all of these levels.

The comprehensive set of reasons for failure that has been identified in literature surveys emphasizes that failure of ICT4D implementations are not only related to issues of funding, and that sustainability needs to be considered from multiple perspectives. For example, Toyama (2011) found in his survey of ICT failures that reasons include: technology that is not appropriate to the context, lack of local partnerships, ignorance and disregard of socio-cultural norms, poor infrastructure, poor relationship management with government, lack of community engagement, services that do not match needs, lack of financial viability, and lack of incentives.

A brief survey of failures of telecentres in South Africa (Gush, 2006; Hulbert and Snyman, 2007) and Africa (Attwood & Braathen, 2010; Bailey & Ngwenyama, 2013; Gathege & Moraa, 2013a, 2013b; Kenya ICT Authority, 2013; Republic of Uganda, 2006) allowed this research to identify failures that correspond with the various dimensions of sustainability (as outlined in Section 1.3.1).

These failures can be translated into critical success factors and summarized as follows:

Table 1.1 Summary of critical success factors from literature, per dimension of sustainability

Dimension of sustainability	Critical success factors (derived from elements of failure)
Economic	Define a clear, needs-focused service offering; clear and well-defined financial and non-financial objectives; self-sustainability (entrepreneurship, partnerships); and funding models where costs are clearly understood.
Social/ cultural	Enable community readiness and uptake; customise and contextualise the solution; ensure participation; involve local competencies.
Political	Develop a good understanding of local context, and manage interference.
Technological	Deploy technology and software that is appropriate, and ensure that it is designed for low maintenance and can remain in working order.
Institutional	Have clearly defined objectives; manage strategically; complement existing initiatives and work within the policy context; conduct participatory M&E; ensure that the beneficiary organisation has sufficient support, human resources, capacity, a clear vision and purpose, and is enabled to make decisions and manage operations.

Examination of these factors would enable the identification of decision processes and categories that affect the delivery of sustained benefit, within each dimension.

1.3.3. The implementation context and decision-making: pre-cursors for unsustainability

The reasons for failure and lack of sustainability of ICT4D implementations ideally need to be managed and mitigated through mechanisms that are inherent in intervention (i.e., project or programme) design. However, development interventions in general, and ICT4D projects specifically, take place in contexts with specific complicating characteristics. The various project management methodologies of commercial technology projects are rarely applied to ICT4D contexts. It is postulated that characteristics inherent to ICT4D interventions lower their success rate and frustrate delivery of sustained benefit.

A number of these complicating characteristics can be enumerated through observation and analysis of different project contexts. The following characteristics were observed in ICT4D case studies, and are proposed as a description of the implementation contexts of a number of ICT4D projects (summarised and adapted from Marais & Meyer, 2015):

Table 1.2 Examples: project-level drivers of unsustainability

Project phase	Characteristic	Sustainability impacts (for example)
Initiation	Multiple role players with differing agendas and different views on what the problem is Unclear, sometimes conflicting objectives	No agreement on the desired value and benefit of intervention No agreement on extent to which benefits need to be sustained Unclear communication of benefits to stakeholders Creation of unrealistic expectations Inefficient spend of limited resources
	Multiple funders, fragmented budgets	Source of funding defines desired outcome for specific funder – could stand in conflict to an overall objective of long-term benefit
Conceptualisation	Ambitious concept Unfamiliar implementation environment	Leads to development of solutions that do not match the readiness of the implementation environment
Solution design and development	Resource-rich solutions for resource-poor environments	Solutions are implemented, but are unaffordable in the long run
Implementation	Unfamiliar implementation environment Unexpected challenges	Solutions are more expensive than anticipated Focus on technology only, without consideration of other aspects that are required to sustain the solution in its context
Training and maintenance	Limited literacy Remote locations Low skills base Low technology base	Solutions are more expensive than anticipated Solutions are not affordable in the long run Solutions cannot be maintained by local skills
Monitoring and evaluation (on-going)	M&E approaches that verify execution of activities rather than informing delivery of value	Key risks and sustainability requirements are not identified and managed

One of the key complicating factors is considered to be the role of multiple decision-makers within the context of an ICT4D intervention. These decision-makers operate at strategic, tactical and operational levels, and each has his or her own scope of influence and own power to frustrate the ability to deliver sustained benefit. For example:

Table 1.3 Examples: impact of conflicting decisions on sustained benefit

Level of decision-maker	Influence on sustained benefit
Strategic	
Different funders require different (own) Key Performance Indicators (KPIs) to be achieved.	The intervention aims to satisfy conflicting objectives that are unrelated to long-term benefit to the community.
Tactical	
The implementation team decides to develop smart (and sometimes experimental) technology solutions, within their field of expertise.	Solutions are unaffordable to the institution that needs to adopt and maintain them in the long run.
Operational	
The purchasing team decides to take a least-cost approach to technology selection.	Technology is not appropriate to the deployment environment and fails regularly, leading to a high total cost of ownership and long-term unaffordability.

Based on the characteristics of the context of an ICT4D project as outlined in Table 1.4, it is contended that the delivery of sustained benefit from ICT4D interventions constitutes a *messy* or *wicked* problem. Churchman (1967) first defined this concept in order to highlight the extent to which the solutions from the field of Operations Research have failed to address the problems of managers. It was formally described by Rittel and Webber (1973) in the context of social policy planning. Wicked problems in essence refer to problems that are complex; that do not have clear-cut solutions; that are difficult to solve due to conflicting and changing requirements; and that have complex interdependencies. Such problems have been recognised in a variety of areas, mostly those that are associated with complex systems, and are characterised by the following (Hevner *et al*., 2004):

- Unstable requirements and constraints based upon ill-defined environmental contexts;
- Complex interactions among subcomponents of the problem and its solution;
- Inherent flexibility to change design processes as well as design artefacts (i.e., malleable processes and artefacts);
- A critical dependence upon human cognitive abilities (e.g., creativity) to produce effective solutions; and
- A critical dependence upon human social abilities (e.g., teamwork) to produce effective solutions.

For consistency, this thesis will use the term ‘messy’ throughout to refer to the problems addressed in this work.

The characteristics of the environments within which ICT4D projects take place (1.4) can be linked to the characteristics that are associated with messy problems as outlined by Hevner *et al*. (2004).

Table 1.4 Characteristics of ICT4D problems mapped to characteristics of messy problems

Characteristic of messy problem (Hevner *et al.*, 2004)	ICT4D problem and solution environment
Ill-defined Unstable requirements and constraints based upon ill-defined environmental contexts.	Unclear, sometimes conflicting objectives Ambitious concept
Complex Complex interactions among subcomponents of the problem and its solution.	Multiple role players with differing agendas Multiple funders, fragmented budgets Unfamiliar implementation environment Resource-rich solutions for resource-poor environments
Requires flexible solutions, dependent on human abilities Inherent flexibility to change design processes as well as design artefacts (i.e., malleable processes and artefacts). A critical dependence upon human cognitive abilities (e.g., creativity) to produce effective solutions. A critical dependence upon human social abilities (e.g., teamwork) to produce effective solutions.	Unexpected implementation challenges Limited literacy Remote locations Low skills base Low technology base M&E approaches that focus on verifying transactions rather than informing delivery of value

The usefulness of recognising the problem of delivery of sustained benefit in ICT4D interventions as a messy problem lies in the fact that it focuses the development of solutions towards ***recognition of the multiple complexities*** that are involved, and towards development of guidelines or frameworks that assist in recognising complexities and ***structuring*** the problem, rather than on developing one-size-fits-all 'optimal' solution paradigms. Pries-Heje and Baskerville (2008) highlight the fact that decision support systems have a technical orientation that makes them unsuitable for the solution of messy problems. This is partly attributable to the complexity and high level of uncertainty that is inherent to messy problems (Pries-Heje & Baskerville, 2008). As such, a decision model in itself will be unsuitable for bringing clarity in the context of messy problems. In contrast, approaches that focus on problem structuring aim to bring clarity and develop consensus on problem definition (Checkland, 1981; Rosenhead, 1996). It involves multiple role players, and shifts the focus towards participatory approaches in decision-making.

It is worth keeping in mind that perspectives on messy problems are (amongst others) rooted in the traditional environments of engineering or planning (Rittel and Weber, 1973). In these predominantly first-world contexts, the ‘messiness’ is to some extent taking place within a well-structured environment. In the context of ICT4D, where resources are limited and multiple influences from less structured environments affect project delivery, it can be expected that complexity is more exacerbated.

In their Harvard Business Review article, Blenko *et al*. (2010:5) state that ‘the value that an organisation creates is ultimately no more or no less than the sum of the decisions that it makes and executes’. One of the key characteristics of ICT4D interventions is the multiple role players (including at least the funders, the implementers, and the participants) that are involved in taking the intervention from concept to implementation, and hence the existence of multiple decision-makers that could enable or frustrate the delivery of benefit. Alignment of decision-makers at different levels could *potentially* provide the opportunity to affect lasting change and improve long-term benefit.

This research is therefore aimed at developing a *framework for decision-making* that will provide some structure and a focus point for the delivery of sustained benefit. In order for this objective to be realised, the implementation context as well as the key drivers of unsustainability will be considered. In addition, the characteristics of an appropriate project process in ICT4D environments will be proposed, to serve as a context within which the decision framework will be useful and usable.

1.4. THE RESEARCH PROBLEM

1.4.1. Problem statement

The high failure rate of ICT4D implementations, and the need for development progress, calls for approaches that ensure that the benefits from implementations are realised (Section 1.1). Sustainability is an often-discussed topic; however, its attainment at implementation level is poorly understood (Section 1.3.1).

Development interventions take place in contexts with characteristics that influence the nature of the problem as well as the nature of solutions that would be appropriate in the context. The ‘messiness’ of the problem environment, and the peculiarities associated with the ICT4D interventions in such environments, calls for a shift in focus towards solutions that recognise multiple complexities, and that seek to structure solutions in an inclusive manner and with recognition of these complexities (Section 1.3.3).

The multiple perspectives on sustainability, and the tenuous link between the understanding of sustainability, the role of the intervention relative to sustainability, and the ability to sustain benefits from an ICT4D intervention leave room to examine the ways in which interventions seek to sustain benefits (Section 1.3).

These perspectives emphasize the need for a mechanism that elicits an appropriate perspective on sustained benefit for a specific ICT4D intervention, and that aids in structuring the intervention towards delivery of sustained benefit. This research develops a decision framework as a means of fulfilling this role. The focus is on the contribution of aligning decision-making in a complex environment to improve the ability to deliver sustained benefit.

1.4.2. Research objective

The objective of this research is to:

Develop a framework for decision support, in order to facilitate the design and implementation of ICT4D interventions for sustained benefit

The framework will serve the following purpose(s):

- Guide the process of ICT4D intervention design and implementation towards delivering sustained benefit, by crystallising and focusing fragmented decision-making;
- Provide an analytical framework that will enable the important strategic, tactical and operational decisions and actions that influence delivery of sustained benefit to be identified, and their scope of influence to be understood;
- Provide a mechanism within which decision tools can be defined, contextualised and prioritised, with the view of supporting decision-making for sustained benefit throughout the design and implementation process; and
- Provide a mechanism that can guide designers towards the development of policy implications, based on their learning from a specific ICT4D implementation.

Considering these purposes, a framework will be developed that will facilitate better decision-making within the 'virtual organisation' that exists around the implementation of an ICT4D intervention in a resource-constrained environment. Decision-making is taken as a point of departure, with the aim of influencing this behaviour towards a common purpose of sustained benefit. The framework will describe and interpret reality, by taking a systems view on the context within which ICT4D interventions are deployed.

1.4.3. Research questions

The following research questions are defined, based on the research objective as outlined in Section 1.4.2.

Main research question

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

Sub-questions

The sub-questions are defined and categorised as follows:

Sustained benefits and failure

QN 1 What are the elements of sustained benefit that need to be considered, in the context of ICT4D interventions?

QN 2 How can the understanding of ICT failures be used within a decision framework to reduce the failure of ICT4D interventions?

Decisions and value

QN 3 What are the categories of decisions that should be considered when developing an ICT4D intervention, in order to catalyse the delivery of sustained benefit?

QN 4 What strategies for decision support could be useful to support decisions that influence sustained benefit?

QN 5 What decision process, or other concept of value creation, should be used for contextualisation of the decision tools or models for sustained benefit?

Project process

QN 6 What are the characteristics of an ICT4D project process, that is conducive to the delivery of sustained benefit, and that can serve as background for the decision framework?

1.4.4. Relevant fields of study

Key aspects of the research proposed here relate to: the *delivery of sustained benefit, decision-making in ICT4D interventions* and *failure of ICT4D interventions*. These aspects inform the knowledge base that is considered for the development of the framework for decision-making for sustained benefit. For each of these, the various sources of knowledge are expected to inform the following views on the research problem:

1.4.4.1. Failure of ICT4D interventions

A significant body of literature exists on the reasons for failure of ICT4D interventions. Reasons vary across a spectrum from economic to institutional, political, social, and technological aspects (see Section 1.3.2). An understanding of failures, as well as a classification of failures into factors that relate to the nature of decision-making that needs to be supported, will enable the researcher to develop an understanding of the scope and characteristics of a decision framework that would be useful in informing sustained benefit by mitigating such failures.

1.4.4.2. Sustainability and sustained benefit

This research sets sustainability (in this work interpreted as *sustained benefit*) as a key objective for ICT4D interventions. As outlined in Section 1.3.1, the definitions of sustainability are mainly at conceptual level, and rarely enable the development of project or implementation-level strategies to ensure that sustained benefit is delivered. However, selected constructs of sustainability do exist that could be used to translate high-level definitions to practical strategies and frameworks, such as the various dimensions of sustained benefit that have been defined (see Section 1.3.1).

An exploration of the body of literature on sustainability and sustained benefit would serve two purposes, namely:

- To develop an appropriate definition of sustained benefit, that could form a focus point or objective for the models within the framework for decision-making for sustained benefit; and
- To inform the operationalisation of sustainability, in a practical implementation context.

1.4.4.3. Decision-making in ICT4D interventions

This research project is based on the assumption that an exploration of decision-making in complex, messy problems, as well as the development of a framework for decision-making, would enhance the capacity of ICT4D interventions to deliver sustained benefit. Multiple role players influence the outcome of ICT4D interventions, and it is assumed that coordination of multiple, uncoordinated, sometimes conflicting decisions would lead to an improved outcome. It is also assumed that, by focusing decision-making towards sustained benefit, the ICT4D intervention would better be able to deliver long-term benefit.

An exploration of the literature pertaining to the current use of decision models and decision modelling approaches in ICT4D are expected to inform the scope and extent of the decision framework. Literature pertaining to decision sciences in general (including decision analysis and decision modelling) would inform the characteristics of frameworks that could enhance decision-making in complex systems where multiple actors are involved, and where coordination and integration of decision processes are required. It would contribute information about useful approaches and models. In addition, it would inform the definition of an underlying process of value creation.

1.5. SIGNIFICANCE AND CONTRIBUTION

This research proposes to contribute to the body of knowledge by developing a framework that will focus decision-making in ICT4D implementations towards sustained benefit, and as such enable implementers and funders, in conjunction with communities, to *design for sustained benefit*. An initial review of literature could not identify such a framework, thus confirming the need for the development thereof.

At a ***theoretical*** level, the research enhances the current body of knowledge pertaining to sustainability by developing a framework that links concepts of value creation by means of decision-making to a goal of sustained benefit. Further contribution is through the definition and clarification of concepts that will support the proposed framework. These include a definition of *sustained benefit* that is usable at project level, by extending the existing definitions of sustainability. Also, it includes the definition of an appropriate value chain or decision process that will serve to integrate uncoordinated decision-making towards a common goal.

At a ***methodological*** level, the framework will provide a process or method that can be used to design an intervention with the view of delivering sustained benefit. The method includes elements that will guide implementers to elicit information that can be used to inform policy development.

At a ***practical*** level, the framework is making a potential contribution, since it has not been tested in practice. It is expected to influence the design of ICT4D interventions by guiding implementers to examine their approaches for conflicts and omissions in decision-making, and by taking a holistic and inclusive approach to intervention design and implementation. In addition, use of the framework is expected to lead to useful and usable policy recommendations, based on project learning.

The following specific contributions to theory, method, and practice are identified:

Table 1.5 Summary of research contributions

	Contribution
Theory: Knowledge abstractions to inform future exploration	➢ A summary of the diverse ways in which sustainability is interpreted in literature, and an outline of multiple perspectives on sustainability (Chapter 3). ➢ A summary of the applications of the sustainability concept in ICT4D (Chapter 3). ➢ Conceptualisation of sustained benefit as an extension of the concept of sustainability, when operationalising the long-term value of ICT4D interventions (Chapter 3). ➢ An overview of the themes related to ICT4D failures (Chapter 4). ➢ A summary of how knowledge about ICT4D failure is applied for improvement (Chapter 4). ➢ A summary of the extent to which decision-making is addressed in ICT4D literature (Chapter 5). ➢ A definition of the decision problem and decision-making in ICT4D, based on the characteristics of messy problems (Chapter 5).
Method	➢ A definition of appropriate characteristics for project processes in ICT4D interventions (Chapter 6). ➢ The definition of a framework that would focus decision-making towards sustained benefit (Chapter 10).
Practice	➢ Recommendations for the development of a practitioner's guide for the framework (Chapter 10).

See Section 11.4 for an evaluation of the knowledge contribution in terms of its level, role, and nature.

1.6. LIMITATIONS

Development of the framework or artefact is based on a combination of literature review and case study research. Inherent limitations of this approach relates to the generalizability of the research. A two-case approach was selected, which should lead to richer theory development, and to some extent better mitigate issues of generalizability than a single case approach. However, the case studies were selected from ICT4D implementations by the same implementing organisation. While this provides a means of establishing commonality across implementations, it also implies that organisation-specific limitations may influence the extent to which theory is confirmed.

The framework was developed through a post-hoc analysis of the two case studies. While this approach provides the benefit of hindsight in the development of the framework, it limits the ability to test the framework in a real-world application.

In addition, the case studies comprise ICT4D implementations that were funded and initiated by government departments in South Africa. The level of competence and maturity in design and implementation of ICT4D implementations influence the elements that are included or excluded from the framework. While this provides a very specific (and potentially useful) framework for implementation in the South African context, the generalizability to other contexts may be limited.

A fundamental assumption of this research is that the interpretation of an ICT4D implementation in the context of a virtual organization, and an improvement in coordination between decision-makers, will lead to an improved ability to deliver sustained benefit. It implies that inter- and intra-organizational decision-making is a key causal factor in the success of ICT4D implementations. The extent to which this is true, and the extent to which ICT4D implementations can be improved to deliver sustained benefit, is not clear. Specifically, numerous other influences could determine success, including environmental factors, and systemic interactions that are not the subject of decision-making. The validation process that is followed (comprising an iterative application of case studies, as well as an expert review of the framework) intends to develop a framework that addresses key links between decision-making and sustained benefit.

Future research should focus on applying the framework to projects as they are being implemented, and in contexts that are different to the ones described by the case studies (different implementation organisations, private sector and not-for-profit funding organisations, national and regional governments in different geographies, decision-makers with different world-views). In addition, future research could focus on creating an empirical understanding of the relationship between improved decision-making and sustained benefit. The latter aspect is complex to assess, and may remain a theoretical question for the foreseeable future.

1.7. THESIS OUTLINE

This research follows a Design Science research approach (see Chapter 2). The research approach describes a process to be followed, from problem definition and structuring through the development and validation of an artefact and dissemination of results (Peffers, 2006). This process informs the research plan, and the outline of this thesis (captured in Figure 1.1, and repeated below for convenience).

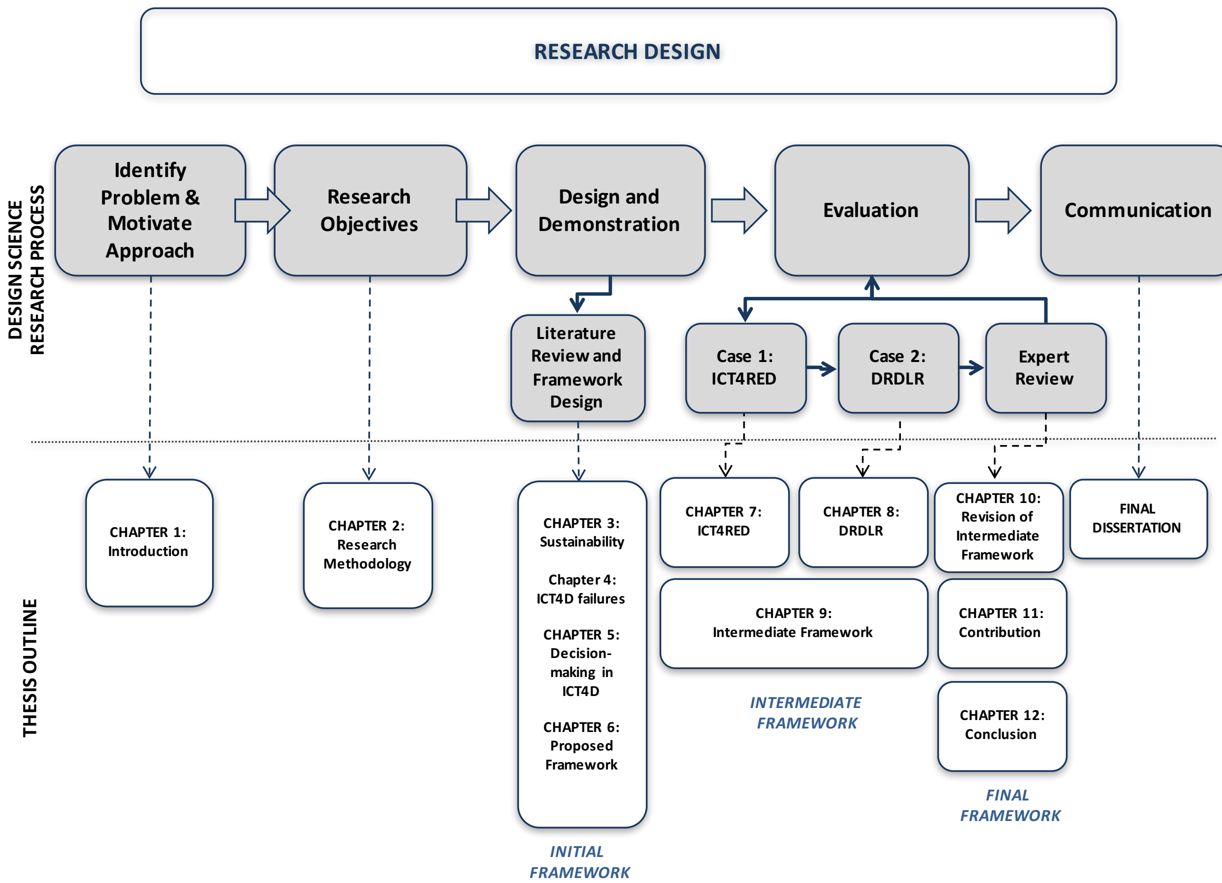

Figure 1.2 Thesis outline, in the context of the Design Science research process

The structure of the dissertation is outlined below, indicating the purpose or key message of each chapter:

Table 1.5 Thesis outline

Chapter	Title	Key message
1	Introduction	Problem statement, research purpose, dissertation overview.
2	Research methodology	Summary of research methodology.
3	Literature: sustainability and sustained benefit in ICT4D	From abstract definitions to mechanisms of influencing sustained benefit.
4	Literature: failures in ICT4D	Aspects of failure to address in a decision framework.
5	Literature: Decision-making in development projects	Classification of decision approaches to accommodate within decision framework.
6	Initial decision framework	Initial framework, based on literature.
7	Case application: ICT for Rural Education (ICT4RED)	Usefulness of the decision framework. Proposed adaptations to framework based on case.
8	Case application: ICT Hubs	Usefulness of the decision framework. Proposed adaptations to framework based on case.
9	Intermediate decision framework	Framework refinement and validation, based on case analyses
10	Final decision framework	Framework refinement based on expert evaluation
11	Conclusion	Reflection, contribution, limitations, future work.

1.8. SUMMARY

This dissertation outlines the development of a decision framework, which aims to enable implementers of ICT4D interventions to design their projects to deliver sustained benefit. Frameworks that make the concept of sustainability practical at a project level are scarce, and a framework with a decision focus could not be identified in literature. The research follows a Design Science research approach, and is based on two cases of ICT4D implementations in rural areas of South Africa.

The value of the work is rooted in the contribution that it stands to make by facilitating improved and sustained benefit from ICT4D implementations, where failure rates are high and benefits often do not reach to, or beyond, implementation of hardware. The contribution of the research is at a theoretical level (linking concepts of sustained benefit to a value creation process and decision focus), a methodological level (developing a framework that can serve as a method of design for sustained benefit), and a practical level (changing the nature of implementations by informing the design of interventions for sustained benefit). Limitations of the research mainly relate to generalizability of results, based on the case study approach and the selection of cases.

CHAPTER 2. RESEARCH METHODOLOGY

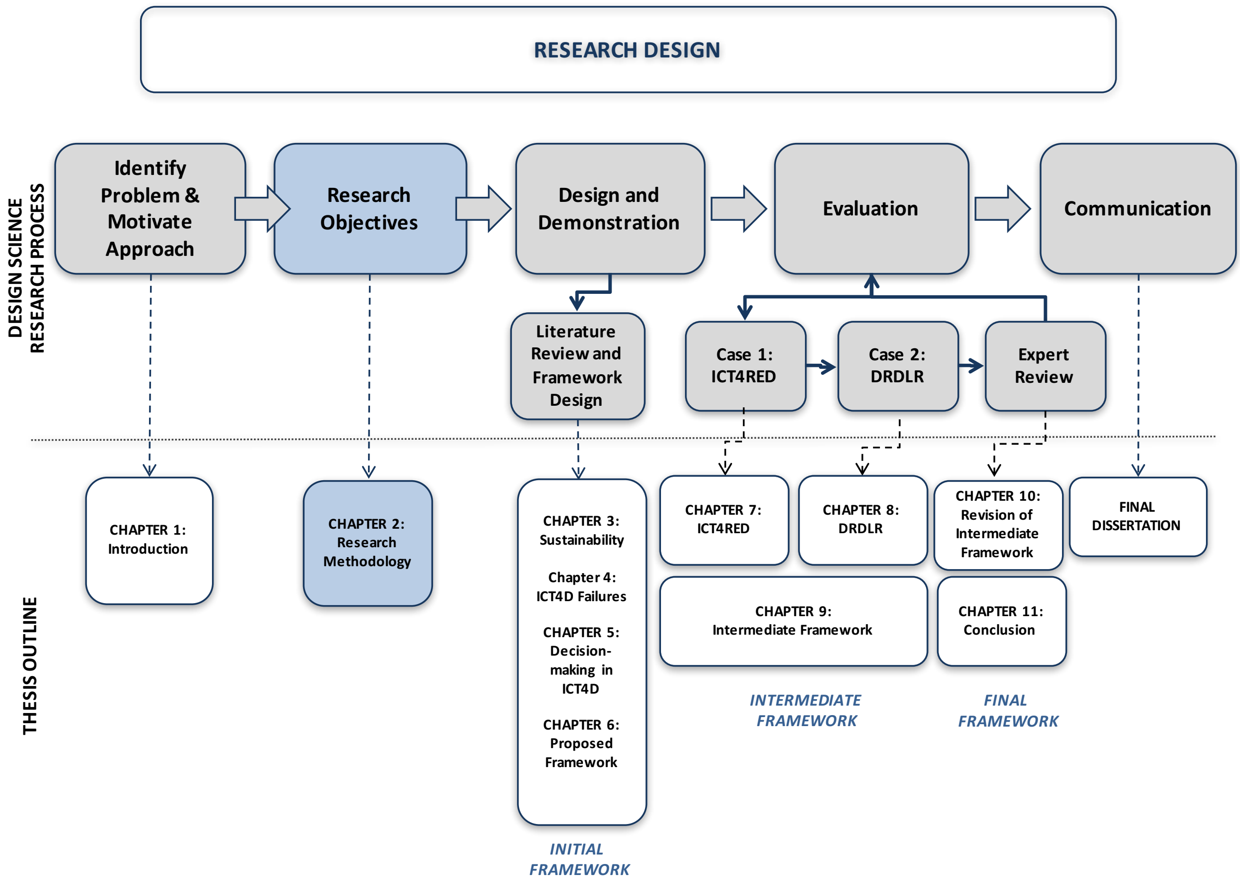

Figure 2.1 Research process and thesis outline: Chapter 2

2.1. INTRODUCTION

Research methodology is defined as a theory of how the specific research project should be undertaken (Saunders et al., 2016). By defining a methodology, the researcher provides structure to the process, and ensures that the research will uncover knowledge and deliver answers in accordance with the questions that are being asked.

Methodologies in the natural sciences are well defined, and focus primarily on delivering results based on data analysis, rooted in a positivist philosophy (Orlikowski and Barudi, 1991). Towards the end of the 1980s, researchers in Information Systems Research called for methodologies that move away from those suited to the natural sciences, to include methods that are appropriate to Information Systems as a subject that 'spans many disciplines in the social sciences, in business, and occasionally, in the natural sciences' (Galliers & Land, 1987:901). This view is echoed by Orlikowski and Baroudi (1991), who found in a study of Information Systems research between 1983 and 1991 that the single (positivist) philosophy is too restrictive, and that the field could benefit from a plurality of approaches. A decade later, Chen and Hirschheim (2004) found that research done between 1991 and 2001 was still dominated by positivist approaches using quantitative methodologies, even though qualitative methods had gained ground. Currently, while some authors argue that IS research has reached maturity, they still refer back to the predominantly positivist roots of the field (Van Zyl, 2015).

Authors that move away from arguing the use of either one or the other approach in Information Systems Research emphasize the interdisciplinarity of ICT4D research (Burrel & Toyoma, 2009), as well as the selection of research methods based on the type of knowledge that they provide (Weber, 2004). Avgerou (2017:12) positions ICT4D research as 'a combination of foundational theories on technology, context and development', with the use of middle-range theories specific to the questions under consideration.

Some authors have warned against mechanistic approaches to the development of research methodologies, calling for consideration of multiple perspectives (Orlikowski & Baroudi, 1991; Roode, 1993; as interpreted by Van Zyl, 2015), and for researchers to integrate across perspectives and find their own view on the problem and potential ways of addressing it, rather than being mechanistic in their approaches (Van Zyl, 2015). Others argue for greater rigour in ICT4D research (Weber, 2009).

The success of a research methodology ultimately lies in its ability to answer the research questions that are posed, and to demonstrate 'whether our knowledge has been improved to the extent that this knowledge can be applied in practice' (Galliers & Land, 1987:901).

Saunders et al. (2016) outlined a structure associated with the research process, by defining a comprehensive progression of aspects that need to be addressed: research philosophy, research approach, research strategy, time horizon of research, and finally data collection methods. These aspects follow on and encapsulate each other, as outlined in the 'Research Onion' (Saunders et al., 2016), and ensure that a rigorous and consistent process is conducted.

Gregor (2006) argued that, before the ontology (the researcher's view on reality) and epistemology (assumptions about knowledge) of a research problem is considered, the nature of theory or type of knowledge that could result from the research problem should be contemplated.

This chapter develops the argument for the use of Design Science Research (DSR) as an appropriate method for the problem at hand. Its relevance becomes clear in the sections that follow, but is fundamentally rooted in the ability to develop solutions (artefacts) to solve human problems (Hevner & Chatterjee, 2010), as well as in the rigour of the process that is followed (Peffers et al., 2007). Furthermore, scholars have recently argued that DSR has the potential to create impact in its field of application by (amongst others) appropriately positioning and structuring its contribution relative to the relevant knowledge base (Gregor & Hevner, 2013) and socio-technical system[1] within which it is applied (Drechsler & Hevner, 2016). The latter reflects technology as part of the social system, emphasizing the integration of elements such as technology, people, processes, and policy (Fischer and Hermann, 2011). In this research, impact will be reflected by the ability of the product (artefact) to enable decision-makers to structure and implement their ICT4D interventions with a view of delivering sustained benefit.

In an attempt to maintain the necessary rigour while at the same time developing a method that is relevant and appropriate to the topic, this work considers the nature of

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[1] This concept refers to the holistic system comprised of the integration of social and technical aspects that integrate towards achieving a goal (Whitworth, 2009). It emphasizes the integration of various elements, including technology, people, processes, and policy (Fisher and Hermann, 2011).

the research problem as well as the product that is to be developed as a point of departure for the development of a research methodology (Sections 2.2 and 2.3). Based on this understanding, a spectrum of research perspectives is then considered in order to define a philosophy and approach that is appropriate to the research purpose and product (Section 2.4). This is followed by a motivation of the choice of research strategy (Section 2.5), as well as the associated data collection and analysis approaches (Section 2.6), that will enable the development of the appropriate research product. The chapter is concluded in Section 2.7.

2.2. CHARACTERISTICS OF THE RESEARCH PROBLEM

The purpose of this research is to:

Develop a framework for decision support, in order to facilitate the design and implementation of ICT4D interventions for sustained benefit.

According to this purpose, the work will deliver a *framework* to inform decision-making for sustained benefit, within a project context that has very specific characteristics. It is postulated that the level of complexity in ICT4D interventions calls for a framework that goes beyond popular approaches to project design and management. In addition, the research problem exists in an environment where the capacity to integrate, coordinate, and drive decision-making across organisational boundaries is relatively low. Given these factors, a practical approach (framework) is required that can guide interventions towards delivery of sustained benefit. The framework is intended to extend over the boundaries of multiple organisations and decision-makers, and to provide a focal point through which the intervention can define and deliver sustained benefit.

As such, the research problem has (amongst others) the following characteristics:

- Understanding, structuring, and making sense of an ill-defined problem;
- Engaging with the elements of a socio-technical system (Fischer and Hermann, 2011) – including technology, people, procedures policies, decision processes, and decision models – in the context of sustained benefit;
- Creating an artefact, based on a thorough understanding of the underlying organisational decision dynamics that affect sustained benefit:
  - that is useful and usable;
  - that can create value through its repeated application to solve an organisational problem; and

- Reflecting on the outputs that are created through use of the artefact, to ensure that value is created through relevant and appropriate use.

The development of the framework with these characteristics calls for a research process that will facilitate an understanding of the underlying interactions and concepts that will lead to the creation of an artefact. It also calls for reflection on its use, in a way that will inform and unlock value for ICT4D implementations.

2.3. THE RESEARCH PRODUCT

The Design Science Research Process (DSRP) that is adopted in this study (see Section 2.5) produces an *artefact* as research product, which (in this case) will comprise of a *framework for decision-making*. These concepts are outlined below.

2.3.1. A framework for decision-making

As outlined in Chapter 1, the framework will serve the following purpose(s):

- Provide a conceptual framework that will enable the important strategic, tactical and operational decisions and actions that influence delivery of sustained benefit to be identified, and their scope of influence to be understood;
- Provide a mechanism within which decision tools can be defined, contextualised and prioritised, with the view of integrating and supporting decision-making for sustained benefit throughout the design and implementation process; and
- Provide a mechanism that can guide designers towards the development of policy implications, based on their learning from a specific ICT4D implementation.

It was emphasized before (Section 1.4.2) that the intention is that the framework will facilitate better decision-making within the ‘virtual organisation’ that exists around the implementation of an ICT4D intervention in a resource-constrained environment.

2.3.2. Characteristics of the framework

A *framework* is defined as a particular set of rules, ideas or beliefs that is used to deal with problems or to decide what to do (HarperCollins Publishers, 2015). Sprague (1980) states that a framework is helpful in organising a complex subject, identifying the relationships between the parts, and revealing the areas in which further development will be required. In terms of its origins, Heeks (2006:2) defines a framework as a construct that ‘explicitly derives itself from a body of theoretical work’. Hassan (2014) differentiates between conceptual, research, and theoretical frameworks. He positions a framework as a ‘product of theorising’ that can ultimately be used to inform model development, and that can guide the generation of further research questions.

The premise of the work proposed here is that the long-term impact of an intervention, and the benefit that can be delivered, can be influenced through the development of a structured framework for decision-making with respect to the design and implementation of ICT4D interventions. For the purpose of this research, a framework is viewed as a means of organising a complex subject and identifying the relationships between parts (Sprague, 1980), and of structuring concepts *towards a specific goal* of supporting decisions for sustained benefit.

The researcher is interested in developing a conceptual framework of the thoughts and structures that can be used to guide planning and decision-making with respect to ICT4D interventions towards sustained benefit. To this end, the definition of a framework of Miles and Huberman (1994), as interpreted by Hassan (2014:12), can be adopted as ‘the researcher’s map of territory being studied, which consists of the map of main concepts, constructs and their related positions’.

The decision-making framework will include an *objective of value creation*, expressed in terms of sustained benefit, and will allow for decision-making towards that objective. It will furthermore include a construct that describes a means of value creation in ICT4D interventions. This could be in the form of a *value chain* or *process of decision-making*. Examples of value creation constructs are the *ICT4D value chain* of Heeks and Molla (2009), and the *Value for Money outcomes chain*, as described by Emmi et al., (2011). The decision-making framework will assume that the intervention is executed within a *project process* that is conducive to the delivery of sustained benefit.

The framework developed by this work would provide structure within the messy environment of delivering benefit from ICT4D interventions. It would serve as a guideline to enable decision-makers to consider the key elements that affect delivery of sustained benefit, and to manage their decisions accordingly. It could, for example, incorporate principles and practices that should be considered during use. The nature of the project process within which development interventions take place is critical to the ability to deliver sustained benefit. The framework would therefore be contextualised within an appropriate project process.

In addition to focusing decision-making towards value creation, the framework should also enable participation. Sustained benefit is in this work considered from a holistic perspective, and refers to benefit for all stakeholders involved in the ICT4D intervention – including funders, implementers, and project participants. Each of these stakeholders has different objectives, and sees benefit from different perspectives. In environments where resource inequality is significant, participation often does not take place on an equal basis: the funders or implementers often hold the resources (and are therefore custodians of the potential benefit), and recipients or beneficiaries are often not in a position to influence the nature of the interaction. A framework for decision-making needs to be cognisant of such imbalances, and needs to allow for participation if it is to ensure equal perspectives on the concept of sustained benefit.

2.3.3. The framework as artefact

Hevner and Chatterjee (2015:2) define the product of Design Science Research as an *artefact*, when they say that ‘design in information systems deals with building software artefacts which solve a human problem. The designed artefact must be evaluated to show that not only does it solve the problem but also does it in an efficient manner by providing utility to its user’. Hevner et al., (2004) further differentiate artefacts into constructs, models, methods, or instantiations. In this research, the framework will be a construct that represents the product of a Design Science research approach (see Section 2.5), and could be used *as a guideline within which practitioners can develop their own approach to the design of ICT4D projects and programmes* with a view of creating benefits that last.

2.4. RESEARCH PHILOSOPHY AND APPROACH

2.4.1. Research philosophy

Defining the underlying research philosophy and clarifying the assumptions that underlie the research project has the purpose of aligning and translating the worldview of the researcher into an appropriate research method and strategy. These assumptions can be expressed in terms of ontology (explained earlier as the researcher’s view on reality), epistemology (assumptions about knowledge), and assumptions about human nature

(Holden & Lynch, 2004; Myers, 2013). Some authors argue that the focus on ontology and epistemology is superfluous and unnecessary, and that researchers will in any case pragmatically focus on solving their research problems in the most appropriate manner (Connell & Nord, 1996; Eastman & Baily, 1996; Hughes & Sharrock, 1997, as interpreted by Holden & Lynch, 2004). However, others argue that a thorough understanding of the research philosophy not only ensures that appropriate method is followed, but may also open the mind of the researcher to other possible approaches, and enhance confidence in their own approaches (Holden & Lynch, 2004).

Research paradigms are sometimes defined and described in a conflicting manner; definitions are selected here to provide a structure within which to define a methodology. Myers differentiates philosophical assumptions based on epistemology, and defines the following dominant research paradigms in business and management research (Myers, 2013):

Positivist Reality is objectively given and can be described by measurable properties, which are independent of the researcher and his/her instruments. It attempts to test theory and increase the predictive understanding of phenomena, and underlies scientific research.

Interpretivist Access to reality is through social constructs (such as language, consciousness, shared meaning, instruments). The focus is on the complexity of human sense making, and phenomena are understood through meanings that people assign to them.

Critical The epistemological assumptions are similar to that of interpretivist paradigms, but the belief is that the ability of people to change their economic and social circumstances takes place within social, cultural, and political constraints. The purpose is to challenge rather than describe knowledge and beliefs.

An early 1990s study by Orlikowski and Baroudi (1991) show that research philosophy in Information Systems (IS) research is heavily skewed towards positivist approaches. They argue that Information Systems research is in essence the study of relationships between people, technology and organisations, and that other research philosophies are equally relevant. Later work indicates an increase in interpretive research in most business and management disciplines (Myers, 2013).

Recently, critical realism has emerged as a trend in social and ICT4D research, facilitating and focusing on 'exposure of context… legitimisation of different stakeholder views and reduction of research bias, and support for ICT4D's interventionist approach and its goal of delivering international development' (Heeks and Wall, 2017:in press). This provides a perspective from which to integrate strategic and contextual influences, and allow for interpretive and contextual approaches (Njiha, 2008).

Pragmatism has been on the rise as research paradigm (Goldkuhl, 2012). It provides a means of straddling the above (sometimes mutually exclusive) research paradigms, and allows the researcher the freedom to select a paradigm that is relevant and useful to the problem, and that enables multiple perspectives on the problem. Pragmatists regard acquisition of knowledge as a 'continuum, rather than as two opposing and mutually exclusive poles of objectivity and subjectivity' (Goles & Hirschheim, 2000:261). The emphasis is on selecting methods that work, and that are appropriate and relevant – 'the research is driven by interest, value, and relevance' (Van Zyl, 2015:14).

Holden and Lynch (2004) provide a continuum of approaches, from subjective to objective, that outline and describe research philosophy in social science (See Figure 2.2). The left hand side of the continuum broadly corresponds to interpretivist approaches, and the right hand side to positivist approaches. Nuances in between allow for variations of these approaches, including critical research approaches. The highlighted areas outline the positioning of this research.

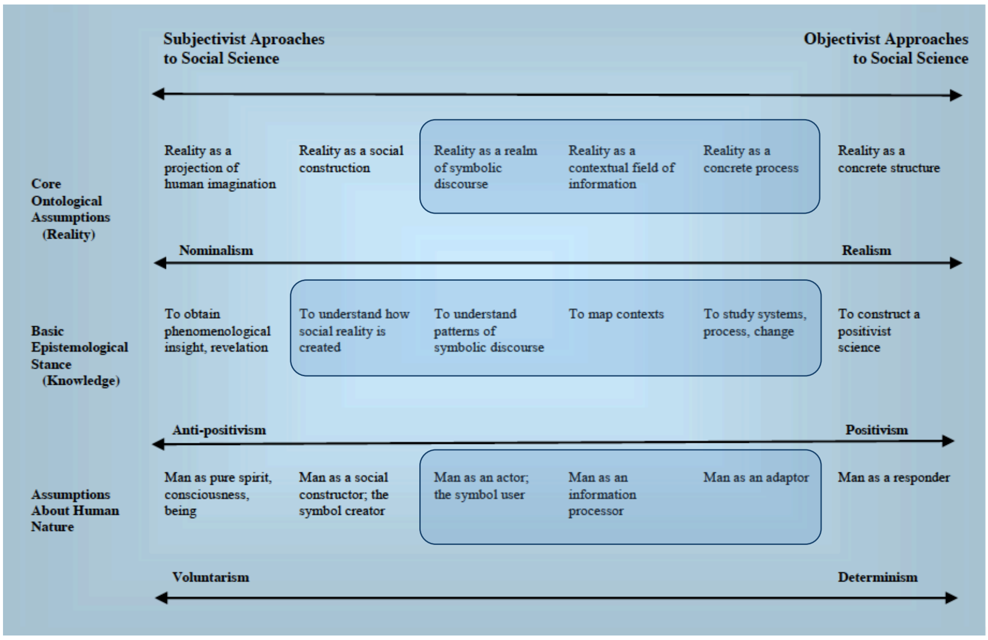


Figure 2.2 Positioning of this research, over the basic assumptions of the subjectivist-objectivist debate (from Holden & Lynch, 2004)

The premise of this research is to create a framework (artefact) that is a description and interpretation of reality, by taking a systems view on the context within which ICT4D interventions are deployed. Decision-making is taken as a point of departure, with the aim of influencing this behaviour towards a common purpose of sustained benefit.

This requires an understanding of causalities within the system, and that assumptions are made with respect to the influence that decisions have on sustained benefit. The researcher seeks to understand the (virtual) processes and consequences that develop across decisions made by different decision-makers (intentionally or unintentionally). An objectivist, analytical position is adopted, from which reality is positioned, in terms of Figure 2.2, as a *contextual field of information*, and a *concrete process.* In the same framework, the epistemological position is consequently one of *mapping contexts*, and *studying systems, processes, and change*.

The framework that is developed needs to allow for problem structuring, for highlighting the consequences of decisions along a construct of value creation, and for making choices between short-term gains and long-term sustained benefit. It is assumed that participants in the context will see the value of the framework in terms of reaching their (joint) objectives, and that recommended approaches will be adopted to improve their outcomes. To this end, the researcher is therefore assuming that man is an *actor*, a *symbol user*, and an *adaptor.*

A key focus point of the work is the definition and interpretation of sustained benefit. Multiple role players are involved, and the concept is considered from multiple (potentially conflicting) perspectives. For example, funders may have a predominantly 'Return on Investment' view, while community members may be interested in benefits that cannot be translated into financial terms, or that extend beyond the horizon or interest of funders. Implementers of technology, on the other hand, may have objectives that are related to the enhancement of novel technology, or the appropriateness of technology in the context, and their views of sustained benefit may not extend beyond the lifespan of technology. The researcher aims to consider these multiple perspectives, and recognises the subjectivity of different stakeholders in creating their own meaning and realities. Recognition of these multiple realities allows the researcher to emphasize the importance of participation in the definition of a framework for decision-making.

In summary, the artefact that is developed as a product of the research is intended to guide and influence a system that is 'deviating from purpose'. It is assumed that the outcomes can be influenced and enhanced through the application of a framework. This positions the research towards objectivism, positivism, and (critical) realism, while being cognisant of subjectivity in constructing different realities. At the same time, a pragmatic approach is required to generate knowledge in an appropriate and usable way, in order to solve a complex problem. In terms of the structure in Figure 2.2, this research is therefore positioned as follows:

Ontology	Reality is contextual, but is also created as a result of a process of change. It is not purely external from consciousness, nor is it purely a product of individual consciousness.
Epistemology	Knowledge is acquired by mapping contexts and understanding systems, processes and change (interpretivist, subjective), but is also aimed at understanding and influencing constraints (positivist, objective, critical).
Assumptions about human nature	Man is seen as an actor, information processor, and as able to adapt to the change that is brought about by frameworks, technology, and processes. Man is not purely a product of his/her environment, nor is man completely able to create his/her environment.

However, the researcher simultaneously needs to develop a framework that will guide future planners with respect to decision-making. This means that the complexity of the decision environment needs to be considered, and project planners need to be challenged to take different perspectives on the effect of their decision-making on the sustainability of ICT4D interventions (objectivist, critical, realistic).

From the perspective of methodology and strategy, an approach is sought that will allow the researcher to understand and interpret the aspects that influence sustained benefit (interpretivist perspective). This will be reflected in the case study approach that is chosen as a means of understanding, making sense of, and interpreting the context within which decision-making takes place and to inform the development of elements of the decision framework. The case studies will be analysed within multiple iterations of a Design Science Research methodology (see Figure 2.5), and an *interpretivist* approach will be followed. This approach is aligned with, and in support of, the *hermeneutic cycle*, which will be followed in the data analysis process, as it pertains to the various case studies (Wang et al., 2008; see Section 2.6.3).

Given this research positioning, and the multiple perspectives and approaches that are required on the generation of knowledge, it is appropriate to state that the researcher will follow a ***pragmatist*** approach, which will allow the straddling of various research paradigms while taking a usable approach to interpreting and addressing the problem at hand. It will be supported by a strong ***interpretivist*** view on data analysis and use, as implemented during the design and development, demonstration, and evaluation phases of the Design Science Research Process (see Section 2.6).

2.4.2. Research approach

Gregor (2006) argues that, before ontology and epistemology of a research problem is considered, the nature of theory or type of knowledge that could result from the research problem should be considered; this should form the background against which epistemological approaches are chosen. She then proceeds to differentiate between five types of theory, namely theory for analysing (what is), theory for explaining (how and why), theory for predicting (what will be), theory for explaining and predicting (what is, how, what, when, what will be), and theory for design and action (how to do).

Considering the characteristics of the problem, and the purpose to develop a decision framework that is intended to have practical implications for designing interventions towards sustainability, it is contended that the work proposed here is aimed towards *theory for design and action*. According to Gregor (2006), this type of theory says *how to do* something, which is in accordance with the intent of this research problem. Theories for explaining and predicting (what is, how, what, when, what will be) and for analysing (what is) are expected to inform the theory for design and action in this research.

When adopting a *theory for design and action* as background to a problem, the researcher is placed within the realm of Design Science or Design Science Research (see Section 2.5.1). The latter is contrasted with Behavioural Science Research as one of two complementary paradigms of Information Systems research: Behavioural Science Research is seen as the ‘problem understanding paradigm’, and Design Science Research as the ‘problem-solving paradigm’ (Niehaves, 2007:2).

It is fair to assume that these paradigms are not mutually exclusive, and that elements of both need to be incorporated in a good ‘how to do’ answer to a research problem. However, the balance of focus of this research will be within the ‘problem solving’ paradigm, based on a Design Science Research approach.

2.5. RESEARCH STRATEGY (design and method)

2.5.1. Design Science Research

Information Systems Research is positioned at the confluence of people, organisations and technology, and concerns itself with the study of the effective application of Information Systems within organisations (Hevner et al., 2004). Design Science Research is seen as foundational to Information Systems Research, and concerns itself with the creation of new artefacts of products through which information systems can be used (Hevner et al., 2004; Denning, 1997).

Design Science, with its roots in engineering and the science of the artificial (Hevner et al., 2004), comprises a body of knowledge about the design of artificial phenomena. It developed out of a need to move beyond the descriptive, interpretive research with output that is, according to Peffers et al., (2007:45), 'still mostly explanatory and, it could be argued, not often applicable to the solution of problems encountered in research and practice'. It stands in contrast to the natural or behavioural sciences (which are aimed at describing and explaining phenomena), by focusing on 'how to design and construct artefacts and artificial systems having desired properties' (Carlsson, 2006:193). It comprises aspects of both product and process (Hevner et al., 2004), and should contribute to knowledge development as well as the real-world application environment (Gregor & Hevner, 2013).

Debates in Design science exist as to whether design could be research (Vaishnavi & Kuechler, 2013), whether theory could be developed as the outcome of a design process (Fischer et al., 2010), and what the philosophical origins of Design Science are (Niehaves, 2007). Regardless, the concept of Design Science has utility in the sense that it informs structured approaches to creating new knowledge about design (research products and processes), while at the same time creating new design products and processes (Hevner et al., 2004, Peffers et al., 2006).

In addressing its purpose of supporting the design of artefacts, the Design Science paradigm follows a structured process. It originally comprised three different cycles, namely: a relevance cycle (which positioned the development of an artefact within its immediate application environment), a design cycle (artefact design and testing), and a rigor cycle (grounding of the research, and addition to the knowledge base) (Hevner, 2007). Recently, a fourth cycle has been added, the *Change and Impact* cycle, that concerns itself with the change that is brought about in the context of the broader socio-technical system (see Fig. 2.3; Drechsler & Hevner, 2016).

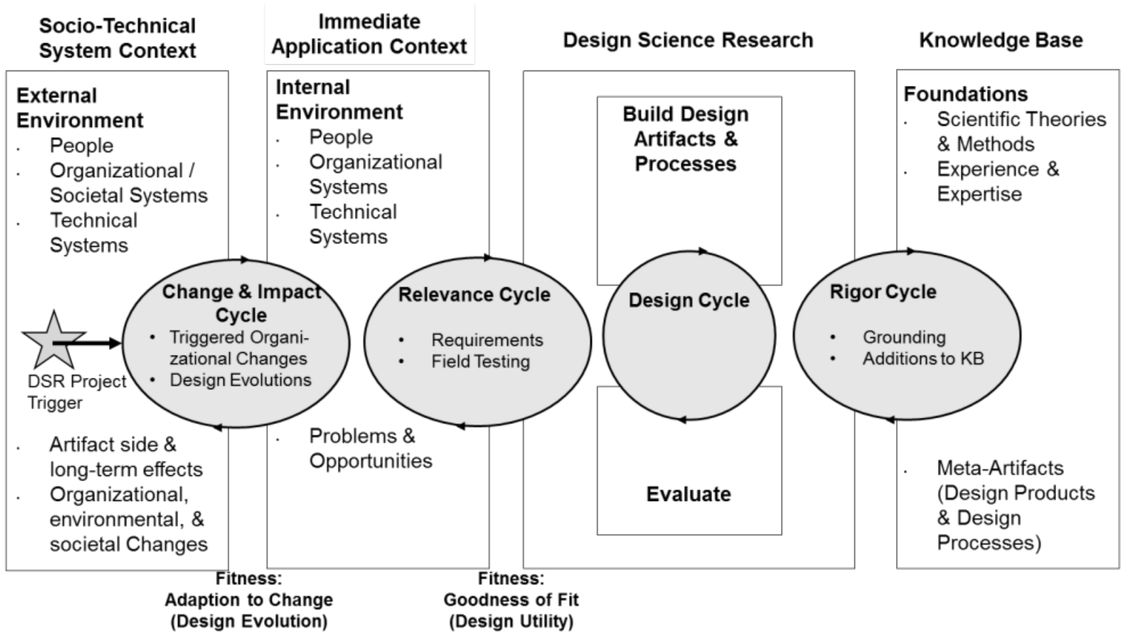


Figure 2.3 A four-cycle view of Design Science Research (Drechsler & Hevner, 2016).

Within this Design Science Research paradigm, various authors have proposed research processes, as outlined in the next section.

2.5.2. The Design Science Research Process

As noted in the introduction, research designs are procedures of inquiry within which the research takes place (Creswell, 2013b). The Design Science Research Paradigm has been chosen for this research because of its ability to provide structure to the research process, and to enable the development of an artefact that is rigorous, defensible, and usable in practice. The research processes of Hevner et al., (2004), Carlsson (2006), and Peffers et al., (2006), are considered here.

The research framework proposed by Hevner et al., (2004) has been the basis of the three-cycle model outlined in the previous section, which was later developed into a four-cycle model (Dreschler & Hevner, 2016). It combines a behaviourist and a design paradigm, and considers applications in the problem environment while at the same time developing new knowledge. The model is supported by seven guidelines for Design Science Research (Hevner et al., 2004; Niehaves, 2007), as outlined in Table 2.1. The relevance for this research is also highlighted:

Table 2.1 Guidelines of Design Science Research (Niehaves, 2007)

Guideline	Description	Relevance to this research
Guideline 1: Design as an artefact	Design Science Research must produce a viable artefact in the form of a construct, model, method, or instantiation.	A framework will be developed to guide decision-making towards sustained benefit in ICT4D interventions
Guideline 2: Problem relevance	The objective of Design Science Research is to develop technology-based solutions to important and relevant business problems.	The framework is aimed at guiding implementation of ICT4D in environments where resources are limited and sustained development is critical
Guideline 3: Design evaluation	The utility, quality, and efficacy of a design artefact must be demonstrated rigorously by means of well-executed evaluation methods.	An ongoing (formative) evaluation as well as a summative evaluation (based on expert opinion) will be conducted (see Section 2.6.4)
Guideline 4: Research contribution	Effective Design Science Research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.	Contribution of this research is in terms of an artefact that is expected to improve the benefit that is delivered from ICT4D interventions.
Guideline 5: Research rigor	Design Science Research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.	A well-structured, integrated process will be followed, including multiple review points (see Figure 2.8).
Guideline 6: Design as a search process	The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment.	An iterative process will be followed to develop and refine the artefact, allowing for an exploration and accommodation of a complex problem environment.
Guideline 7: Communication of research	Design Science Research must be presented effectively to technology- and management-oriented audiences.	Research results will be disseminated through articles in publications with different audiences.

Carlsson (2006) reacts to the focus of DSR on an artefact. In response, he develops a framework that is focused on the role of the artefact as part of the broader socio-technical system, and that is rooted in a critical realism perspective. This framework, the Information Systems Design Science Research Cycle, comprises phases of theories or models of IS intervention, hypotheses (what might work for whom in which contexts), observation (multi-method data collection) and finally, outcome (what works why for whom in which context).

The Design Science Research Process as proposed by Peffers et al., (2006) will be used as basis for this research. This process model provides a structured approach, from problem identification and statement of objectives, through an iterative process of solution development, testing, and communication (see Figure 2.4).

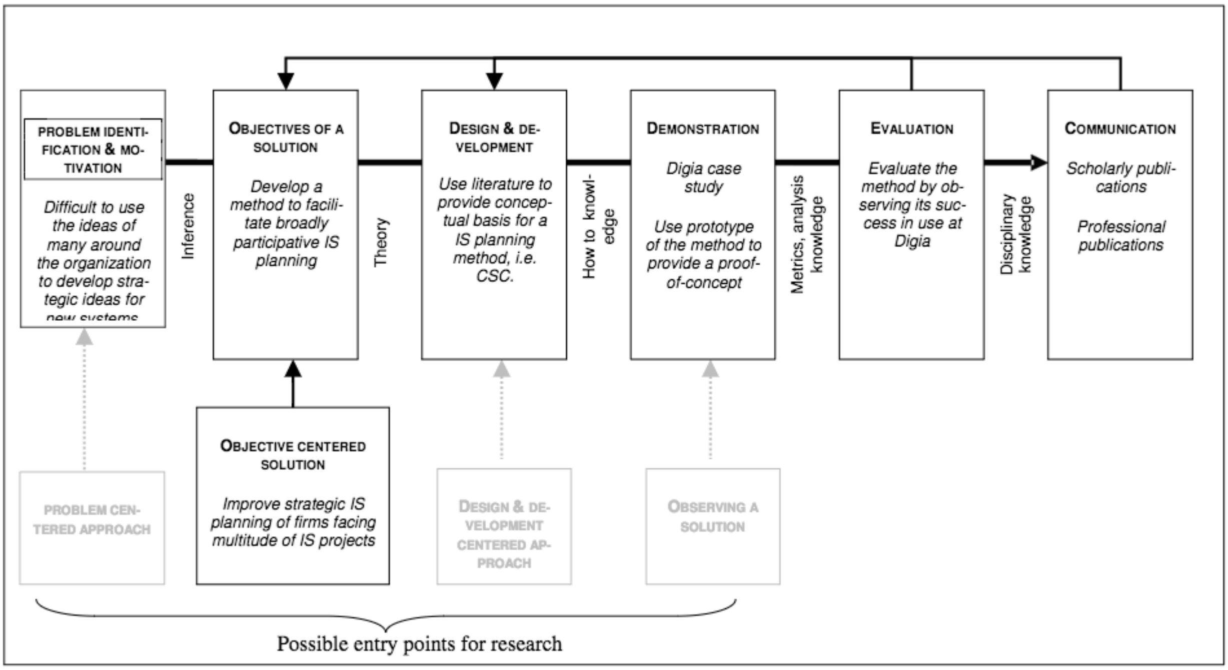


Figure 2.4 Design Science Research Process Model, adapted for the Digia study (Peffers et al., 2006)

The artefact from this research, that is, a framework for decision support, needs to be applicable in a number of diverse contexts that cannot beforehand be described in their entirety, for an audience that cannot be clearly delineated. The iterative process described by Peffers et al., (2006) provides an appropriate mechanism for solution development and enhancement, based on multiple sources of information (literature, case studies), and through multiple contexts (case studies). In addition, the iterative development of the artefact in multiple contexts allows for the inclusion of multiple perspectives (as well as participation of multiple stakeholders) in the exploration of sustained benefit. The latter is a key aspect that needs to be addressed by the artefact.

This iterative process of Peffers et al. (2006) addresses the *relevance*, *design*, and *rigor* cycles of the model proposed by Drechsler and Hevner (2016; see Fig. 2.3). The fourth cycle, *change and impact,* distinguishes between the immediate and the wider application context. It states that,

> *'Viewed from a stakeholders' perspective within this external environment, the goals of a DSR project are not simply the building and evaluation of artefacts as such but to provide broader impacts to stakeholder communities in organisations and/or society'*

(Drechsler & Hevner, 2016:5).

This aspect is particularly relevant in this research, in which the ICT4D artefact is intended to support sustained change in the community within which it is implemented.

In this research, the *change and impact* cycle is addressed in the cognisance of the decision framework of the broader context within which it functions, and the manner in which this is addressed.

2.5.3. Relevance and contribution of Design Science to this research

The role of Design Science Research, and its contribution to the problem of sustained benefit in ICT4D interventions, is rooted in number of aspects. These include the dual role of Design Science in knowledge creation and solution creation, the role of the process of design in facilitating change, and the applicability of Design Science as a means of addressing problems that bridge people, technology, and organisational problems. In addition, it provides a structured and implementable framework within which solutions can be created and tested.

Design science creates knowledge as well as solutions (artefacts)

The research problem, as defined in this study, comprises in the first instance a need for the development of a solution (framework) to the practical problem of a lack of sustained benefit in ICT4D implementations. However, the problem environment is ill defined, ill structured, and characterised by uncoordinated and fragmented decision-making. Design Science will contribute here in its role as a bridge from the practical to the theoretical, and in its ability to take on the role of *explanation through design* (Holmström et al., 2009). As such, it is expected to contribute to the development of a solution (artefact), while at the same time serving as a basis 'to develop valid knowledge that can be used by professionals in the field in question to design solutions to their field problems' (Van Aken, 2005:22). Here, knowledge will comprise an improved understanding of the relationship between decision-making and sustained benefit, as well as an understanding of how to structure and address the problem in a value-creating manner.

In their definition of three levels of maturity of DSR artefacts, the decision framework would contribute at the second level (i.e., nascent design theory), in which it presents 'knowledge as operational principles/architecture' (Gregor & Hevner, 2013:342). Further, it could be classified as facilitating *improvement* in Gregor and Hevner's (2013) DSR Knowledge Contribution Framework, that is, 'Developing new solutions for known problems' (Gregor & Hevner, 2013).

The process of design enables change

The development and implementation of ICT4D solutions in resource-constrained environments has at heart the intention to enable change in the community within which implementation takes place. Sustained change in the participant system is indeed a key precursor for the delivery of sustained benefit. However, the way in which change is facilitated is sometimes not well thought through. A number of authors promote the concept of design and Design Science as enablers of change. March and Story (2008) quote Simon (1996:130) to emphasize the role of Information Systems design in facilitating change:

'Everyone designs who devises courses of action aimed at changing existing situations into preferred ones'.

Carlsson et al. (2011) consider Design Science Research as an essential part of IS Research due to its capacity to understand as well as change the world. Wang and Wang (2010) consider alignment of design research and IT innovation as a key component in design theory; they consider the role of design in improving business practice through new IT systems as one of the guidelines for alignment.

Bridging people, technology, and organisational boundaries

The contribution and relevance of Design Science to this research lies in its ability to bridge the boundaries between people, technology, and organisations. ICT4D implementations are in essence aimed at bridging these worlds, in order to create opportunities for (economic) development. However, it is precisely the interaction between people (community, funders, implementers), technology (sometimes with resource-rich demands in a resource-poor environment), and the (virtual) organisation that exists (between the implementers, funders and community), which defines this as a messy problem. Hevner and Chatterjee (2010:79) quote Kapor's definition of design as 'where you stand with your foot in two worlds – the world of technology and the world of people and human purposes – and you try to bring the two together'. Furthermore, Hevner et al. (2004) and Herselman and Botha (2015) highlight Design Science Research in IS as being *appropriate to the resolution* of messy problems, and Pries-Heje and Baskerville (2008) describe the role of Design Science as *enabling organisational decision-making* in the environment of messy problems. Similarly, Drechsler and Hevner (2016:3) emphasize that Design Science Research projects 'take place in complex settings with many stakeholders'. Hevner et al. (2004:75) accentuate the ability of Design Science to cross boundaries by confirming the position of the behavioural science paradigm, as well as the Design Science paradigm as being ‘at the confluence of people, organisations and technology’.

A rigorous framework for solution development

Any solution needs to achieve some form of validity in the view of its intended users. Furthermore, solutions need to be implementable, to be useful and usable to the intended audience. Peffers et al., ascribed the slow adoption of Design Science Research to a lack of an accepted methodology, and developed the Design Science Research Process Model to be ‘consistent with previous literature, provide a nominal process model for doing DS research, and (it) provide a mental model for presenting and evaluating DS research in IS’ (Peffers et al., 2007:45).

Other Design Science Research Frameworks have similar rigorous underpinnings, and provide mechanisms through which artefacts can be developed that are appropriate to the solution environment, and that can be evaluated and validated within their context of use (Hevner et al., 2004; Carlsson, 2006).

2.5.4. Structuring this problem in terms of the Design Science Research Process

The research strategy or method is intended to guide the collection, analysis, and interpretation of data. Research methods could be qualitative, quantitative, or mixed (Myers, 2013), and could use a variety of data collection tools such as surveys, experiments, interviews, case studies, and samples.

In this research, the Design Science Research Process of Peffers et al., (2007) is used to develop the artefact based on knowledge gathered in multiple design iterations. The proposed research process is structured as follows:

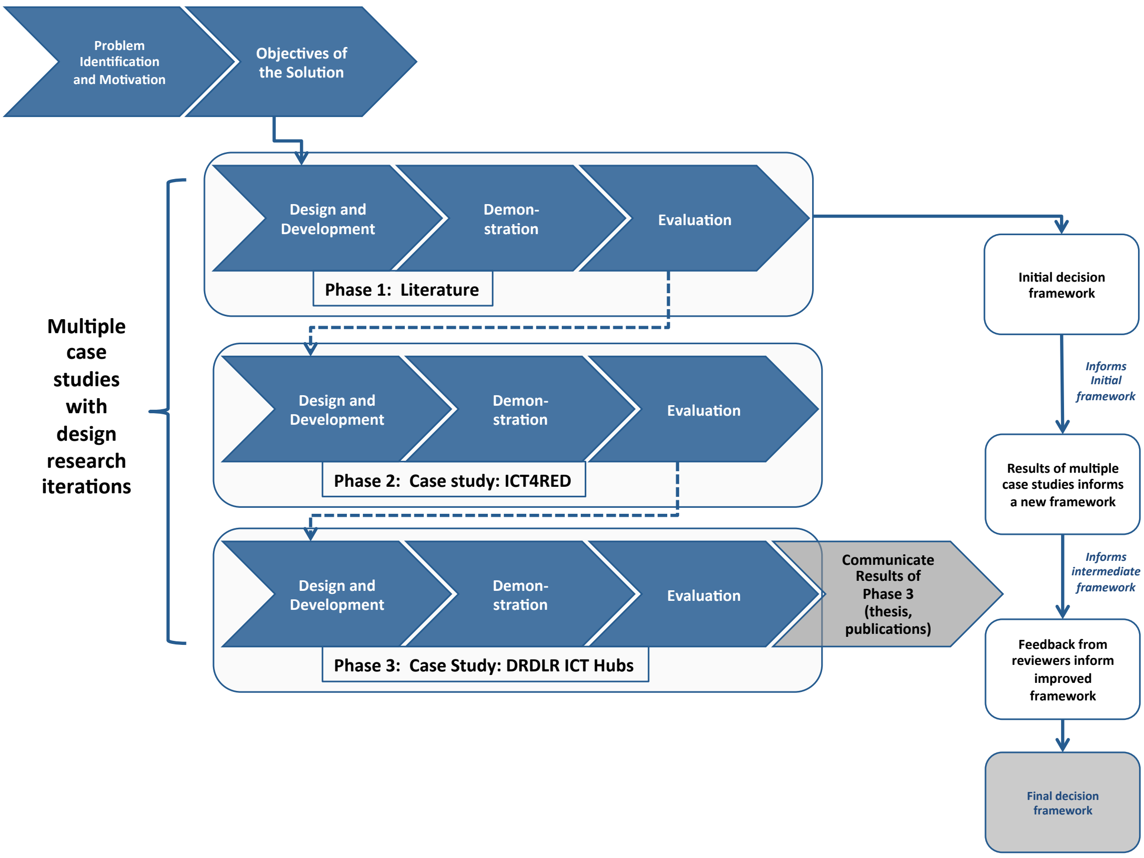


Figure 2.5 Design research iterations in this project (from Herselman & Botha, 2014; Peffers et al., 2007)

Following the definition of the problem and the research purpose, new knowledge will be created by designing an artefact through iterations of *literature reviews* and *case studies*. This combined strategy will develop understanding, collect data, understand interactions, and inform the development of the decision framework.

A review of the literature pertaining to the topics outlined in Section 2.6.1 will be used to define a preliminary decision-making framework. The case studies will be used in an iterative fashion to test the preliminary framework or theory, and then to further build the theory based on information obtained from the case analysis. Each iteration will deliver increasingly refined versions of the framework, and will comprise a design, demonstration, and finally evaluation phase (the latter is the basis upon which improvements to the framework will be motivated – see Section 2.6.4).

Benbasat et al. (1987) describes the case study approach as appropriate to research in its formative stages, as well as to 'sticky, practice-based problems where the experiences of the actors are important and the context of action is critical' (Benbasat et al., 1987:369). The research problem outlined in this work closely resembles the latter description (see Section 2.2). The research will be exploratory and descriptive, and will involve some elements of validation (testing).

2.6. DATA COLLECTION AND ANALYSIS

Literature reviews and case studies will form the basis of data collection and analysis.

2.6.1. Role of the literature review

Literature reviews have distinct roles, including ‘(i) identifying, summarising and critiquing current theory and methods; (ii) identifying ontological, epistemological and methodological problems and gaps; and (iii) providing much-needed evidence for decision-makers when identifying and supporting priority issues – especially through funding for policy development’ (Pickering et al., 2014:1757). For graduate students, the role of the literature review is often to provide an overview of existing research, and justify research questions by identifying gaps (Okoli & Schabram, 2010).

In this work, the role of the literature review goes beyond identification of gaps, to inform the development of the artefact. Three bodies of knowledge will be explored, namely the failure of ICT4D projects; sustainability and sustained benefit; and decision-making in ICT4D. The contributions of the various bodies of knowledge to the development of a decision framework are summarised as follows:

Table 2.2 Role of literature review

Body of Knowledge	Contribution
Sustainability and sustained benefit	A usable definition of sustained benefit, extrapolated from sustainability concepts. A means of translating the definition to a practical framework in support of sustained benefit.
Failure of ICT4D interventions	Scope and characteristics of the problem that need to be addressed by a decision framework in support of the design of interventions for sustained benefit.
Decision-making in ICT4D	Classification of the types of models that relate to the characteristics of decision-making in ICT4D interventions, and that would be useful in a decision framework. Definition of a construct of value creation (e.g., decision process) that could be used to contextualise the decision tools or models for sustained benefit.

The translation between the various contributions and the elements of a decision framework can be further clarified:

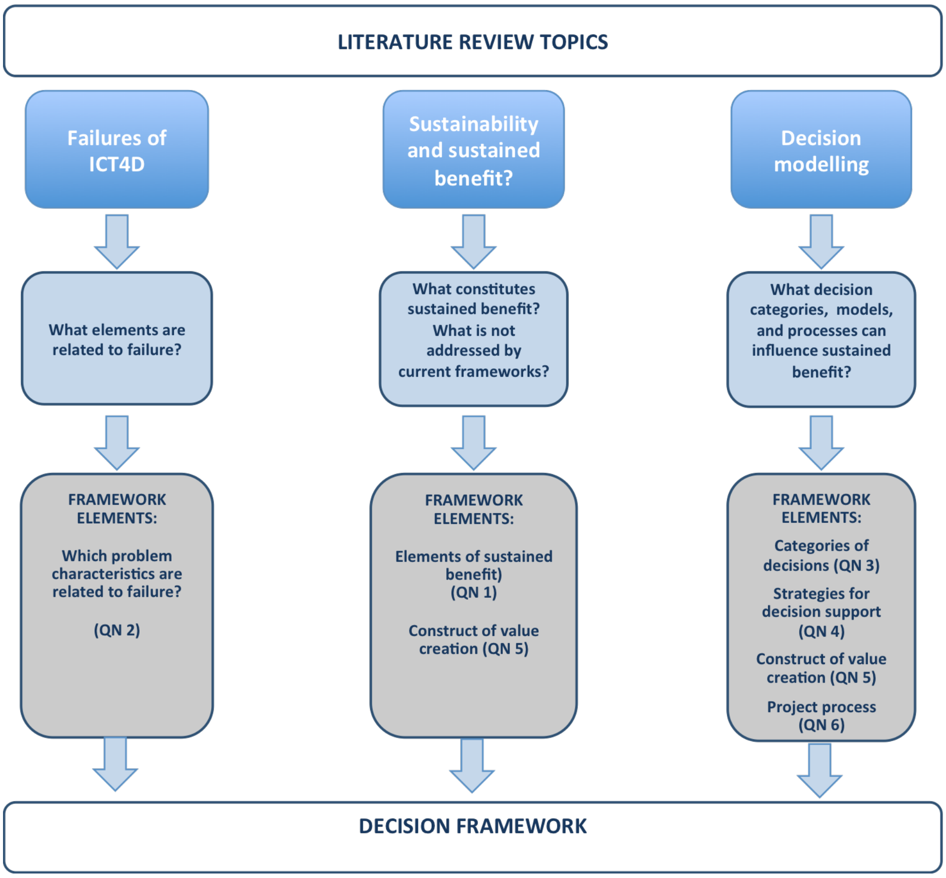


Figure 2.6 Role of the literature review in the development of a decision framework

Grant and Booth (2009) differentiate between 14 different types of literature reviews, and define a systematic review as a process that 'Seeks to systematically search for, appraise and synthesize research evidence, often adhering to guidelines on the conduct of a review' (Grant & Booth, 2009:95). A systematic or at least systematised review allows for the creation of new knowledge through the exploration of the relevant bodies of knowledge in a structured manner (Grant & Booth, 2009; Pickering et al., 2014). It has evolved from a need to increase the accuracy of decisions that are supported by an evaluation of literature, especially in the health field (Grant & Booth, 2009).

A structured approach to literature reviews has many advantages, including comprehensiveness, replicability, structured production of new text, and reduced levels of expertise required to produce usable new knowledge. In addition, it is applicable to trans- and multidisciplinary topics (Pickering et al., 2014). It is done against predefined criteria, and with the aim of identifying specific focus areas and gaps.

A structured literature review process will be applied to the topics outlined in Figure 2.6. Depending on the nature of the topic and its role in the study, either a systematic or a scoping review will be conducted (Grant & Booth, 2009). In a scoping review, an assessment is made of what is already known (Armstrong et al., 2011; Colquhoun, 2016). The extent of the assessment is determined by time constraints, and results are summarised in narrative or tabular form (Grant & Booth, 2009; Boyd & Bastian, 2011). This approach may be appropriate for an assessment of decision-making in ICT4D, for which extensive literature as well as reviews of literature is available.

For the remaining two topics, a systematic review aimed at exhaustive, comprehensive searching (Grant & Booth, 2009:95) may be more appropriate. A structured process will be followed, comprising phases such as planning, selection, extraction, and execution, as proposed by Okoli and Schabram (2010). The exact method of review for each topic is outlined in the relevant chapters.

2.6.2. Case studies and their selection

Case studies are used as data collection methods in qualitative research, and as 'empirical evidence to convince other researchers of the applicability (or inapplicability) of a particular theory or proposition' (Myers, 2013:74). They can be used in exploratory, explanatory or descriptive fashion (Yin, 2014), for theory testing or theory building (Irani et al., 1999; Myers, 2013). They are useful in understanding complex social phenomena, and allow researchers to

> *'retain the holistic and meaningful characteristics … such as life cycles, organisational, and managerial processes …'* (Yin, 2014:63).

Two case studies are proposed to inform the research. These include:

(1) The deployment of ICT in the rural school environment of the Eastern Cape, ICT4RED, and
(2) The deployment of ICT Hubs in rural environments.

The multiple-case design (two-case design) allows for a rich theoretical framework to be developed, and for the adaptation of the first framework based on new information found in a second case study (Yin, 2014). In this research, both case studies serve as evidence of, and add a practical dimension to, what is discovered in the literature review.

The unit of analysis will be the ICT4D intervention within its (planned) implementation context, that is, the case is bounded by the implementation of the intervention, as well as by all the role players affected by, or involved with, the intervention. The case will therefore comprise specific elements and role players that influence sustainability, such as the virtual organisation (comprised of the implementation team, funder, recipient organisation, and community), the project process, and the nature of and demands placed by the technology. For practical purposes, the cases are bounded in time by the period over which implementation took place (i.e., practical considerations will preclude an assessment at an extended period after implementation of the cases). The latter aspect influences the ability to assess the effect of lag time on sustainability.

The choice of case studies is on the one hand informed by their appropriateness to the research topic, and on the other by access to the cases for research and analysis. The selection of cases is therefore partially informed by convenience (access).

However, the selection also fulfils case selection criteria as proposed by Myers (2013):

Table 2.3 Criteria for case study selection

Criteria for evaluating the case	*ICT4RED*	*ICT Hubs*
The case must be 'interesting', i.e., it must reveal something that was not known before	The case is an experimental (from first principles) deployment of a holistic ICT implementation in education.	The case is an experimental deployment of an implementation to enable rural access to ICTs. It has a less holistic approach.
The case must display sufficient evidence	The scope and extent of the case, as well as the duration and practical nature of rollout, provides sufficient activities and interactions from which to collect evidence. It includes implementation, as well as extension of learning to general strategy.	The duration of rollout, and obstacles to realisation of implementation schedules, provides sufficient material from which to collect evidence.
The case should be 'complete', i.e., all relevant evidence to prove or disprove the case must be collected	The project life cycle allows for development of decision models within the scope of the ICT4RED implementation, and testing of models and decision processes in other contexts, based on learning.	The project life cycle and implementation challenges allow for understanding of issues of sustainability in the project design phase, as well as assessment of implication thereof in the implementation phase.
The case must consider alternative perspectives, i.e., must reflect real life situations (including contradictions)	The experimental nature of the project, and adaptation of project design to fit local conditions, create sufficient information to reflect contradictions.	The experimental nature of the project and diverse implementation sites create sufficient information to reflect contradictions.
The case study should contribute to knowledge, i.e., must be generalized to one or more theoretical concepts	The uncoordinated decision environment within which the project is implemented, as well as innovative project design elements, provides sufficient scope for the development of new theoretical concepts.	The uncoordinated decision environment within which the project is implemented provides sufficient scope for the development of new theoretical concepts.

The cases will be used in a post-hoc manner to develop the decision framework, based on the researcher's participation in both case studies. Sources of evidence for the case studies will include project documentation, interviews with project participants, and participant observations (through the researcher's participation in the development and use of decision support models, and participation in post-project reflection on the two cases to inform learning).

2.6.3. Case-based data collection and analysis

The analysis of the two case studies needs to yield sufficient information to refine the initial framework for decision-making. The cases must be interpreted from multiple perspectives, in order to identify elements that should be included in the framework.

In 1808, Friedrich Ast emphasized the circularity of interpretation as an interaction between the individual and the whole, and as such provided the principles and basis for the hermeneutic circle (Mantzavinos, 2016). This definition – as well as Schleiermacher's interpretation of sense making as iterative interpretation of text between the reader, individual parts of the text, and the text in its entirety (Mantzavinos, 2016) – formed the basis of hermeneutic analysis.

In IS Research, hermeneutic analysis aims to make sense of the whole, and the relationship between people, the organisation, and information technology (Myers, 2016). The hermeneutic circle has been applied in terms of the following progression or interaction: information – data – meaning – information – data (Wang et al., 2008). It emphasizes the need for iteration, reflection, and integration when making sense of data in IS Research.

Klein and Myers (1999) base the following principles for interpretive analysis on hermeneutics:

Table 2.4 Principles for interpretive analysis (Klein and Myers, 1999).

Principle	Interpretation	Relevance to this research
1. The Fundamental Principle of the Hermeneutic Circle	This principle suggests that all human understanding is achieved by iterating between the interdependent meaning of parts and the whole that they form. This principle of human understanding is fundamental to all the principles	The essence of this research is to develop an artefact that has an impact at the systemic level, by enabling better decisions at the individual level, towards a common goal.
2. Contextualisation	Requires critical reflection of the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged.	The case-based approach of the research facilitates reflection on the contexts within which this problem plays out.
3. The Principle of Interaction Between the Researchers and the Subjects	Requires critical reflection on how the research materials (or 'data') were socially constructed through the interaction between the researchers and participants.	Development and review of specific models is done in each of the cases studies in collaboration with decision-makers within each case.
4. The Principle of Abstraction and Generalization	Requires relating the idiographic details revealed by the data interpretation through the application of principles one and two to theoretical, general concepts that describe the nature of human understanding and social action	The framework will serve as an abstraction of the decision contexts within which the problem of sustained benefit in ICT4D interventions play out.
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 data tell'), with cycles of revision.	The multiple case Design Science Research approach calls for iterative reflection on the research product, as well as iterative refinement thereof.
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.	The framework will serve as a guide to multiple decision-makers, across different levels of the system within which it is implemented.
7. The Principle of Suspicion	Requires sensitivity to possible 'biases' and systematic 'distortions' in the narratives collected from the participants.	A review of the framework from the perspective of a generalized guideline for decision-making requires that biases or context-bound solutions be identified and eliminated.

In Creswell's (2013a) definition, case analysis will include a holistic perspective (i.e., consider the entire case in its context), as well as an embedded perspective (i.e., with a view on decision-making).

Based on descriptions of case analysis by Creswell (2013a), as well as the principles underlying the hermeneutic cycle, it is proposed that the cases are analysed as follows:

Table 2.5 Method of case analysis

Type of analysis	*Objective & activities*	*Method*
Within-case analysis	Identify and describe the context of the case. Identify the objective of the ICT4D intervention. Define the decision context (stakeholders, constraints, influences). Identify key themes that affect and inform decision-making.	The researcher will analyse and interpret project documentation, as well as notes from meetings, presentations, and discussions to develop the context. Participant observation, as part of the sustainability modelling activity on each project, as well as learning during model development, will further inform the analysis. Decision maps and rich descriptions will be used to support the analysis, where appropriate.
Cross-case analysis	Identify generalizable elements across cases that would inform framework development.	A comparison of the within-case descriptions and analyses would enable the identification of elements to include in the framework, as well as the identification ways in which to enhance elements that have already been identified.
Interpretation	Integrate the generalizable elements that were defined in the cross-case analysis, to inform the revised decision framework	The relevance of the generalizable elements to the framework will be assessed, and its level of integration will be determined (i.e., does it constitute a new element, or a revision of an existing element). The framework will be adapted accordingly, to constitute the *intermediate* framework.

A case study approach allows for data collection from multiple sources and in multiple formats, including interviews, documents, observations, etc. (Creswell, 2013a). As outlined earlier and implied in the Table 2.5, data will be collected from project documentation, interviews with project participants, participation in the project, and observation of the progress of the project at the time of implementation. Triangulation between data sources will enable the identification of framework elements, and assessment of new information against an already conceptualised framework will inform further refinement thereof. The analysis will be based on the principles for interpretive field research of Klein and Myers, as outlined in Table 2.4.

2.6.4. Evaluation, model validation and communication

Evaluation is an integral part of the Design Science Research Process model (Peffers et al., 2007). It should 'observe and measure how well an artefact supports a solution to the problem…involves comparing the solution to actual observed results from use of the artefact in the demonstration' (Peffers et al., 2007:58). However, it has been argued that little guidance exists with respect to the evaluation of artefacts in literature (Herselman & Botha, 2015; Prat et al., 2014; Shresta et al., 2014), and that the methods and objectives of evaluation are fragmented and unclear (Prat et al., 2014). Some authors have proposed evaluation design frameworks to address this gap in the Design Science Research literature, including the work of Herselman and Botha (2015), Prat et al. (2014), and Venable et al. (2016). The approaches of the latter two authors are summarised below:

Table 2.6 Frameworks for evaluation

Author	*Approach to evaluation*	*Proposed method*
Prat, N., et al., (2014) *'Artefact evaluation in information systems design research: a holistic view'*	The artefact is considered to be a system that needs to be evaluated against the specific dimensions of a system (goal, environment, structure, activity, and evolution)	Use four different characteristics against which to define an evaluation method: • Form of evaluation (quantitative, qualitative) • Secondary participant (e.g. students, practitioners, researchers) • Level of evaluation (abstract artefact, instantiation) • Relativeness of evaluation (comparable artefacts or absence of artefact)
Venable et al., (2016) *'FEDS: a Framework for Evaluation in Design Science Research'*	FEDS includes a two-dimensional characterisation of DSR evaluation episodes (particular evaluations), with one dimension being the functional purpose of the evaluation (formative or summative) and the other dimension being the paradigm of the evaluation (artificial or naturalistic).	Follow an evaluation design process comprised of the following four steps: • Explicate the goals of the evaluation, • Choose the evaluation strategy or strategies, • Determine the properties to evaluate, and • Design the individual evaluation episode(s).

In general, a method of evaluation needs to be appropriate to the nature of the item that is being evaluated. Furthermore, it needs to 'provide feedback for further development, and … assures the rigour of the research' (Venable et al., 2016:77). The *how, what, when,* and *why* to evaluate become central to the evaluation method (Lagsten, 2011; Prat et al., 2014; Venable et al., 2016), as is addressed by the frameworks in Table 2.6.

For this research, a method is required that will enable assessment of the utility of the decision framework in multiple unknown future contexts. To this end, both of the above frameworks are used in this research. First, the Framework for Evaluation in Design Science Research (FEDS) is used to develop a strategy for evaluation of the artefact, and then the systems approach of Prat et al. (2014) is used to identify the properties to evaluate, as well as the appropriate method of evaluation.

Evaluation strategy

The FEDS was developed to answer the following question (Venable et al., 2016):

'What would be a good way to guide the design of an appropriate strategy for conducting the various evaluation activities needed throughout a DSR project?'

It proposes a number of steps in answering this question, which the researcher applied to develop an evaluation strategy for the decision support framework (artefact).

As background to application of the framework, Venable et al. (2016) differentiate between formative and summative evaluations. The former is aimed at 'improving the outcomes of the process under evaluation', while the latter aims to 'judge the extent to which outcomes match expectations' (Venable et al., 2016:80).

A second concept is that of naturalistic vs. artificial evaluation. The former 'explores the performance of the solution technology in its real environment', while the latter is aimed at 'proving or disproving the design theory and/or the utility of the DSR artefacts' (Venable et al., 2016:81). The authors outline the following possible evaluation strategies, depending on the nature of the artefact and the purpose of the evaluation.

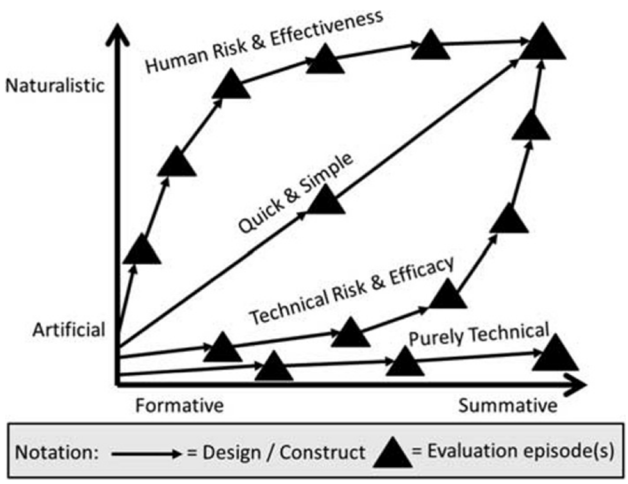


Figure 2.7 Evaluation strategies (Venable et al., 2016)

Before applying the framework, the researcher broadly states the following goal:

Assess the usefulness of the framework
in guiding decision-making for sustained benefit

The decision framework under consideration should be applicable in multiple contexts (that are unknown at the outset), and needs to be evaluated in a manner that will increase its robustness in multiple environments.

The outcome of applying the FEDS can be summarised as follows:

Table 2.7 An evaluation strategy for this research, developed from FEDS

STEP	*This project*	*Other options in the Framework (Venable et al., 2016)*
1. Explicate the goals	*Uncertainty and risk reduction*: • Risk that the artefact will not work in the use or social situation	Rigour (efficacy and effectiveness) Ethics Efficiency
2. Choose a strategy for evaluation	Human risk and effectiveness	Quick and simple Technical risk and efficiency Purely technical artefact
3. Determine the properties to evaluate	The following properties are selected from the systems approach to evaluation of IS artefacts (Prat et al., 2014): • Goal • Environment • Structure • Activity • Evolution	Any appropriate framework can be considered, including: • Adapting levels of granularity (Sun & Kantor, 2006) • Adapting context, input, process, product (Stufflebeam, 2003) • Adapting criteria as design goals (Mathiassen et al., 2000) • Adapting both rationality and understanding (Smithson & Hirschheim, 1998)
4. Design the individual evaluation episodes **(method)**	See below	Consider: • Constraints in the environment • Prioritise these factors to determine which are essential, less important, etc. Determine a plan (who, what, when)

The *Human Risk and Effectiveness* strategy was selected because it is considered critical for the evaluation to rigorously establish that the benefit created by the artefact (in this case: decision framework) will continue (Venable et al., 2016). This defines a strategy of more artificial evaluation initially, which are replaced by naturalistic evaluations; the focus will be on formative rather than summative evaluations.

Evaluation method

The evaluation of artefacts produced by Design Science Research is critical to 'prove rigor, to show evidence and to label the research as "science" ' (Herselman & Botha, 2015:1). The application of a well-defined process is therefore required. For this research, the properties as well as the method of evaluation is derived from Prat et al. (2014) – who describes a model of generic evaluation methods in terms of the form of the evaluation, secondary participants, level of evaluation, and relativeness of evaluation.

For this research, Prat et al.'s (2014) model is used to define the following method:

Table 2.8 An evaluation method, developed from Prat (2011)

STEP	*This project*	*Other options to consider (Prat et al., 2014)*
Form of evaluation	Qualitative Analysis and logical reasoning	Quantitative Formal proof
Secondary participants	Practitioners and researchers	Students
Level of evaluation	Abstract artefact directly (evaluation of literature review model) Instantiations (evaluation of model changes based on case studies)	As outlined for this project
Relativeness of evaluation	Absolute (does the artefact achieve its goal)	Relative (to comparable artefacts, or in the absence of a comparable artefact)

Based on the discussion in this section, the following evaluation process is proposed:

- Three formative evaluations are undertaken during the development of the artefact (i.e., two case studies and an expert review).
- Each evaluation will assess the usefulness of the decision framework at the particular stage of its development (initial, intermediate), and expand the design.
- Case studies: the case study evaluations will be done by the researcher.
- Expert review: the third and final evaluation will be done by researchers and practitioners that have not been exposed to the artefact during its development. While this evaluation may inform the decision framework, some pointers may be left for future research. It is therefore of a formative as well as summative nature.
- The evaluation instrument will evaluate the properties identified through Prat et al.'s (2014) systems evaluation approach, as outlined in Table 2.9.

Table 2.9 Properties of artefact to evaluate, based on systems evaluation (from Prat et al., 2014)

Property	*Description*	*Applied to this decision framework*
Goal	Efficacy, validity, or generality of the framework	Is the framework effective in its goal of aiding decision-making, does it produce a valid outcome, and is it applicable to more than one decision situation?
Environment	Consistency of the artefact with the environment (people, processes, technology)	Is the framework eliciting decision-making that is relevant to the people, processes, and technology that are involved in the decision problem?
Structure	Completeness, simplicity, clarity, style, level of detail and consistency of the artefact	Have critical elements been omitted from the decision framework?
Activity	Completeness of function, consistency of activity, accuracy and performance of the artefact	Is application of the decision framework yielding a usable and useful result?
Evolution	Robustness and learning capability	It is possible to change the instantiation of the decision framework, based on learning that comes to light during its application?

This evaluation and communication approach is integrated with the overall research methodology as follows:

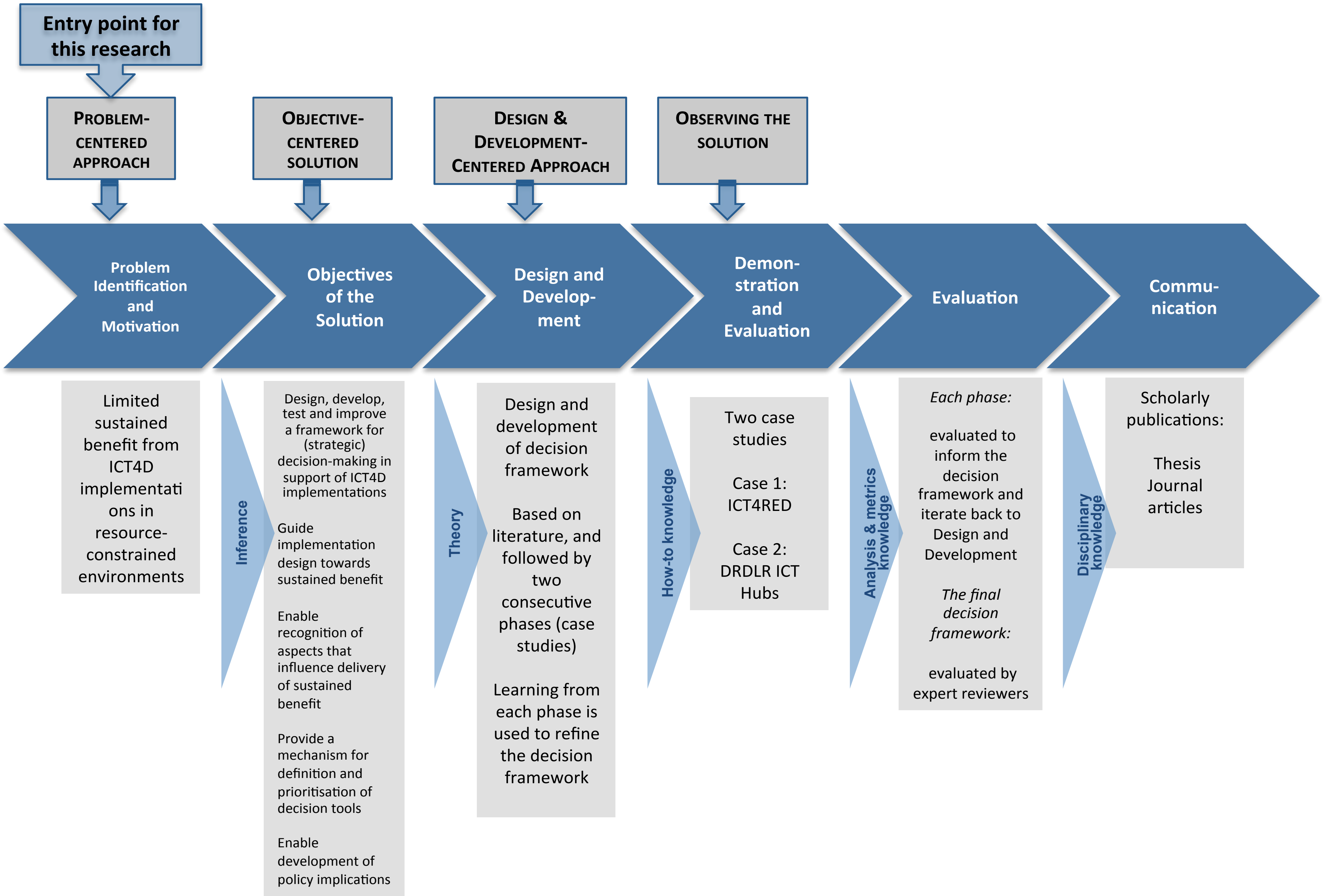


Figure 2.8 Design Science Research Process (DSRP) Model, adapted for this research from Peffers et al., (2006)

2.7. SUMMARY

A *Design Science (DS)* research strategy is proposed for the development of the framework. Its appropriateness for this work lies in the ability to create both theory and products, to cross the boundaries of people, organisations and systems, and to provide a structured mechanism within which iterative design cycles can be executed. The research methodology is summarised as follows:

Table 2.10 Summary of research methodology

Dimension of Research Methodology	This Research	Method
Philosophy	Pragmatism and Interpretivism	
Approach	Problem solving paradigm: Design Science Research approach	
Strategy	Multiple case studies within a Design Science Research Process An evaluation strategy that is based on the FEDS framework, and informed by a systems approach to evaluation.	*Case selection:* • Convenience, but compliant with a case selection framework. *Evaluation method:* • Define properties to evaluate based on a systems approach to evaluation
Data collection	Literature review Case studies Expert review	Systematic or rapid reviews Interviews Participant observation Interviews Survey
Data analysis	Literature review Case studies • Within-case analysis • Cross-case analysis • Interpretation	Document analysis Document analysis, rich descriptions Comparative descriptions Comparison of applicability of tools within framework

A formative evaluation of the artefact will be undertaken on an on-going basis throughout the research project. The evaluation strategy is based on the FEDS framework (Venable et al., 2016).

It is anticipated that the Design Science approach, research design and research method as proposed here will provide a sound basis to enhance a preliminary, literature-based decision support framework with rich information from the case studies.

Cases have been selected in such a way that sufficient similarities exist in terms of intent of the implementations, implementation environment, decision-making environment, and complexity of implementation to enable sufficient evidence to be created for theory development.

Review of the decision framework will be based on an evaluation process that includes on-going evaluation and assessment by the researcher, and an evaluation of the final framework based expert feedback. Communication and dissemination of research results will take place through the formal route of scholarly publications.

CHAPTER 3. LITERATURE REVIEW: SUSTAINABILITY & SUSTAINED BENEFIT

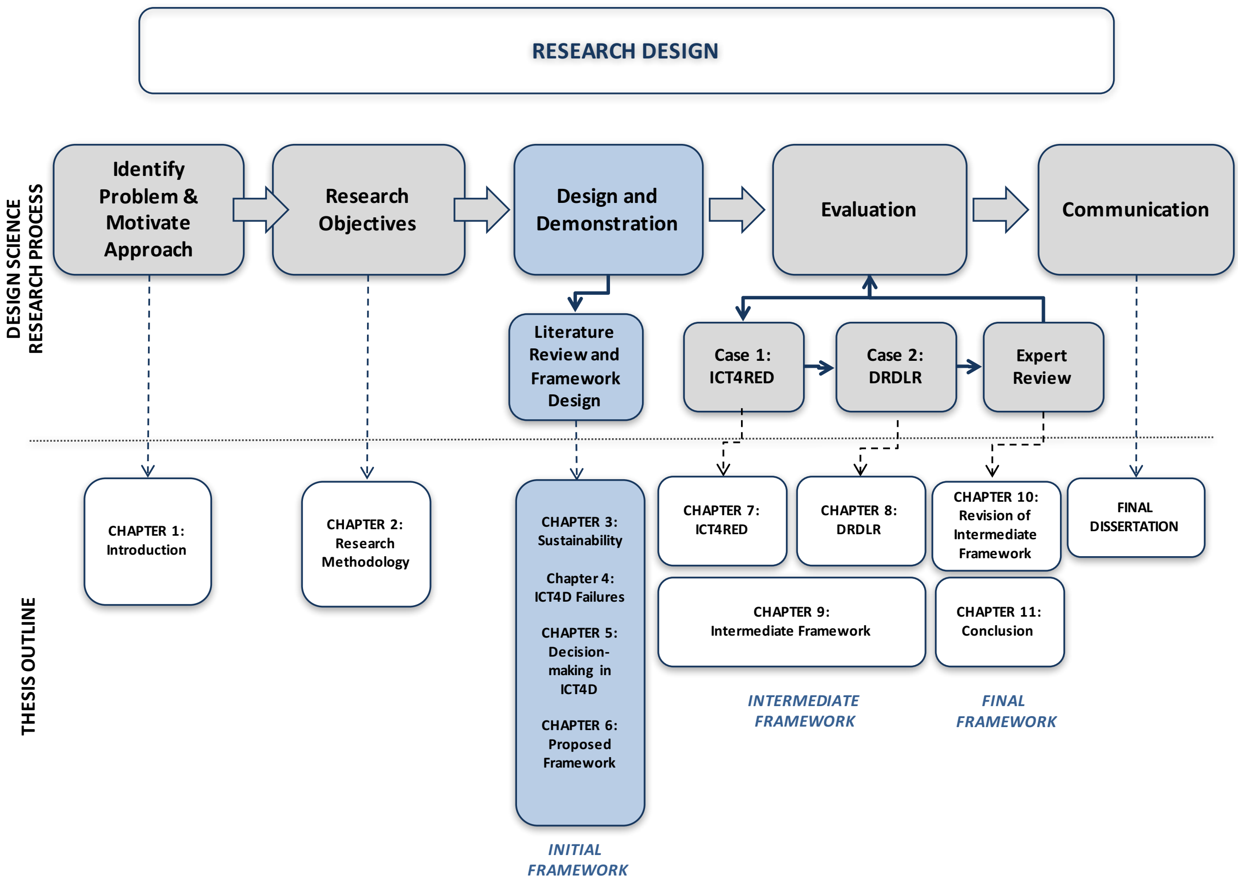


Figure 3.1 Research process and thesis outline: Chapter 3

3.1. INTRODUCTION

In this research, the researcher seeks to construct a decision framework that enables decision-makers to develop solutions towards sustained benefit. This requires that an understanding be developed of the key issues that inform the decision framework, as well as of the current conversation pertaining to these issues. In Chapter 2, the relevant literature review topics have been identified as *sustainability and sustained benefit*, *failures in ICT4D,* and *decision models in ICT4D*. These topics are expected to contribute to the research as follows (Table 2.2, repeated here for convenience):

Table 3.1 Role of literature review

Body of Knowledge	Contribution
Sustainability and sustained benefit	A usable definition of sustained benefit, extrapolated from sustainability concepts. A means of translating the definition to a project-level framework in support of sustained benefit.
Failure of ICT4D Projects	The scope and characteristics of the problem that need to be addressed by a decision framework in support of design of interventions for sustained benefit.
Decision-making in ICT4D	Classification of the types of models that relate to the characteristics of decision-making in ICT4D interventions, and that would be useful in a decision framework. Definition of a construct of value creation (e.g. decision process) that could be used for contextualisation of the decision tools or models for sustained benefit.

This chapter explores the first topic, while the second and third are addressed in Chapters 4 and 5, respectively.

A *systematic literature review* provides the opportunity to develop a structured perspective on the research that is relevant to a specific topic. It enables the researcher to explore the body of knowledge in a systematic manner, and to identify aspects that could add value to the conversation, or gaps that need to be addressed (Grant & Booth, 2009; Okoli & Schabram, 2010; Pickering et al., 2014).

This chapter develops a method that is applied to the first two literature review topics outlined in Table 3.1. For each topic, a typology of themes is developed. These topics provide somewhat contrasting views (those of sustainability and failure) on the aspect of value from ICT4D interventions. For each topic, the implications for the decision framework are summarised at the end of the review, and the implications for the two topics are integrated in the final section of Chapter 4.

This chapter firstly provides some background on sustainability and sustained benefit (Section 3.2), after which it summarises the systematic literature review method (Section 3.3), followed by a review of the literature of sustainability and sustained benefit (Section 3.4). The chapter is summarised in Section 3.5.

3.2. SUSTAINABILITY AND SUSTAINED BENEFIT

3.2.1. The focus of this work

ICT4D as an enabler of development has received increasing interest, with awareness heightening in the late 1990s (Howard, 2008; Kleine & Unwin, 2009). It has been seen as a potential solution for the inability of development initiatives to make meaningful impact. However, ICT4D project failures have led to a decline in interest (Heeks, 2016; Howard, 2008), much of which has been attributed to the fact that ICT4D interventions are not *sustainable* (Howard, 2008). Kendall (2015) reflects that, while some projects are successful, large-scale or long-term sustainable small-scale interventions that achieve their development outcomes are limited (Kendall, 2015). The latter perception, in turn, led to extensive work in understanding the reasons for failure of ICT4D interventions.

The importance of sustainability has been highlighted at both the macro (industry) and the micro (project) level. Heeks points to sustainability as an important factor for the continued role of ICT in the development arena (Heeks, 2008). At the project level, Kanungo states ‘Sustainability arises as the critical success factor that influences how information and communication technology resources are managed in the post-experimental phase’ (Kanungo, 2001:400).

However, in spite of its deemed importance, the concept of sustainability remains unclear and often confused. *Sustainability* is a concept that is used in many contexts related to ICT4D, but that is often not clearly defined and differentiated relative to the context within which it is used. In addition, definitions are very seldom usable at project or programme level. Heeks (2014b:15) confirms this sentiment when he states that ‘sustainable development is an empty slogan: continuously invoked but never examined.’

The meanings and applications of sustainability in the context of ICT4D range from the association between ICT4D and sustainable development (WCED, 1987), through sustainable livelihoods (DFID, 1999), to environmental sustainability (Barreto & Santos, 2012), sustainable ICT for development (Heeks, 2008; Kamau et al., 2014; Pade-Khene & Lannon, 2017), and the response of organisations to the challenges laid down by the concept of sustainable development (Baumgartner & Ebner, 2010; Dyllick & Hockerts, 2002; Stubbs & Cocklin, 2008). The definition has become confused (Nayak, 2013), and the utility of the concept in practice is unclear.

The premise of this work is to contribute to the operationalisation of the concept of sustainability in the context of ICT4D. This asks, firstly, for a reflection on the current understanding and interpretation of sustainability, as well as for an understanding of the current ways in which the concept of sustainability is applied in ICT4D interventions, which is the purpose of this systematic review. For sustainability to become an actionable and usable concept, its various interpretations need to be examined, and it needs to be differentiated as a mechanism that can in some way enable development *practitioners* to *do things differently* and hence to make the results of their efforts more valuable over time.

Many perspectives are taken on development, from approaches that ‘equate development with economic growth’ (Kleine, 2010:675, lists Hirschman, 1958; Lewis, 1954; Myrdal, 1957; Rostow, 1960), to human-centric approaches that focus on enabling choice (Kleine, 2010; Sen, 1999), or developing capitals (Sen, 1999; DFID, 1999). However, the reality remains that ‘development’ – regardless of its underlying philosophy – still largely takes place by means of *funders* who initiate *interventions* that need to deliver some form of *benefit*, and that are *designed* and executed within a specific *budget*, in the form of a *programme* or *project.* This approach is unlikely to change in the near future, and development interventions are likely to exist in the form of projects or programmes over many years to come, while absorbing significant future investment. The challenge is to shape these interventions in a manner that the intended benefit can be sustained for the appropriate period of time.

Given this background, the intent is to develop a framework that enables the concept of sustainability to be operationalised at a programme or project level, such that the intervention can be guided to have an (appropriately defined) lasting effect, independent of the underlying development philosophy.

This chapter reviews the literature that is relevant to the concept of sustainability, with the aim of addressing the following research sub-question (Section 1.4.3):

QN. 1 What are the elements of sustained benefit that need to be considered, in the context of ICT4D interventions?

It is intended to contribute the following information to the research (see Table 3.1):

A usable definition of sustained benefit.

A means of translating the definition to a project-level framework in support of sustained benefit.

This formulation shifts the focus from sustainability to sustained benefit. The alternative term of sustained benefit has been adopted as the focus point of this work, with the aim of providing clarity around the difference between sustainability as a general concept, and sustained benefit as the benefits that need to be sustained when a specific ICT4D implementation is undertaken within a community. The literature is explored with the view of examining sustainability (and sustained benefit, where it is used), positioning sustained benefit relative to the current conversation, and adopting relevant elements from the sustainability concept in the definition of sustained benefit. The review focuses on two aspects, namely the current interpretations and elements of sustainability, as well as the ways in which this concept is applied.

3.2.2. Related concepts

In addition to sustainability, a number of related concepts exist that engage with the long-term impact of ICTs on development. Among these is ***resilience***, which deals with the capacity of the community to 'withstand….' or 'to change in the face of an external disturbance' (Ospina & Heeks, 2016:5). This perspective takes a view on the 'potential impact of development interventions in strengthening – and potentially weakening – the resilience of low-income communities' (Ospina & Heeks, 2016:4). ICTs are highlighted as a possible means of enhancing the development potential of low-income communities, who are seen as most vulnerable to external shocks (Boeri *et al.*, 2017.)

Capability-related perspectives include a focus on individual choice (Sen, 1999), and DFID's Sustainable Livelihoods Framework (DFID, 1999), in which a focus on capabilities is a means of attaining sustainability as reflected in DFID's definition:

'A livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base'. (DFID, 1999:1.1).

Other concepts include ***indicators of long-term development impacts*** such as the earlier Millennium Development Goals, and the recently adopted Sustainable Development Goals. The latter comprises 17 "Global Goals" with a combined 169 targets. Goals include ending poverty and hunger, improving health and education, making cities more sustainable, and combating climate change. Criticism of this work includes, amongst others, the lack of an emphasis of the role of ICTs (Unwin, 2015).

In Chapter 1, the scope of this work was delineated as focusing on *sustaining the benefits from ICT4D interventions* (Section 1.3.1), as emphasized by the discussion in Section 3.2.1. However, the link between sustaining the (anticipated) benefits from the intervention and their effect on the sustainability of the overall system is important, and needs to be interpreted by the decision framework.

Perspectives vary on the role and impact of ICTs on overall sustainable development (e.g., Gigler, 2011; Heeks, 2008; Nemer, 2016). While this research is based on the premise that the introduction of ICTs will be a catalyst for some systemic change in the community, it does not consider sustainability in its broadest sense. That is, it does not dictate or assume that an ICT intervention will be the key facilitator of the broader social, environmental, economic, or other form of sustainability of the community. Instead, this research is aimed at facilitating decisions towards the intended (defined) change that is expected from the ICT4D intervention under consideration, by interrogating the alignment of decision-making.

This research therefore addresses the systemic perspectives outlined earlier in this section through the link between the benefits that need to be sustained and the systemic impact that is anticipated from such benefits. The latter is dependent on the chosen underlying development philosophy, which is not dictated by the framework (See Section 3.4.4.1; Chapter 9). The various related concepts, as discussed in this section, are therefore not explicitly included in the literature review.

3.3. SYSTEMATIC LITERATURE REVIEW METHOD

A systematic literature review 'seeks to systematically search for, appraise and synthesize research evidence…. it is transparent in the reporting of its methods to facilitate others to replicate the process' (Grant & Booth, 2009:102). In this section, the method that was followed for conducting this systematic review is outlined. It aims to facilitate a replicable scan of relevant literature, and then to classify the results in terms of a typology of themes for both the topics under consideration. This provides a means of making sense of the various topics, and a way of informing the key elements that need to be considered in the decision framework.

Okoli and Schabram (2010) describe a seven-step process for a systematic literature review. Following and adapting this process, a systematic review is conducted that is described as follows:

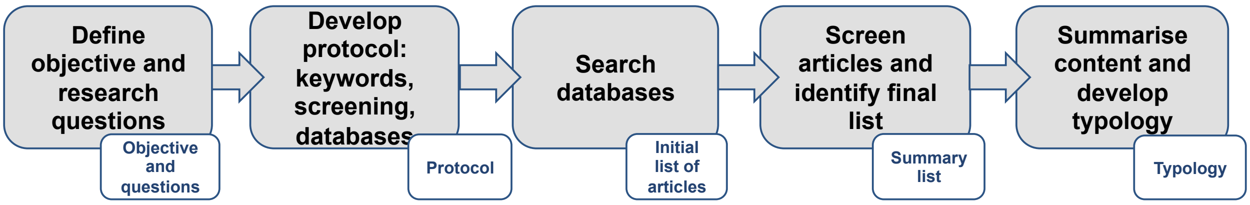


Figure 3.2 Systematic review methodology

The steps in this process were designed to arrive at a typology of interpretations and use of *sustainability and sustained benefit*. It is similarly used to address the second topic, namely *failures of ICT4D initiatives* (see Chapter 4).

3.3.1. Generic protocol

The review protocol is aimed at identifying and selecting articles that are *relevant*, *of sufficient scope,* and *of good quality*. This is achieved by designing a protocol that defines appropriate keywords (for relevance and scope); the databases that are to be included in the search (for relevance and scope); and a method for screening (including and excluding) articles (for relevance and quality).

The generic protocol was guided by the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) (Moher et al., 2009), and is outlined in Table 3.2.

The generic protocol is applied to sustainability and sustained benefit in Section 3.4, and to ICT failures in Chapter 4.

Table 3.2 Generic systematic review protocol

Step	Detail
Keyword identification	Consider keywords that logically link the search to its objectives Use keywords to do an initial search, and evaluate the nature of returned articles Adjust keywords until the initial search returns an appropriate and relevant set of articles
Select databases	Choose databases that are likely to return work that is related to the topic. Harzing's (based on Google Scholar) has been used in each case as the primary database, for its ability to rank articles according to a quality score. Other databases have been added to provide a broader perspective. The list of articles were augmented by the researcher's own selection of articles related to the topic.
Screen articles	Harzing's Publish or Perish was used to identify a highly ranked initial set of articles, based on the keywords, predefined time periods, and publication types. The search was augmented by a similar search of articles in other databases. The title and abstract of the initial set of articles were screened for relevance to the topic, and articles not directly related to the topic were excluded. The full-text articles were read, and further irrelevant articles were excluded
Summary and typology development	Full-text articles were tagged based on their content, and the tags were used to describe the body of literature (e.g., in terms of field of ICT4D addressed, geography, etc.), and to develop a classification or typology of selected themes (such as the nature of the definitions or concepts of sustainability that were used by the various authors).

The application of the protocol, as well as the approach to defining keywords, searching, and screening are outlined separately for each of the literature reviews.

3.4. LITERATURE REVIEW: SUSTAINABILITY AND SUSTAINED BENEFIT

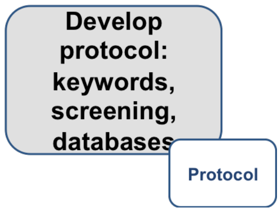
3.4.1. Objective

This review is aimed at answering the following question (Section 3.2):

QN 1. What are the elements of sustained benefit that need to be considered, in the context of ICT4D interventions?

This question in essence calls for an understanding of the way in which sustainability and sustained benefit is interpreted in the literature, and how it is applied in ICT4D interventions. An understanding needs to be developed of how literature views sustainability in its broadest sense — that is, what is sustainability about in the view of researchers, practitioners, and authors?

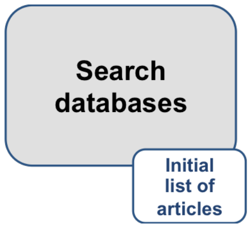
3.4.2. Application of protocol



The search protocol for this topic summarised in Table 3.3.

Table 3.3 Systematic review protocol: sustainability and sustained benefit

Item	Description
KEYWORDS	(Sustainability OR sustained benefit OR sustained change) AND ICT4D
DATABASES and journals	Harzing's (based on Google Scholar), ScienceDirect, WebOfScience
SCREENING	
Include	All dates All articles, conference papers, and books in English Articles related to project and intervention sustainability Highest-ranked articles over all dates, augmented with highest ranked articles published over the last three years (2013–2016).
Exclude	Articles related to environmental sustainability, or sustainability and sustainable development in general
Summary and typology development	Mark all articles based on: • geography (where was the project or intervention implemented) • type of article (case description, reflection on sustainability, framework development, framework application) • field of application (agriculture, health, etc.) • definition of sustainability (defined, discussed, or implied) • concept of sustainability (e.g., different dimensions, process, network, etc.)

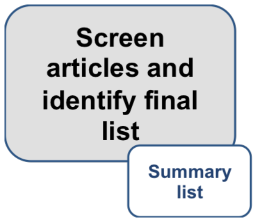


A preliminary search indicated that the most relevant results are obtained by using the keywords listed in Table 3.3. Harzing's search engine (based on Google Scholar) was used to identify the top 1000 articles (ranked according to the H-index and citation number) for keywords found anywhere in the article; to ensure that recent thinking was included, the search was repeated for the top 1000 articles between 2013 and 2016, and duplicates were removed. This list was enhanced by similar searches through ScienceDirect and WebOfScience. The latter engines allowed for keyword searches on title and abstract only, thus returning significantly less articles. All academic articles, conference papers, and book chapters written in English were included in the search.

The results of the database search are summarised in Table 3.4:

Table 3.4 Search results

ICT4D +	Sustainability	Sustained change	Sustained benefit	Total
Harzing's	1573	15	5	1593
ScienceDirect	25	28	27	80
WebOfScience	181	2	1	184
Total	**1779**	**45**	**33**	**1857**



The preliminary list of articles was enhanced with publications that were known to the researcher, and duplicates were removed. The remaining list of articles was screened for relevance, and articles unrelated to the topic were removed. These included articles related to environmental sustainability or sustainable development in general, or articles that did not address the sustainability of interventions.

A full text review of articles was then undertaken, during which articles were again assessed for eligibility. Unrelated articles or articles of poor quality were removed. The process is summarised according to the PRISMA methodology:

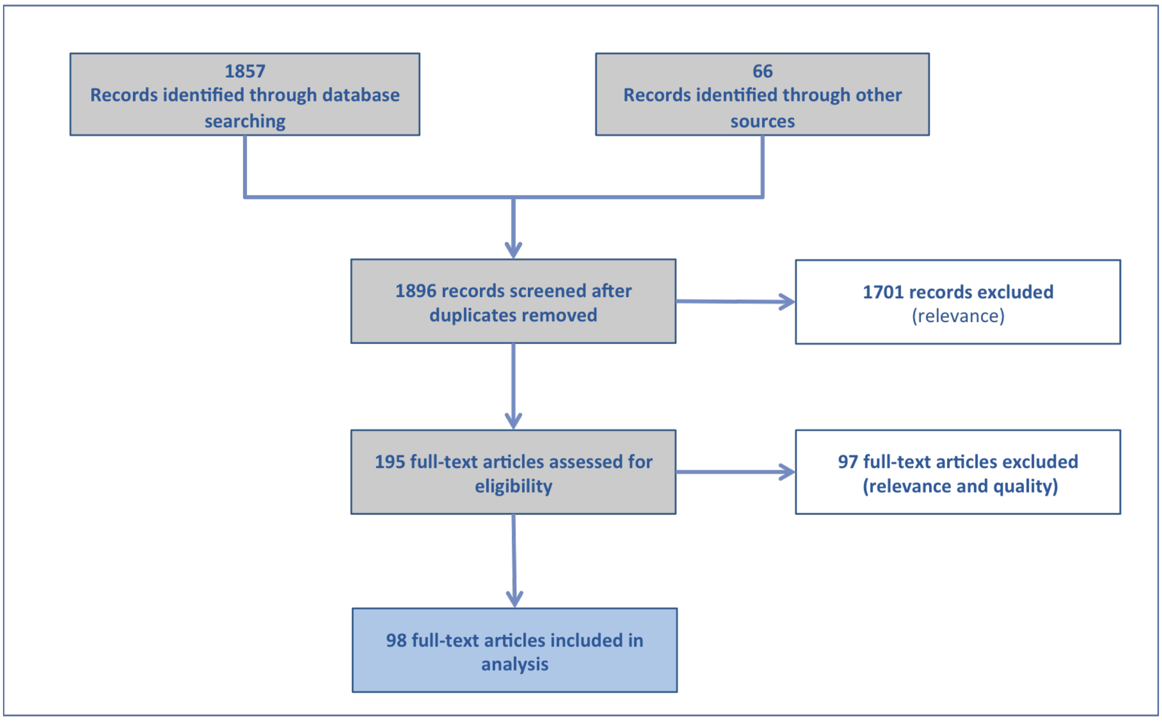
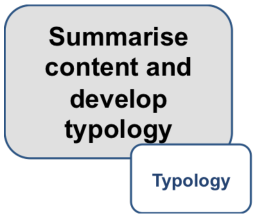


Figure 3.3 PRISMA diagram of systematic review: sustainability and sustained benefit

The selection of articles according to the H-index and citation index from Harzing's constituted a quality assessment. This assessment, as well as review of full-text articles for relevance, was to some extent subject to the researcher's bias.

3.4.3. Overview of search results



As noted earlier, the research question in Section 3.2 in essence asks for an understanding of 'what sustainability is about', as portrayed in the literature. To this end, this survey investigated the way in which articles dealt with the following two aspects: the definition and interpretation of sustainability and sustained benefit, as well as the application or use of the concept of sustainability and sustained benefit. The following were explored:

- Is a definition of sustainability or sustained benefit made explicit?
- How is the sustainability concept interpreted?
- To what end is the sustainability concept used?

In addition to understanding these conceptual aspects, descriptive data were collected to describe the nature of the articles, the field of application, and the geographic area where the work took place. These results are summarised in Section 3.4.3.1.

3.4.3.1. Descriptive review of articles

The focus areas of the full-text articles are summarised below:

Geography

- The majority of articles that mention sustainability are related to work in Africa (42%) or Asia (34%).

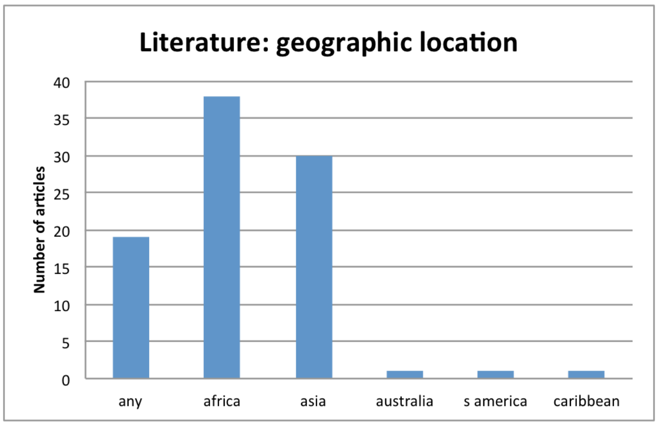


Figure 3.4 Literature by geographic location

Date of publication

- The majority of publications are dated between 2010 and 2015.

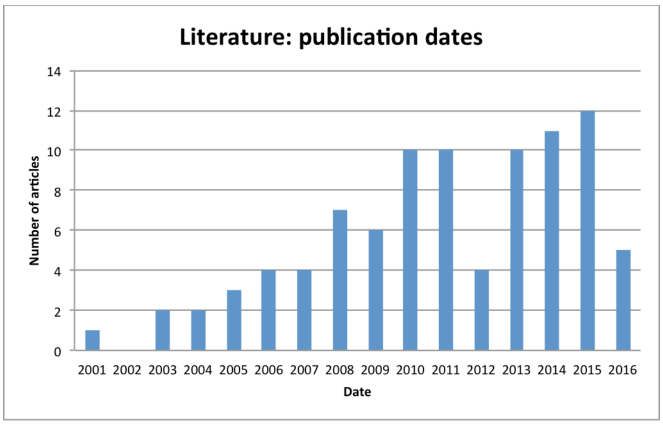


Figure 3.5 Literature by date of publication

Field of application

- Telecentres, ICT hubs, or information kiosks are the main focus areas of articles that mention sustainability.
- This is followed by articles focusing on education, and health, e-governance, and agriculture.
- Work related to minor focus areas such as e-services and microfinance is not shown.

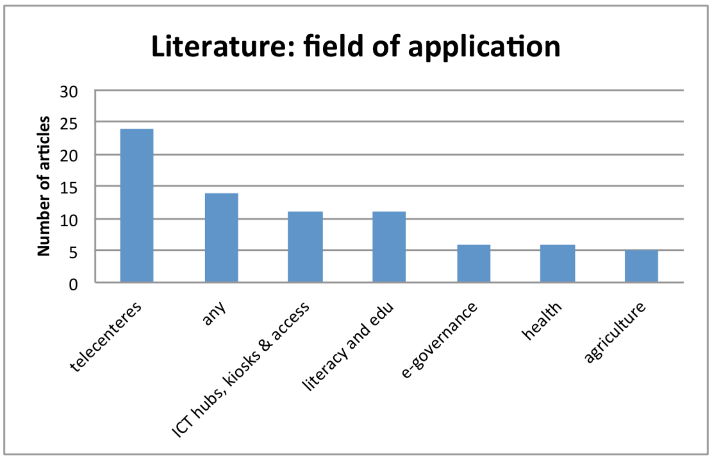


Figure 3.6 Literature by field of application

Type of article

- The majority of the work develops or applies a framework for ICT4D projects that includes sustainability in some form.
- This is followed by articles that include a reflection on ICT4D, (including sustainability), and articles that describe cases.

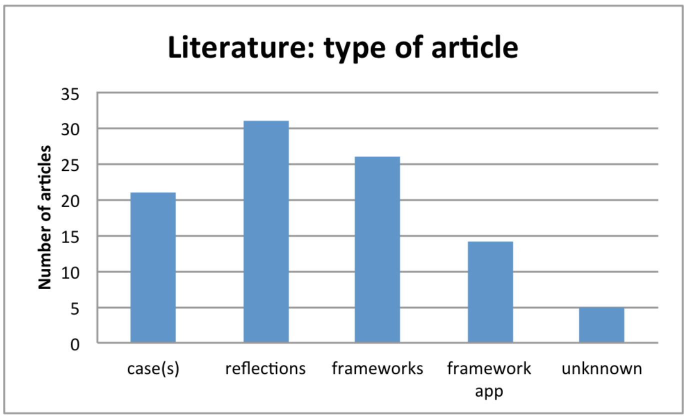


Figure 3.7 Literature by type of article

Definition or interpretation of sustainability

- The majority of articles either define (25%) or discuss (29%) the concept of sustainability.
- However, a large proportion of articles (33%) refer to sustainability without providing an explicit definition or interpretation.

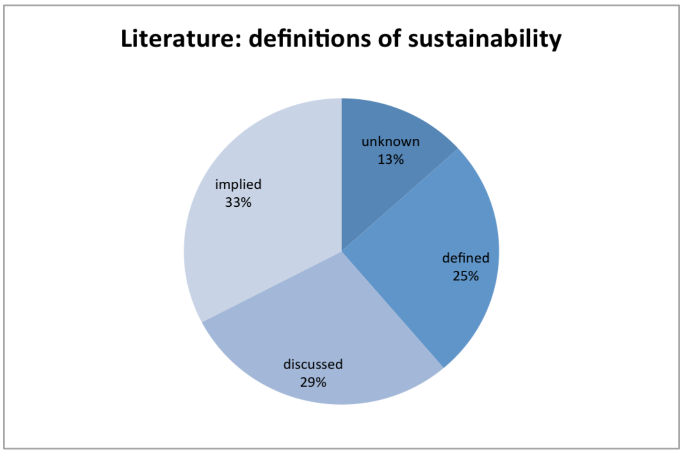


Figure 3.8 Literature by extent to which sustainability is defined

Summary per field of study

Table 3.5 Summary of literature per field of study

Field of Study	Geography (% per area)					Type of Article (% per type)				Definition / interpretation of sustainability given (% per type)		
	Africa	Asia	S Am	Car	Any	Case	Refl	Fr	Fr App	Def	Disc	Impl
Telecentres	24	66	0	0	10	45	24	24	6	29	25	33
ICT Hubs, kiosks & access	50	42	0	0	8	66	8	25	0	40	40	20
Literacy and education	73	9	9	0	9	40	20	20	20	30	30	40
E-governance	57	29	0	0	14	16	16	32	32	43	28	28
Health	71	28	0	0	0	67	16	16	0	33	0	67
Agriculture	60	40	0	0	0	40	20	40	0	10	40	50
Any	7	7	0	0	86	0	67	27	6	14	56	28

Key: S. Am – South America; Ind – India; Car – Caribbean; Refl – reflection; Fr – framework; Fr App – Framework application; Def – defined; Disc – discussed or interpreted; Impl - implied

Note that the extent to which sustainability is addressed is not reflected in this analysis of articles. In the majority of cases, sustainability does not form the major focus area of the article, even though it may be made explicit in the title or abstract.

3.4.3.2. Definitions and interpretations of sustainability and sustained benefit

An exploration of the various definitions or interpretations of sustainability emphasizes a broad spectrum of views, and hence the need for contextualisation. Of the reviewed articles, approximately 54% either defined or discussed interpreted a definition or interpretation of sustainability. These definitions or interpretations were analysed, and themes were extracted. The latter were categorised according to the essence of what was addressed.

Table 3.6 summarises these definitions or interpretations into seven different themes.

Table 3.6 Definitions of sustainability: themes from literature review

How is the concept defined or interpreted?	For example (summarised or quoted from the relevant text)	Defined or quoted by
A. Sustainability is defined by what is sustained		
Sustain the intervention or project	The ability of a project or intervention to continue in existence after the implementing agency has departed; self-sustaining without ongoing outside support (Bailey & Ngwenyama, 2013)	Bailey and Ngwenyama, 2013 Harris et al., 2003
	Sustainability within this context does not refer to the economic concept of sustainable advantage of ICT interventions, but a scenario where an intervention has matured to a point where it has gained enough economic footing and social momentum to survive without large investments from non-local benefactors. An intervention is sustainable if it can continue to grow using only local resources and management. (Breytenbach et al., 2013)	Breytenbach et al., 2013
	It has also come to have an associated meaning (and sub-discipline, 'sustainability science'; Mollinga, 2010) that focuses on the nature of communication and relationships surrounding development and the way in which development can be self-sustaining without ongoing external inputs (Barjis et al., 2013)	Barjis et al., 2013
	Operate successfully within the community without relying on outside support (Pade-Khene, et al. 2011)	Pade-Khene at al., 2011
	The term 'sustainability' is used here primarily in the sense that a particular intervention would continue in operation beyond the period of initial project funding. (Geldof et al., 2011)	Geldof et al., 2011
	In the field of ICT4D, the term 'sustainable' refers to initiatives that are able to transition to models that can be supported by local and domestic resources. (Howard, 2008)	Howard, 2008
	Sustainability for a project or an organisation means being able to maintain or prolong the services with the means available and this depends largely on the type of services provided, income generation, and future plans. (Jacobs & Herselman, 2005)	Jacobs and Herselman, 2005
	No further intervention is required by the donor agency or agencies to keep the system or project running (Joubert, 2008)	Madon et al., 2007
	Sustainable IT interventions are those that can pay their own way, generally without reliance on government funding (Lennie et al., 2005).	Ziotnikova, 2011
Sustain the benefits	Sustainability is concerned with measuring whether the benefits of an activity are likely to continue after donor funding has been withdrawn.	Chianca, 2008
	Ensuring that the institutions supported through projects and the benefits realised are maintained and continue after the end of the project	IFAD, 2006 Kisan et al., 2013 Weide, 2015 Zlotnikova and Van der Weide, 2015
	The continued flow of benefit streams after the end of the project funding.	Mahonge, 2015 Russel et al., 1995
	Sustainability is concerned with the likelihood that the benefits from an intervention will be maintained at an appropriate level for a reasonably long period of time after the withdrawal of donor support.	Batchelor and Norrish, 2005 DANIDA, 2006

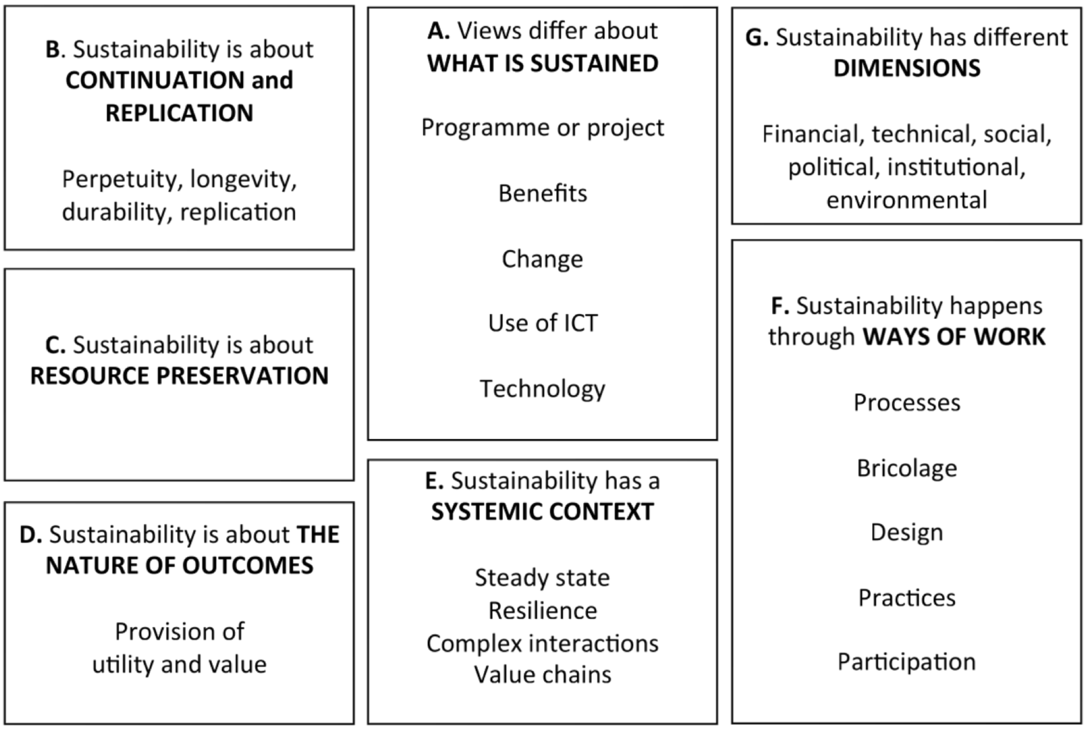
	Sustainable projects are perceived as providing substantial benefit with minimal disruption of social structures	Avgerou, 2009 Breytenbach et al., 2013
Sustain change	Sustainability refers to how to maintain these changes over time and under what conditions	Batchelor and Norrish, 2005 Rodriguez et al., 2012
Sustain the use of ICT	True sustainability is a function of both longevity and use.	Pouezevara et al., 2014
	Uptake: assessment typically measures the extent to which the project's ICT deliverables are being used by its target population. Broader assessment could look at the sustainability of this use over time, and at the potential or actuality of scaling-up.	Heeks, 2008 Heeks and Molla, 2009
Sustain the technology	The broad definition of sustainability has been reinterpreted in the domain of information systems to address challenges in the design and implementation of sustainable IT solutions [6-9]. …sustainable IT is a technology that is capable of being maintained over a long span of time independent of shifts in both hardware and software.	Misgund and Hoiberg, 2003 Nawi et al., 2013
B. Sustainability is about continuation, replication or scale		
Durability, perpetuity, longevity	A set of durable activities and resources aimed at programme-related objectives.	Nawi, 2013 Sheirer, 1993
	Simply put, sustainability refers to an ICT4D intervention's ability to work in practice, over time, in a given setting	Sanner, 2014
	Support, maintenance, to keep something in perpetuation, to avoid failure, to keep alive or regenerate	Ali and Bailur, 2007 Fowler, 2000 Reynolds and Stinson, 1993
	Many ICT4D projects failed at an early stage and prompted a new emphasis on ensuring the longevity of ICT4D projects.	Gardstedt et al., 2013 Heeks, 2008
Replication	Sustainability considers whether or not the technology is being put to use to support rural activities that benefit the rural population in a particular area such that the project may be replicated and maintained to influence other areas associated with rural development (International Development Research Centre (IDRC): 2005)	IDRC, 2005 Kene, 2006
C. Sustainability is about resource preservation		
Sustainable development	'Sustainable development' was initially defined as development 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' WCED (1987) perceives sustainability as primarily entailing three pillars namely social, economic, and environment.	WCED, 1987:24; Various
	Sustainable development is achieved through self-reliant human scale development which flows from the individual level to the local, regional and national levels, and which is horizontally interdependent and vertically complementary.	O' Donovan & Roode, 2002
D. Sustainability is inherent in the nature of outcomes		
Utility	ICT programmes which demonstrably and explicitly contribute to community well-being aspirations through the contribution they make to capabilities are being sustained by communities whilst other programmes, which do not make this connection but merely provide a generic resource such as access, are falling	Blake and Garzon, 2012 Kisan et al., 2013 Unwin, 2009 Vaughan, 2011
	If people's needs are met in an appropriate, cost-effective way, then the ICT4D initiative will be sustainable (Unwin)	Marais, 2011
	Utility: Will the telecentre keep meeting the needs of at least some of the stakeholders?	Heeks and Molla, 2009

E. Sustainability has a systemic context		
Steady state	In general terms, however, sustainability is achieved when people inside an organisation no longer think of 'moving toward the goals' and the organisational focus shifts to other areas of competitive advantage (Berge, 2001).	Berge, 2001 Easter and Ewins, 2010
Resilient system	Resilience is the key to the sustainability of these systems. Resilience is the capacity of a system to absorb disturbance; to undergo change and still retain essentially the same function, structure, and feedbacks. A resilient social-ecological system in a desirable or preferred state (e.g. a productive agricultural region) would have a greater capacity to remain in this state even if subjected to shocks.	Marais, 2011 Walker and Salt, 2006
Complex interactions	Sustainability is the outcome of a mixture of endogenous and exogenous factors. When project sustainability is being considered the unit of analysis is always greater than the project itself and the actual scope and extent of the system that is relevant to sustainability needs to be analysed.	Marais, 2011
	A context independent statement about sustainability is the following: 'The key component of the concept of sustainability is a requirement for the sustenance, survival, or flourishing of a process, an organism, or a resource. The viewpoint here is broader than usual: the entity to be sustained often consists of a large variety of interacting factors in a complicated setting.' (Loukola & Kyllönen, 2005:2) In	Loukola and Kyllönen, 2005: 2 Pscheidt and Van der Weide, 2010
	Further, for a system to be successful, it must be sustainable after implementation. ICT4D initiatives are sustainable when the system has the necessary requirements for its 'sustenance and survival among a large variety of factors interacting in a complex environment' (Loukola & Kyllönen 2005:2). However, little is known about how system sustainability can be achieved. In this paper, we argue that to accomplish ICT4D's developmental objective, sustainable system use must become a key and explicit consideration during the project's lifecycle.	Da Silva and Fernandez, 2013 Loukola and Kyllönen,, 2005: 2
	The approach of interpreting on the basis of influencing factors or dimensions although useful, produces static and flat analyses that are limited in terms of the extent to which the dynamics of project sustainability can be analysed. Rather than viewing ICT4D projects as following a linear trajectory, the outcomes of ICT4D projects emerge over time involving the interplay of a variety of actors. In order to gain a richer understanding, the researcher propose that ICT4D project sustainability should be viewed as a process that evolves over time, involving dynamic and complex interactions among a variety of actors.	De Zoysa and Letch, 2013
F. Sustainability is about ways of work		
Process	Sustainability: this maturity area is intended as a set of goals and practices that address sustainability from the strategic planning to the phase-out of the project. Attention to sustainability is in fact considered a necessary condition for the success of the project (although not a sufficient condition) (Heeks, 2005). This area is further divided into economic, social and technical sustainability categories, which must be addressed simultaneously.	Ciaghi et al., 2014
	Sustainability: this maturity area is intended as a set of goals and practices that address sustainability from the strategic planning to the phase-out of the project. Attention to sustainability is in fact considered a necessary condition for the success of the project (although not a sufficient condition) (Heeks, 2005). This area is further divided into economic, social and technical sustainability categories, which must be addressed simultaneously.	Ciaghi et al., 2014
Bricolage: continuous resource-based, context-specific problem solving	Tinkering through the combination of resources at hand. These resources become the tools and they define in situ the heuristic to solve the problem	Ali and Bailur, 2007 Pouezevara et al., 2014 Zahra et al., 2009.

Embedded ICT design for sustainability	The idea of sustainability therefore becomes a consideration in content, structure, user roles, and even in the type or form of application designed. This hints at a need for a deep integration between the forms that ICT interventions take and the long-term political and social development aspirations and visions of the community of users (in this case including both the organisation and the famers).	Kendall, 2015
Continued practices	For the purposes of this research the term 'sustainable' is used when referring to economic and livelihood practices that are carried out for an indefinite period of time and are able to improve the livelihoods of the community in such a way that they do not jeopardise the survival of the communities (Ameyaw, 1992; Ali & Bailur, 2007). Therefore, sustainable development refers to ensuring resource conservation and improvement of the livelihoods of the community.	Ali and Bailur, 2007 Ameyaw, 1992 Manara, 2015
Associated with participation	We should look more deeply at the ideas that create the dichotomy between development founded upon participation and sustainability on the one hand, and development focused on capital and income growth on the other.	Blake and Garzon, 2012
	Carroll and Rosson (2007) define sustainability as a dynamic process in which IT professionals, designers, and researchers work with community groups in ways that give them greater control over technology in their organisation	Carroll and Rosson, 2007 Ziotnikova, 2011
G. Sustainability is defined by its dimensions		
Dimensions	*Financial* According to Harris et al. (2003:126), the concept of financial sustainability refers to 'the capacity that a telecentre has to cover its costs of operation, and/or the costs of initially establishing it'.	Harris et al., 2003 Masiero, 2011
	Financial A telecentre is financially sustainable if it is able to generate enough revenue from the local community for activities it offers.	Madon et al., 2007
	Financial Simply put, sustainability refers to an ICT4D intervention's ability to work in practice, over time, in a given setting. In simple terms, it must be a going concern where income must be at least equal to expenditure.	Sein et al., 2011
	Social Thus, we can tentatively define social sustainability of telecentres as the capacity of providing locally relevant content to prospective users, aimed at fostering local participation to the project.	Masiero, 2011
	Social Social sustainability moves us beyond the conceptualisation of sustainability that is limited to economic factors to embrace social factors that recognise the need to individual and community acceptance of a particular technological artefact (Bailey, 2009).	Bailey, 2009 Mawela, 2013

The key concepts that describe the themes in Table 3.6 can be summarised as follows:

Figure 3.9 Definitions of sustainability: typology of themes from literature review



It is evident that a wide variety of interpretations are associated with sustainability. While many authors initiate their discussion on sustainability (if any) with the *resource preservation* definition of the 1987 Brundtland report (WCED, 1987), authors in general adopt or imply a definition or interpretation within one of the categories of Figure 3.9. A definition or interpretation is often adopted without specific reference to its appropriateness relative to the application at hand.

3.4.3.3. Interpretations of the concept of sustainability

In addition to categorising definitions and interpretations, the full-text articles were also read to understand the way in which the concept of sustainability is used (see Appendix A for the final list of articles). The purpose was to assess the current state of use of the concept, and identify aspects to be addressed by the decision framework. A high-level concept of sustainability was associated with each article, as well as more detailed sub-concepts, where appropriate. The concepts were listed, and related concepts were grouped into themes, based on on the similarity of concepts; themes were named in a manner that described perspectives on sustainability. This open coding method is based on the principles of grounded theory (Strauss & Corbin, 1988), in which data is explored in a systematic manner to develop a theory thereof (Strauss & Corbin, 1988), or to explore concepts and develop themes (Lai and To, 2015).

The resulting typology of themes is illustrated in Figure 3.10 below.

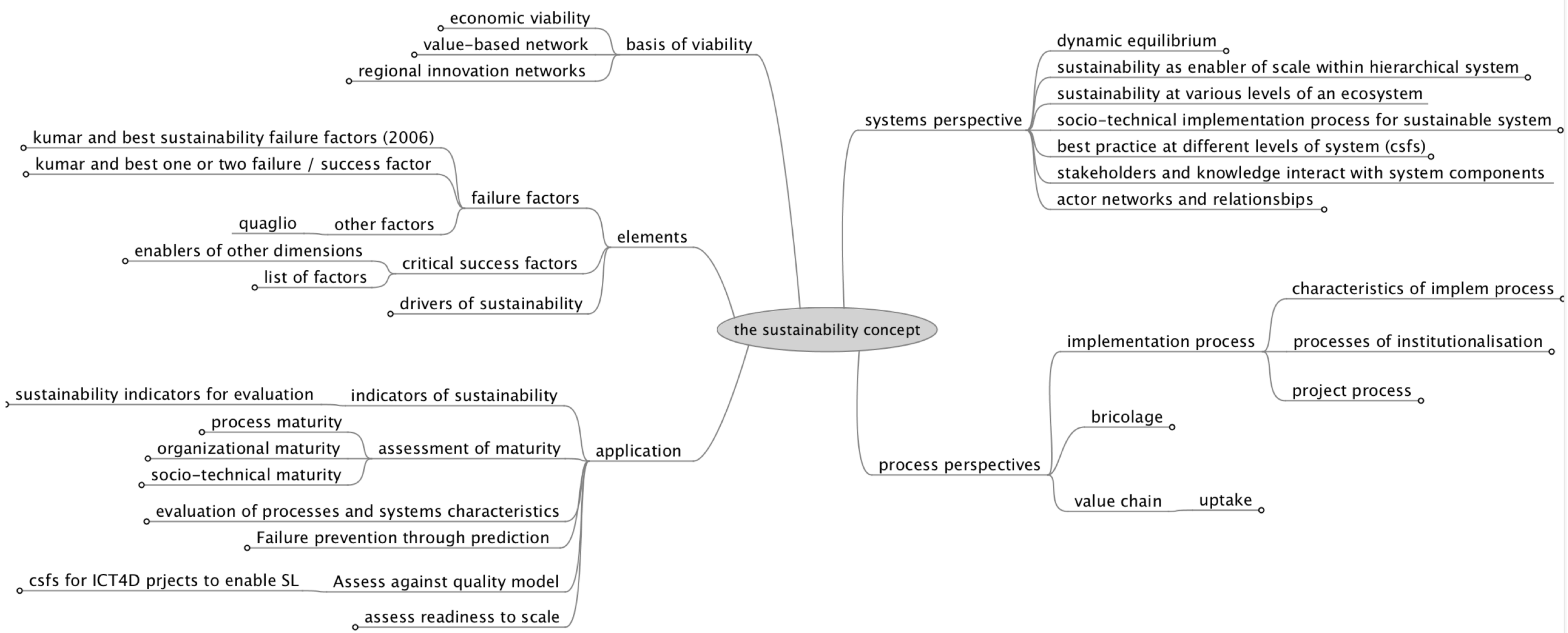


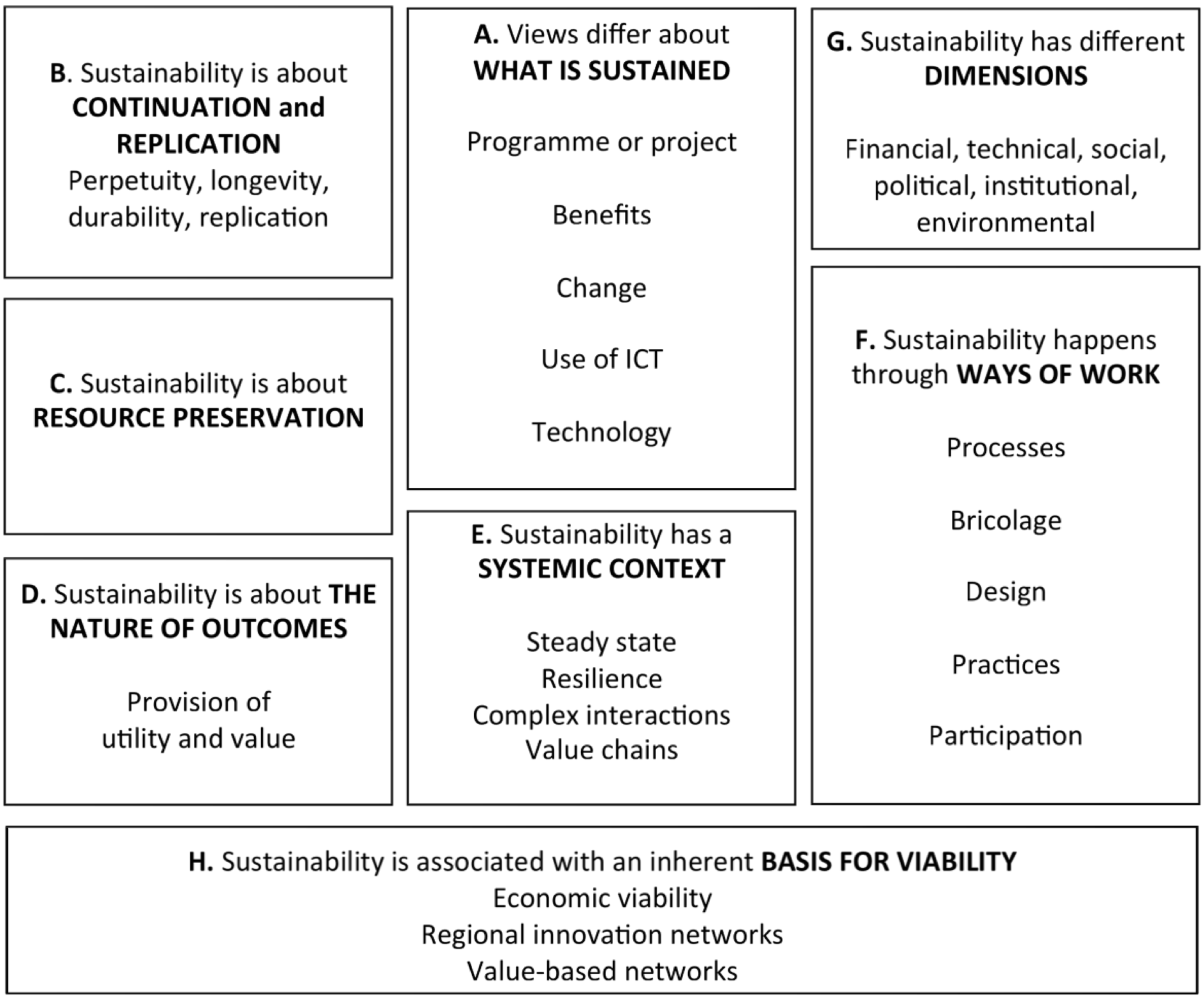
Figure 3.10 Concepts of sustainability: typology of themes from literature review

This typology of themes introduces some new perspectives on the application of the concept of sustainability, to enhance those elicited by the analysis of the definitions or interpretation of sustainability in Section 3.4.3.2.

Perspectives pertaining to the dynamic constructs of ***processes*** (captured in *ways of work*) and ***systems*** are repeated from the previous analysis, as are the concepts related to ***dimensions of sustainability*** such as failure and success factors. However, some additions were made. The concept of the ***basis of viability*** was added, where authors reflect on inherent aspects that lead to sustainability, such as factors that ensure economic viability, development of networks that contain elements of value that will sustain an intervention, and value-adding environments such as regional innovation networks. Further, ***application*** was introduced to reflect the practical application of sustainability concepts and models. These include indicators of sustainability, application of maturity models, failure prevention, and others (see Section 3.4.4.3).

Based on these additions, the typology of themes was revised as follows:

Figure 3.11 Interpretations of sustainability: typology of themes from literature review



In this typology, the ***basis for viability*** has been added as a separate concept, and the ***systemic context*** has been enhanced by the addition of the concept of *value chains.*

The elements (A–H) of this revised typology of themes are discussed in Section 3.4.4.

3.4.4. Interpretation

3.4.4.1. Positioning sustainability in ICT4D

While the literature on sustainability addresses various perspectives (see Section 3.4.3), authors are not always clear as to where their interpretation of sustainability fits in the broader context of ICT4D interventions and socio-economic development. As highlighted earlier, the concept has become confused (Nayak, 2013) and difficult to apply (Heeks, 2014b).

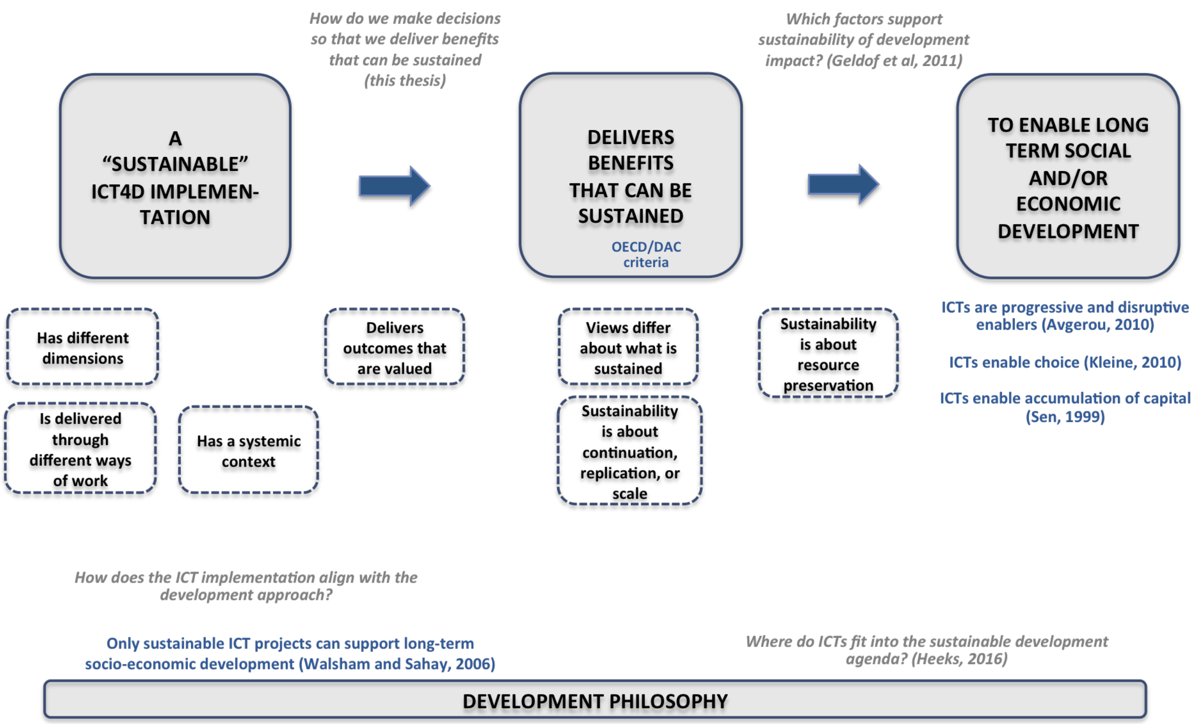


Figure 3.12 proposes an outline of the various contexts within which authors interpret and understand sustainability, based on the researcher's interpretation of the literature. It also highlights some unanswered questions and perspectives that are posed in the literature. The purpose of the outline is to position this research relative to a broader context, so as to clarify the role of the proposed decision framework (see also the discussion on 'Related concepts' in Section 3.2.2). Figure 3.12 Where does sustainable ICT4D fit in?

Authors implicitly discuss their work on sustainability in ICT4D in the context of one or more of the perspectives outlined in Figure 3.12. These are: the sustainability of the ICT4D implementation (i.e., a project-level perspective), the benefits or outcomes that are sustained (i.e., a community perspective), and the long-term development impact.

A 'sustainable' ICT4D implementation

The majority of authors base their discussion on one or more projects or implementations, and the majority of the identified themes are associated with the project or implementation itself. These include the views that sustainability has different dimensions (e.g., Kumar & Best, 2006); that sustainability is inherent in the ways in which the work pertaining to the intervention is conducted (e.g., Pade et al., 2006); that sustainability has a systemic context (e.g., Loukola & Kyllönen, 2005); and that sustainability is rooted in the outcomes of the intervention (Unwin, 2009).

Delivers benefits that can be sustained

While there is no agreement in literature about what needs to be sustained (intervention, change, technology, access, etc.; see Table 3.6), 'something' is delivered by each implementation. This 'something' can be interpreted as the link between the ICT4D implementation and the broader (systemic) development impact, and the sustainability debate to some extent revolves around what needs to be sustained. For the purposes of this research, 'something' is defined as benefits (Chianca, 2008).

Many of these benefits are directly associated with the delivery of access to technology. Examples include telecentres, in which financial viability is seen as a means of sustaining ongoing operations and access to ICT infrastructure (Kumar & Best, 2006). In education, benefits that need to be sustained include ongoing access to educational resources (Casany et al., 2012; Easter & Ewins, 2010), resulting in changed teaching and/or learning practices and increased learner results (Rodriguez et al., 2012) and, per implication, improved socio-economic development. In e-governance, ongoing provision of citizen services needs to be sustained (Kumar & Best, 2006; Naik et al., 2012).

Kleine (2010) disputes this pre-determined approach to benefits from ICTs, and argues (in line with Sen's principles of development as increased freedom of choice) that benefits should evolve from the ways in which users choose to use the technology, rather than being predetermined by funders (Kleine, 2010). The OECD formalises the focus on benefits in its evaluation framework, by defining sustainability assessment as a review of whether benefits will continue once the project funding is terminated (Chianca, 2008). Note that the OECD it is not prescriptive as to whether or not such benefits are pre-determined, that is, whether they are intended or unintended.

Turpin (2013) provides an alternative perspective, by focusing on the community rather than technology as departure point when the contribution of an intervention is considered. She proceeds to develop a model in which the community is viewed as a self-sustaining entity, and the ICT4D project is interpreted with respect to its role in enhancing the capacity of the community to sustain itself (Turpin, 2013). Finally, she suggests that the community structure should be understood and coupling be facilitated between the ICT4D intervention and the social system. This approach provides a systemic process view, rather than an outcomes view, on benefit.

To enable long term social and/or economic development

The role of ICTs has not sufficiently been clarified in the broader development context – a debate that moves beyond the immediate outcomes of ICT4D implementations or projects. Pscheidt and Van der Weide (2010:3) link interventions to development impact by stating that 'only sustainable ICT4D projects can support long-term socio-economic development'.

From a strategic perspective, ICTs are seen as progressive and disruptive enablers (Avgerou, 2009), enablers of choice (Kleine, 2010), or having a role in the development of capitals (Heeks, 2010b). In addition to enabling choice, ICTs have been seen as contributing to economic development by 'saving and making money', and by enabling 'the development of additional livelihood assets' (Heeks, 2010b:12). However, the contribution has been described as limited (Heeks, 2010b), the mechanisms of sustaining development impact are unclear (Geldof et al., 2011), and its role in the sustainable development agenda remains unanswered (Heeks, 2016). In addition, it is noted that the current conversation on sustainability in ICT4D does not engage with aligning the concept at the implementation level with a chosen development philosophy. This leaves opportunity for further refinement of operationalisation.

This thesis

In the interpretation of Figure 3.12, this research is positioned between the perspectives of the ICT4D intervention and the benefits that are generated. It intends to engage owners of interventions, regardless of their development philosophy, in thinking about sustaining the benefits (intended or unintended) of their intervention and contribute (within their own interpretation) to development. The intention is not to prescribe the nature of sustainability (e.g., what is sustained, for how long), but to place it in focus during planning and execution of the intervention. In this manner, it seeks to enhance sustainability by strengthening the process that leads to sustained outcomes, similar to the systems approach sought by Turpin (2013).

3.4.4.2. Focus areas

A temporal view on the literature provides insight into how the focus shifted around the concept of sustainability in ICT4D over time. Some references are used to highlight this shift in focus:

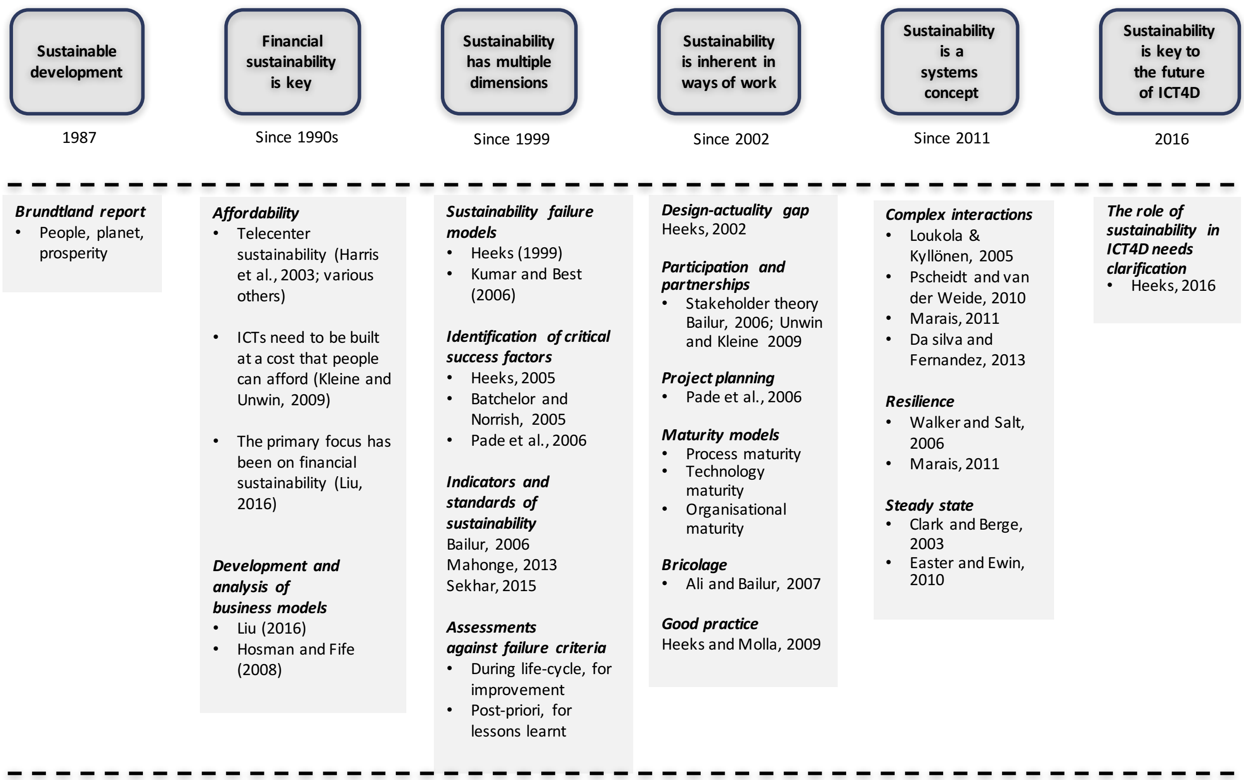


Figure 3.13 A temporal focus on key concepts in sustainability and ICT4D

Note that the references are not all encompassing. Further, a progression is not implied from one concept to another. Instead, this representation is intended to illustrate focus areas over time.

Since the Brundtland definition (WCED, 1987), which is at a conceptual and systemic level and somewhat disconnected from implementation, the focus has shifted towards financial sustainability of interventions (e.g., telecentres), through the realisation that the concept has dimensions other than the financial. A subsequent focus was on operationalisation by seeking ways of work that will ensure sustainability, for example through maturity models (Breytenbach et al., 2013; Ciaghi et al., 2014), project planning processes (Pade et al., 2006), a focus on partnerships, and good practice models (Heeks & Molla, 2009). Another focus was on sustainability as a systems concept (e.g., Loukola & Kynnolen, 2005; Marais, 2011), and the accompanying complexities. Most of the systems-related work is at a concept level, and operationalisation thereof is limited.

As highlighted before, the role of sustainability in sustainable development is still considered to be unclear (Heeks, 2016).

3.4.4.3. How is the concept of sustainability used?

Ways in which the concept of sustainability has been applied can be identified from the reviewed literature (see 'application' and 'implementation process' in Figure 3.10).
These applications have been categorised according to their role in the deployment of ICT4D interventions, as outlined in Figure 3.14.

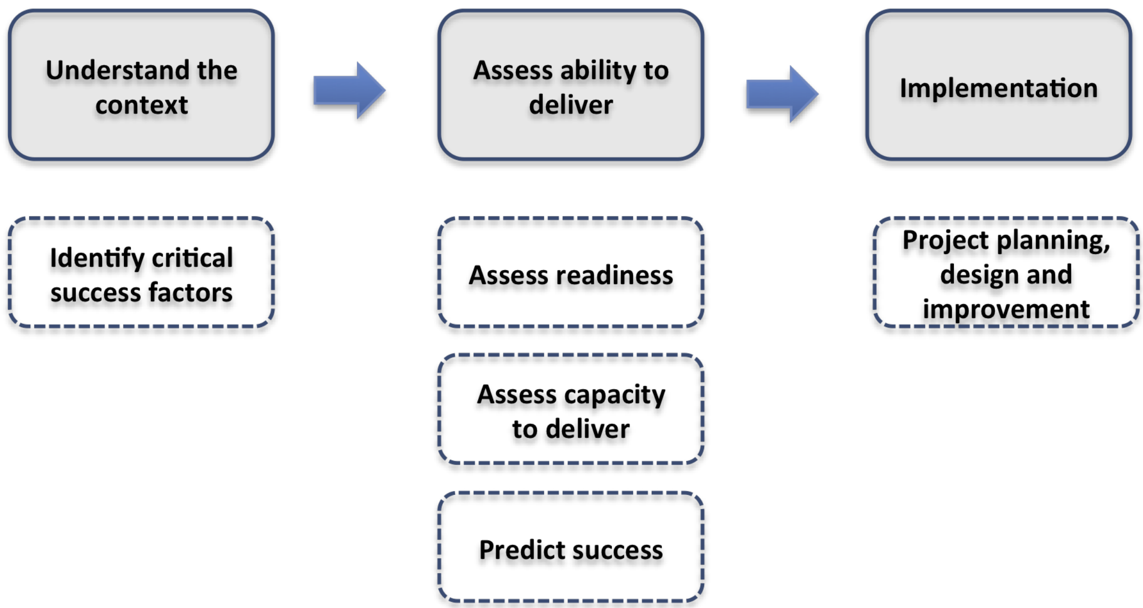


Figure 3.14 Applications towards operationalisation of ICT4D

Applications include significant work to identify critical success factors. Some work has been done to assess readiness and capacity to deliver, and to predict future sustainability, while other applications have focused on planning, designing, and implementing projects with a view of enabling sustainability. The themes and relevant literature are categorised in Table 3.7.

Table 3.7 Applications towards operationalisation of sustainability in ICT4D

	Type of application	For example	Reference
Critical success factors	**Post-hoc assessment**	Assess sustainability of implementation based on indicators (after the fact)	Sekhar, 2015
		Research to determine critical success and failure factors	Kumar and Best, 2006 Numerous others
Readi-ness	**Readiness assessment**	Assess readiness to scale m-health implementations	Leon & Schneider, 2012
Assessment of capacity to deliver	**Assessment of maturity in delivering sustainable interventions**	*Project maturity* Assess observed characteristics of project sustainability that indicate extent of maturity	Breytenbach et al., 2013
		Technical maturity Gauge the technical maturity of a project and advise how to improve this, to enhance overall sustainability	Joubert, 2008
		Organisational maturity Assess and improve organisational processes toward delivery of sustainable ICT4D projects	Ciaghi et al., 2014
Prediction of success	**Prediction of future sustainability**	Predict future sustainability so as to prevent failures (case-based reasoning to predict design-reality gap)	Ayoung et al., 2015
	Monitoring and evaluation of ICT4D pilots	Framework to assess ICT pilot projects, to judge to potential outcome of mainstreaming the pilot project	Batchelor and Norrish 2005
Project planning, design and improvement	**Quality model**	Quality model based on incorporation of factors that promote youth's sustainable livelihoods, to inform project design	Zaremohzzabieh et al., 2014
	Process models to ensure planning of sustainable implementations	Key principles of sustainability to incorporate in collaborative IS development in ICT4D	Pscheidt and van der Weide, 2010
		Processes of institutionalisation that will enable sustainability of ICT4D projects, for evaluation	Madon et al., 2007
		Process for sustainable adoption of technology-enhanced learning environments	Rodriguez et al., 2012
		ICT4D process approach framework for designing, managing, and maintaining success in ICT4D initiatives	Walton and Heeks, 2011
		Process that enables participation throughout planning, implementation, and evaluation	Blake and Garzon, 2012
	Project planning and assessment	Project planning models based on dimensions of sustainability	Pade et al., 2006; Pade-Khene, Mallison, Sewry, 2011

Numerous frameworks or models are concerned with identifying the critical factors that affect sustainability of an implementation, or to assess an intervention against predetermined dimensions of sustainability. While these post-hoc assessment models are useful for identifying future factors to consider in a specific context, they do not play a pro-active role in enabling project design and planning, and thus in directly facilitating future sustainability. Models that focus on this aspect include readiness assessment and maturity models, predictive models, and models used for project planning and design. Each of the models or processes in Table 3.7 takes its own perspective on sustainability, such as embeddedness (Breytenbach et al., 2013), participation (Blake & Garzon, 2012), multi-dimensionality (Pade et al., 2006), and/or on the relationship between sustainability and the implementation process (Madon, 2007; Rodriguez et al., 2012). Some models are application specific (e.g., Leon & Schneider, 2012), while others are application independent but based on the fact that an IS system is deployed (Joubert, 2008). While some models are explicit about the underlying development philosophy (Zaremohzzabieh et al., 2014), this aspect is not always explicitly addressed.

3.4.4.4. Summary: concepts of sustainability

In the previous section, the perspectives that are used in literature in relation to sustainability in ICT4D were identified, based on the definitions and interpretations by authors of the concept of sustainability (see Figure 3.11 for the combined perspectives). Sustainability was then positioned in the broader context of development impact (Section 3.4.4.1), different focus areas were identified (Section 3.4.4.2), and the extent to which the concept has been operationalised was outlined (Section 3.4.4.3).

This section summarises the perspectives on sustainability, as identified from literature (see Figure 3.11).

A. What is sustained?

The key tension in answering this question is whether the intervention in itself, or the benefits that it delivers, should be sustained. The majority of authors implicitly or explicitly refer to the ability of the project or intervention to be sustained without outside resources. This is captured in the often-referenced definition of Harris et al. (2003:2) of sustainability as ‘the ability of a project or intervention to continue in existence after the implementing agency has departed.’ The evaluation questions of agencies such as the

OECD and DANIDA place the focus on continuation of benefits (Batchelor & Norrish, 2005), while a much lesser focus is on sustaining change. Sustaining technology, access to technology, or use thereof is another prominent theme. The underlying aspect to resolve is one of the ability of implementers to develop models or strategies that enable the transfer of initiatives to communities for support by local resources (Howard, 2008).

B. Continuation or replication

The concept of continuation is implicit in discussions of sustainability (Heeks, 2008; Sanner & Saebo, 2014), while some authors make the link between sustainability and replication (Hosman, 2011; IDRC, 2005; Kisan et al., 2013) – thus implying that replication is a prerequisite for sustainability. Some of the questions that are not addressed in these debates are:

- For how long are benefits intended to continue in a given setting?
- Which benefits should continue (intended or unintended)?
- Should all benefits continue for the same duration of time?
- Should small-scale interventions always inherently be considered unsustainable (i.e., is scale a prerequisite for sustainability)?

In terms of the latter question, Coburn (2003) argues that sustainability is merely one of the dimensions of scale, rather than the other way round.

C. Mechanisms of work

This perspective adds a dynamic context to the static assessments that are associated with studies that examine the dimensions and characteristics of sustainability. Ali and Bailur (2007) argue that the concept of sustainability is inherently problematic and unattainable, in terms of continuation as well as in terms of the possibility of operationalisation thereof. They propose the alternative of bricolage, which implies a process of using the resources at hand to resolve problems (Ali & Bailur, 2007). This brings a local focus as well as the possibility to work within resource constraints.

Other authors consider processes of implementation, continued practices, participation, and technology design as a means of securing sustainability (see Table 3.6). These views are in line with that of Larsson and Gronlund (2014), who calls for operationalisation of sustainability to be based on a 'definition of sustainability as dynamic and context dependent, hence giving it a process focus' (Larsson & Gronlund, 2014:146).

A number of authors consider the pro-activeness and long-term focus that is required, and hence call for explicit up-front planning for sustainability (De Zoysa & Letch, 2013; Geldof et al., 2011; Kleine & Unwin, 2009; Nayak, 2013). In addition, a view is held that the application of standard project management processes is not sufficient, given the peculiarities associated with development projects (Ciaghi, 2014).

The benefit of these views is that they shift the focus towards a dynamic and pro-active perspective, which implies pathways towards a desired state, and (in the case of bricolage) the possibility of continuous correction, adjustment, and adaptability to a dynamic environment (Pade et al., 2006; Pouezevara et al., 2014; Walton & Heeks, 2011). In addition, a number of these process-based concepts have been translated into models or frameworks that are operationally applied (see Table 3.7).

D. Outcomes

Unwin (2009) argues that interventions that deliver value (by meeting the needs of communities) are inherently sustainable, provided that they are undertaken in a cost-effective manner (Unwin, 2009). This view of utility and meeting needs (as insurance for sustainability) is echoed by other authors (Blake & Garzon (2012); Heeks & Molla, 2009; Vaughan, 2011). However, meeting needs in isolation and for a short period of time, due to a lack of other considerations of sustainability (e.g., political support), would invalidate this definition; this emphasizes the need for a multi-dimensional view on sustainability.

E. Resource preservation

The Brundtland definition (WCED, 1987) is in essence one of resource preservation, defining growth as sustainable if it happens in such a manner that resources are not depleted, with an immediate as well as a long-term view. This is another dynamic concept, focusing on interconnectedness between systems elements, as well as the dynamic temporal aspect of the concept. However, this element is rarely translated to an operational concept that is embraced at the project level.

F. Systemic context

These views add another level of complexity to the debate, and argue that sustainability cannot be ignorant of the larger context and interactions within which it is contextualised

(Da Silva & Fernandez, 2013; Loukola & Kyllönen, 2005; Marais, 2011). It has a role in sustainability that 'engenders multi-dimensional perspectives, the identification of feedback loops and the consideration of the consequences of actions, acknowledging the complexity of social life everywhere and the inter-relatedness of everything' (Harris et al., 2003:2).

Some authors take the perspective of a pathway towards a steady state (Berge, 2001), or 'a process which evolves over time, involving dynamic and complex interactions among a variety of actors' (De Zoysa & Letch, 2013:2).

Similar to definitions that address mechanisms of work, the systems perspective is in support of a dynamic perspective. The association of sustainability with resilience (i.e., the ability to be unaffected by external shocks) reinforces the concept of persistence within a dynamic, changing environment (Walker & Salt, 2006). As is the case with a resource preservation view of sustainability, evidence in this literature review of operationalisation of the systems concept is scarce. This view is confirmed by Turpin and Alexander (2014), who find that, for information systems in general, 'the results of the survey indicate not only a lack of the use of systems concepts in ICT4D, but also a fragmentedness in the application of systems concepts' (Turpin & Alexander, 2014:1).

G. Multi-dimensionality

Numerous authors have defined sustainability over time as a concept that can be broken down into dimensions, characteristics, critical success factors, or elements. This concept is inherent in the often-quoted Brundtland definition of sustainable development (WCED, 1987), in its definition of environmental, social, and economic elements. Heeks and Bhatnagar's Design-Actuality gap model of ICT4D failure (Heeks & Bhatnagar, 1999) defines 10 critical success factors for successful interventions (Tanner & du Toit, 2015). These are followed by Kumar and Best's well-known five-factor model of sustainability failure (Kumar & Best, 2006).

A number of other authors take similar analytic perspectives, and define sustainability in terms of critical success factors (Batchelor & Norrisch, 2005; Pade et al., 2006), categories for sustainability (Heeks, 2005), types of intervention sustainability (Zlotnikova & Van der Weide, 2015), and principles for success (Ballantyne, 2002; Unwin, 2009).

These models are useful for providing an assessment (after the fact) of how a project or initiative compares in terms of sustainability, or as a means of facilitating project planning by confirming that all critical elements are considered (Pade et al., 2006). However, criticisms against this approach include that it is static (De Zoysa & Letch, 2013) and does not allow for the dynamic elements of progress towards sustainability, as is inherent in process and systems views. Tanner & du Toit, (2015:2), following Ramirez (2011), states that ‘It is difficult to produce universally applicable sustainability indicators for ICT4D initiatives due to their varied, yet interconnected objectives and the different way stakeholders view these objectives’. Other criticisms include that assessments against multiple dimensions often do not take localisation into account, and do not account for the fact that all dimensions or factors are not equally relevant to all applications (Tanner & du Toit, 2015:2). Liu (2016) raises another important concern, namely the relative importance of the dimensions, and the equal weight given to failure factors. In Liu’s interpretation, ‘failure factors should be weighted based on the size of the effect they have on the sustainability so that remedies could be prioritised in order of importance and urgency’ (Liu, 2016:723). Along the same lines, it could be questioned whether a specific set of dimensions (such as Kumar and Best’s (2006) widely applied sustainability failure model, that was developed for telecentres) are transferrable between types of implementation (i.e., are the same dimensions relevant to e-health, education, e-governance, etc.).

Another related consideration includes that of minimum acceptable levels in the application of multi-dimensional criteria. Chianca (2008:49), in considering the five OECD/DAC criteria for international development evaluations (of which sustainability is one), states ‘In considering the five DAC criteria, impact, efficiency and sustainability criteria should have minimum acceptable levels of performance (bars) associated with them’. Given the lack of operationalisation of sustainability as a concept, this is probably an unrealistic expectation, albeit well worth considering when requiring that interventions conform to ‘tick the boxes’ on multiple dimensions of sustainability.

H. Inherent basis for viability

Some authors seek to explore sustainability in the context of some underlying inherent basis for its viability. Examples include the inherent economic viability (sustainability) of education implementations in Africa (Eastern & Ewins, 2010) and the affordability of implementations for poor people (Kleine & Unwin, 2009). Similarly, embeddedness in a value network (Bon et al., 2016) or regional innovation system (Kumar, 2011) is seen as environments that are conducive to sustainability of ICT4D interventions. In essence, these perspectives require implementers to consider the systemic question as to whether there are factors inherent in the environment of any ICT4D intervention that will enable its sustainability.

3.4.5. Implications for decision framework

As outlined in Section 3.2.1, the literature pertaining to *sustainability* (and sustained benefit, where it occurred) was reviewed with the view of defining elements of the alternative concept of *sustained benefit*. This research adopts the view of focusing on the sustainability of the *benefits* that result from an ICT4D implementation, as a link between the ICT4D intervention and socio-economic development. It takes a project- or implementation-level perspective, and seeks to provide a focus point on delivery of sustained benefit. Based on the reviewed literature, sustained benefit was positioned between the perspectives of the ICT4D intervention and the benefits that are generated (see Figure 3.12 and Section 3.4.4.1).

Specifically, the positioning of sustained benefit relative to the broader context of sustainability and sustained change was argued in Section 3.4.4.1 as follows:

A sustainable ICT4D implementation delivers benefits that can be sustained to enable long term social and/or economic development.

Based on the literature review and subsequent discussion, it is proposed that the following interpretation of sustained benefit (as alternative to sustainability) is considered when developing the decision framework:

Table 3.8 Characteristics of sustained benefit, to inform decision framework

Charac-teristic	Sustained benefit:	Reference to discussion
Com-plex	Is multi-dimensional	Section 3.4.4.4 (G)
	Is expressed in the context of a system	Section 3.4.4.4 (F)
Dynamic	Has a dynamic and/or progressive nature	Section 3.4.4.4 (C, F)
Plan and align	Is context-specific	Section 3.4.4.4 (F)
	Allows for alignment with (any) underlying development approach	Section 3.4.4.1
	Is considered up-front as part of the design of the implementation, while allowing for both intended and unintended benefits.	Section 3.4.4.1 Section 3.4.4.4 (C)
	Is considered at the outset of the implementation, in terms of: • What needs to be sustained • By whom? • For whom? • For how long? • Relative priorities of different types of benefits	Section 3.4.4.4 (C) Section 3.4.4.4 (G)
Opera-tional	Is embedded in the way of work through which the implementation is undertaken	Section 3.4.4.4 (C)

These characteristics of sustained benefit emphasize that a proposed decision framework should be able to deal with a complex and dynamic problem environment, facilitate pro-active planning, allow for alignment with the decision problem as well as the intervention approach, and inform operations. Within these characteristics, the definition of sustained benefit would be customised to specific problem environments.

The *complex* and *dynamic* characteristics outlined above represent a strong process and systems perspective. These perspectives were echoed by some authors' interpretations of benefit (see Section 3.4.4.1 and 3.4.4.4, element A), namely that benefits result from the way in which technology is used (Kleine, 2010), and the way in which technology supports the capacity of a community to be a self-sustaining entity (Turpin, 2013). Other authors argued that sustainability cannot be ignorant of the larger context and interactions within which it is contextualised (Da Silva & Fernandez, 2013; Loukola & Kyllönen, 2005; Marais, 2011) — see Section 3.4.4.4, elements F and H.

In Chapter 1, an initial definition of sustained benefit was proposed:

'Sustained benefit will result when the relationships that support sustained change in the system of participants have been enabled to the extent that benefits will continue to be generated in the long run' (Marais & Meyer, 2015:1; Section 1.3.1).

Based on the systems related characteristics outlined in Table 3.8., and the process and systems perspectives argued above, this definition is retained in this research as point of reference when developing an intervention that is focused on sustaining benefits. Customisation thereof will require that decision makers are specific in terms of the nature, extent, and duration of benefits (see Table 3.8; Chapters 6 and 9).

3.5. SUMMARY

The literature review in this chapter was aimed at identifying characteristics of the decision support framework, based on an understanding of the literature pertaining to sustainability and sustained benefit. A systematic literature review process was followed to explore this topic. Related concepts, such as resilience, were excluded from the review.

The review showed that the concept of ***sustainability*** is relatively poorly defined, as is evidenced by the multiple and diverse definitions that are encountered in literature, as well as the relatively large percentage of publications that are not clear in terms of defining the concept relative to the work that they are exploring (see Section 3.4.3).

Regardless, the concept is seen as an important element of ICT4D 2.0 (Heeks, 2009), and as essential to unlocking the future success of ICT4D projects or programmes.

Research sub-question 1 was explored in this chapter, namely:

What are the elements of sustained benefit that need to be considered, in the context of ICT4D interventions?

This question was answered by the generic principles and concepts identified by the literature review, as summarised in Table 3.8. It was further answered by the definition outlined in Section 3.4, which was adopted for reference purposes. This definition would in later chapters be customised for applicability to specific ICT4D interventions (see Table 10.14).

In the next chapter, literature pertaining to failure in ICT4D is reviewed using the same approach, with the view of similarly identifying generic concepts and principles that could inform the decision framework.

CHAPTER 4. LITERATURE REVIEW: ICT4D FAILURES

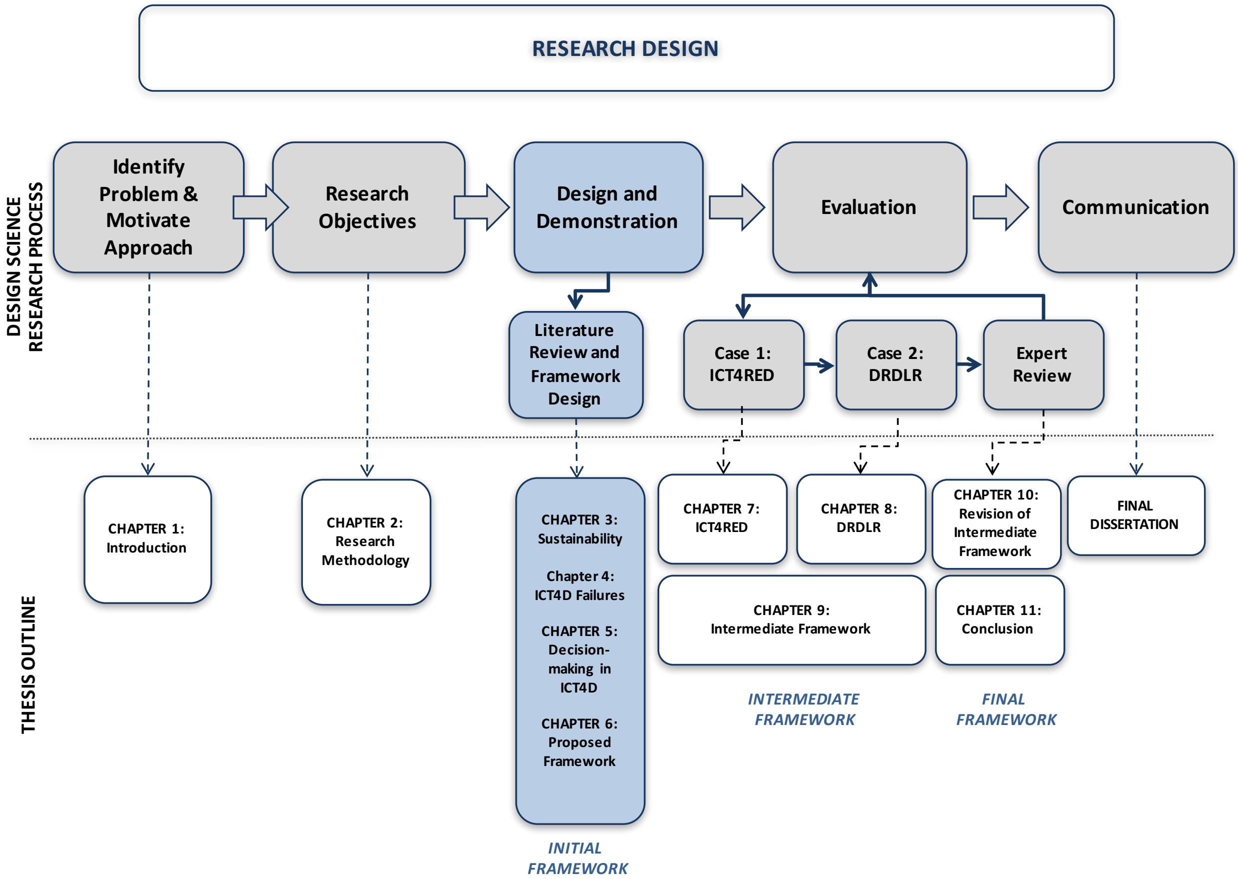


Figure 4.1 Research process and thesis outline: Chapter 4

4.1. INTRODUCTION

This chapter addresses the second literature review topic that was identified in Chapter 2, namely *failures in ICT4D.* It contributes as follows to the research, relative to the other topics under consideration (Table 2.2, repeated here for convenience):

Table 4.1 Role of literature review

Body of Knowledge	Contribution
Sustainability and sustained benefit	A usable definition of sustained benefit, extrapolated from sustainability concepts. A means of translating the definition to a practical framework in support of sustained benefit.
Failure of ICT4D Projects	Scope and characteristics of the problem that need to be addressed by a decision framework in support of design of interventions for sustained benefit.
Decision-making in ICT4D	Classification of the types of models that relate to the characteristics of decision-making in ICT4D interventions, and that would be useful in a decision framework. Definition of a construct of value creation (e.g. decision process) that could be used for contextualisation of the decision tools or models for sustained benefit.

As before, a *systematic review* is used to explore the literature, favoured for its systematic approach, and ability to identify of aspects that could add value to the conversation or gaps that need to be addressed (Grant & Booth, 2009; Okoli & Schabram, 2010; Pickering et al., 2014).

As in the previous chapter, a typology of themes is developed and the implications of the review are derived for the decision framework. The two contrasting views on the value of ICT4D interventions, namely sustainability and failure, are then integrated to derive a single set of implications for the decision framework under consideration.

This chapter provides some background on failure of ICT4D projects (Section 4.2), before applying the systematic literature review method to this topic (Section 4.3). The implications of the reviews for the decision framework are summarised in Section 4.4.

4.2. FAILURE OF ICT4D PROJECTS

The *failure* of ICT4D projects is seen by some to be rooted in the inherent nature of ICT4D project characteristics and environments (Chen, 2015; Dodson et al., 2013). Others see failure as rooted in the extent to which technology has the ability to enable human development (e.g., Nemer, 2016) and the dual role that ICT is attempting to play in developing countries – namely, ‘reducing the digital divide and achieving developmental goals’ (Musiyandaka et al. 2013:2). Similarly, success or failure of ICT in general is seen relative to how its goals are perceived: while it is successful in supporting economic development, it is failing in reducing inequalities (Unwin, 2017).

Researchers have spent significant effort in unpacking and understanding the causes of failure in various ICT4D applications (Blake et al., 2014; Edinger, A., 2017; Heffernan et al., 2016; Johnston et al., 2015; Kettani & Moulin, 2015; Wardayo & Mahmud, 2013; and others); reflecting on the nature of failure (Heeks, 2002; Osah, Pade-Kene, & Foster, 2014); and understanding the factors contributing to failure (Dodson et al., 2013). The extent of ICT4D failure is significant, as is evidenced by the very high reported rates of failure (Dodson et al., 2013; Gigler, 2015; Kettani & Moulin, 2015; and others), and the significant yet (deemed) unsuccessful investment in ICT4D interventions (Dodson et al., 2013).

An understanding of ICT4D failures is to some extent a mirror of an understanding of sustainability. The assessment of sustainability in complex systems is not trivial, and some aspects of an intervention may be sustainable while others fail. For example, an implementation agency may be able to sustain and provide ongoing access to technology (sustained access), while being unable to engage community members in ongoing use of the technology for its intended purpose. Depending on perspective, the failure and sustainability of such an implementation could be interpreted differently.

For the purpose of this work, the view is adopted that the ability to characterise failure should enable the development of strategies to avoid failure and (by implication) enhance sustainability to some extent. However, the predominant debate seems to be largely focused on identifying causes of failure in specific ICT4D applications – including criticism of the so-called ‘patterning’ approach of Heeks that fits specific theories to specific situations (Blake & Glaser, 2013). Over time, numerous studies have identified application-specific failure factors, highlighting causes such as top-down approaches (Kettani & Moulin, 2015; Shiang et al., 2016), political and social factors (Johnston et al., 2015), inappropriate technology or views on technology (Blake et al., 2014; Chen, 2015), and others.

The high failure rate of ICT4D interventions calls for new approaches to conceptualising, designing, implementing, and sustaining interventions. The work that has gone into understanding ICT4D failures and critical success factors needs to be utilised to develop improved approaches. Gregor et al. (2014:1) sees current knowledge building about the causes of failure and their resolution as 'far from cumulative'. Dodson et al. (2013:20) emphasize this point when they quote Best (2010:51) as saying 'we have collectively failed to stand on the shoulders of those who have gone before us. The problem is not the failures. The problem is our failure to learn from the failures'.

Adding value based on the understanding of ICT4D failures and its characteristics requires a general reflection on the nature of failure, and the abstraction of this understanding to develop useful models and frameworks that could aid practitioners in reducing ICT4D failures, and that could ideally inform theory. The literature review of failures in ICT4D is discussed in Section 4.3.

4.3. LITERATURE REVIEW: FAILURES IN ICT4D

4.3.1. Method

The systematic literature review method, as developed in Chapter 3, is an adaptation of the seven-step process of Okoli and Schabram (2010). It comprises the following elements (see Section 3.3):

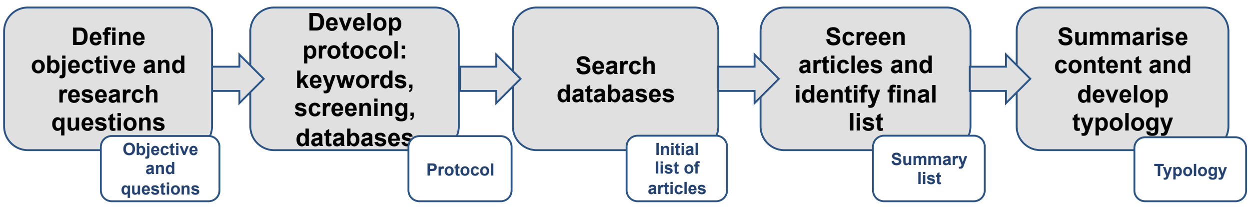


Figure 4.2 Systematic literature review methodology

This process is applied in this chapter in the review of *failures of ICT4D initiatives*.

4.3.2. Objective

The purpose of this literature review is to assess *recent* themes in ICT4D failures, and specifically to examine how the understanding of concepts of failure has been applied to develop approaches that would reduce failure.

Significant work has been done to elicit and enumerate the specific aspects that have contributed to failures in different contexts where ICTs are applied for development. Instead of repeating and reviewing this body of work, the focus of this systematic literature review is to contribute to the understanding of (see Table 4.1):

The scope and characteristics of the problem that need to be addressed by a decision framework in support of design of interventions for sustained benefit.

Given this objective, the focus is on researching how the *recent* understanding of failure in ICT4D has been used to inform improved approaches. Themes in the recent discourse around failure were identified, and the ways in which concepts of failure lead to improved approaches, were established. The following specific research sub-question was therefore addressed in the systematic literature review (see Section 1.4.3):

QN 2. How can the understanding of ICT failures be used within a decision framework to reduce the failure of ICT4D interventions?

This calls in essence for a categorisation of the ways in which authors have used their analysis of ICT failures to develop new tools and approaches to ICT4D interventions (if any).

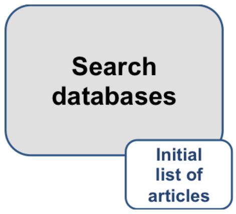
4.3.3. Application of protocol: ICT4D failures

The generic protocol outlined in Section 3.3.1 was used to review the literature of *ICT4D failures.* The search protocol is summarised in Table 4.2.

Table 4.2 Systematic literature review protocol: failures in ICT4D

Item	Description
KEYWORDS	ICT4D AND projects AND failure
DATABASES	Harzing's (based on Google Scholar), ScienceDirect, WebOfScience ICT4D journals: Information technology for development; Information Technology and International Development; EJIDSC; ICTD; Information Systems in Development; Journal of Community Informatics IFIP Working Group 9.4 conference proceedings
SCREENING	
Include	Articles, conference papers, and books in English Articles related to project and intervention sustainability Highest-ranked articles over the last three years (2013–2016).
Exclude	Articles related to environmental sustainability, or sustainability and sustainable development in general
Summary and typology development	Mark all articles based on: • geography (where was the project or intervention implemented) • field of application (agriculture, health, etc.) • type of article (refer to failure, reflect on failure, implement concepts for improvement) • nature or source of failure

A preliminary search indicated that the most relevant results are obtained by using the keywords listed in Table 4.2. Since failures in ICT4D have been reported extensively in past literature, this review aimed to locate recent additions (2013–2016) to the body of knowledge. A search approach was therefore adopted that aimed to locate high-quality papers from a broad base of literature, and to enhance these with recent publications in targeted ICT for Development journals. This initial list of journals was adopted and extended from Turpin and Alexander (2014). In addition, a broad-based search of literature was conducted using Harzing's search engine (based on Google Scholar) for identification of the top 1000 articles (ranked according to the H-index and citation number). The H-index is an author rating that selects for authors with a high output of frequently cited articles (Harzing, 2017). The process followed here therefore selected for articles within the field of interest, from authors that publish often and that are frequently cited.



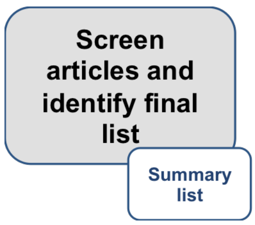
The search was limited to work done between 2013 and 2016. Only academic articles, conference papers, and book chapters written in English were included in the search.

The results of the database search are summarised in Table 4.3:

Table 4.3 Search results

why and ICT4D AND projects AND fail	Total articles identified	H-Index > 5	Total articles included
Harzing's publish or perish	1000	126	126
Information technology for development	49		49
Information technology and international development	4		4
EJIDSC	0		0
IFIP conference proceedings	1		1
ICTD conference proceedings	0		0
IS in developing countries	19		19
Journal of Community Informatics	6		6
Total	**1079**	**126**	**205**

To ensure quality, the articles obtained through the general Harzing's search were limited to those having a citation index of six or more. All articles from the targeted journals were included.



The preliminary list of articles was enhanced with publications that were known to the researcher, and duplicates were removed. The remaining list of articles was screened for relevance, and articles that were unrelated to the topic were removed. A full text review of articles was then undertaken, during which articles were again assessed for eligibility. Unrelated articles or articles that were of poor quality were removed. The latter was based on the researcher's subjective assessment.

The process is summarised according to the PRISMA methodology (see Figure 4.3).

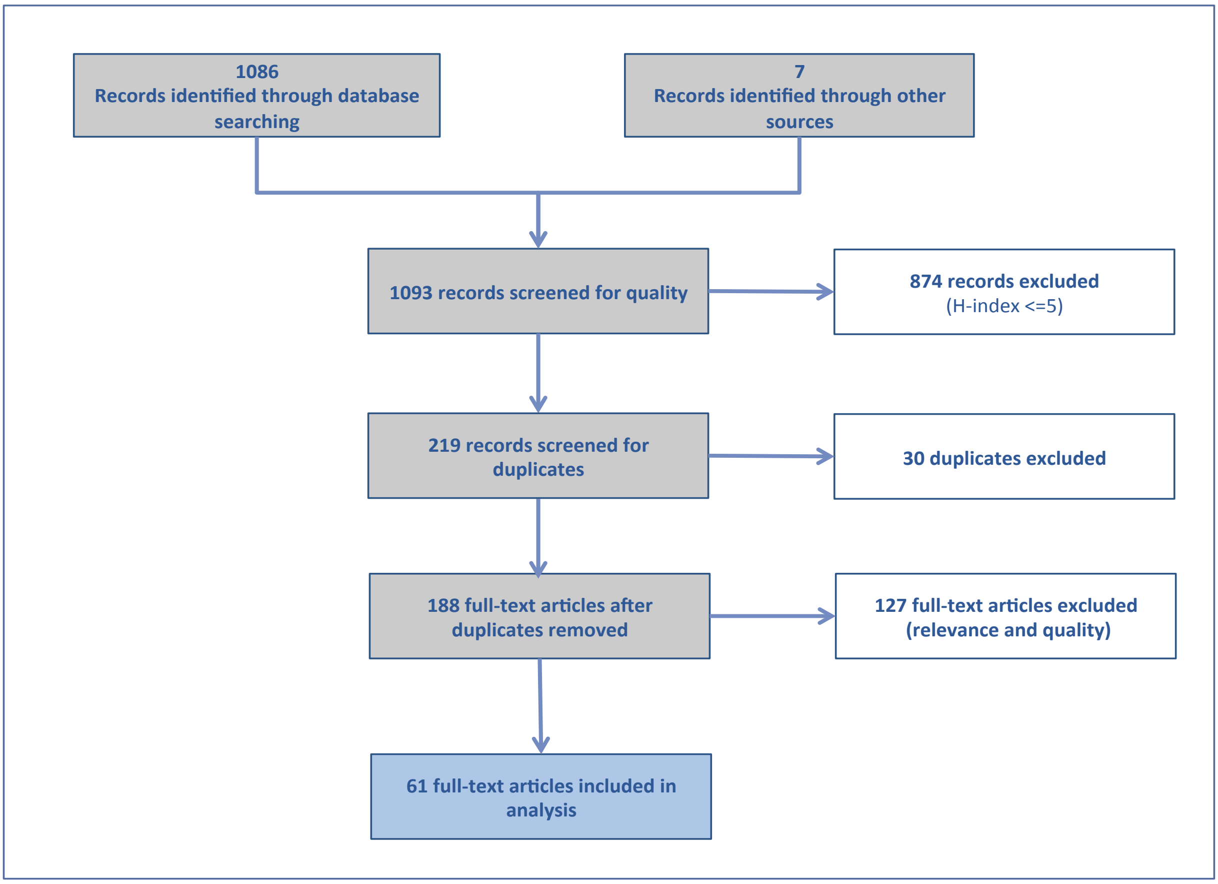
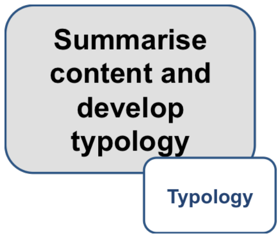


Figure 4.3 PRISMA diagram of systematic literature review: failures in ICT4D

The selection of articles according to Harzing's H-index and citation index constituted a quality assessment. Note that this assessment, as well as the review of full-text articles for relevance, was to some extent subject to the researcher's bias. Further, the assumption that the H-index is a reflection of research quality can be contested (e.g., Hönekopp and Kleber, 2008), and selection for frequently cited articles could introduce further bias that could potentially detract from the relevance of the work to the specific (geographic) area under consideration. This latter automated selection bias was to some extent balanced by the introduction of articles known to the researcher, that were specifically relevant to the area under consideration.

4.3.4. Overview of search results



As outlined in Section 4.3.2, this literature review was aimed at informing our understanding of the nature of the decision problem that is to be addressed by the decision framework. Specifically, it was aimed at determining how the understanding of ICT4D failures could be used within a decision framework to reduce failure. To this end, the literature was reviewed and categorised in order to address the following:

- *What are the key themes in ICT4D failures that are currently mentioned in literature?*
- *How is the understanding of ICT4D failures used to reduce ICT4D failures?*

As before, descriptive data were collected to describe the nature of the articles in addition to examining these questions. This includes the geographic area where the work took place, the date of publication, the field of application, and the type of article (i.e., what does it address in terms of ICT failures).

4.3.4.1. Descriptive review of articles

The focus areas of the full-text articles are summarised as follows:

Geography

- As for the review on sustainability, the majority of articles on failure in ICT4D relate to work in Africa (58%), followed by Asia (12%).
- Thirteen per cent of the work is independent of location.

Date of publication

- This search, which was restricted to work since 2013, shows that interest in the topic is retained over time.
- Note that figures for 2016 do not represent a full year.

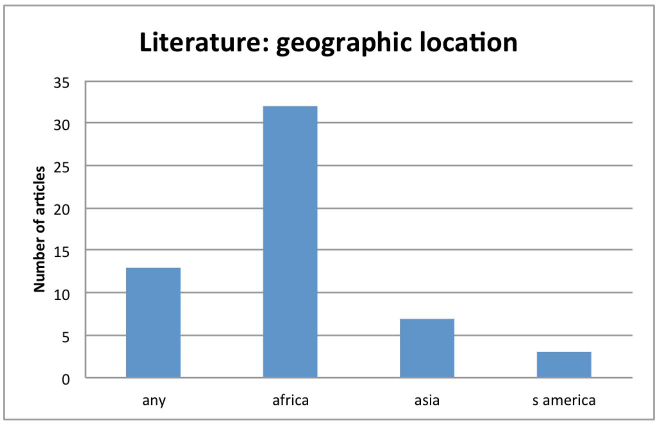


Figure 4.4 Literature by geographic location

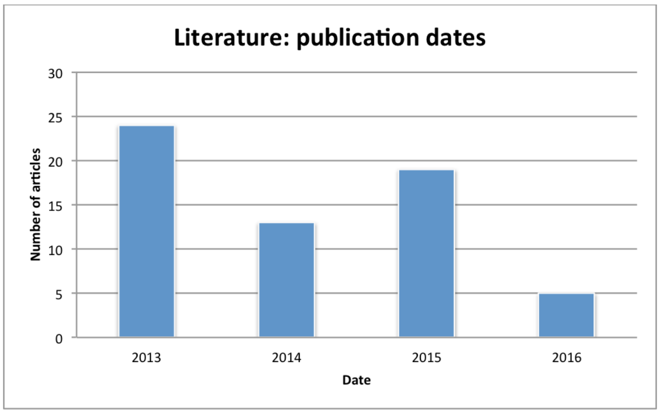


Figure 4.5 Literature by date of publication

Field of application

- As with the review on sustainability, telecentres, ICT hubs, or information kiosks are the main focus areas of articles that mention ICT failures. Work referring to any field of application is similarly prevalent.
- This is followed by articles focusing on health, e-governance, agriculture, and then sustainability.

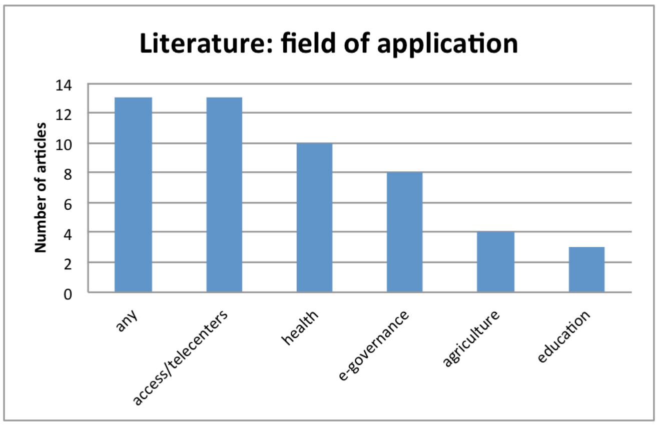


Figure 4.6 Literature by field of application

- Work related to minor focus areas such as e-services or microfinance is not shown.

Type of article

- The majority of the work apply learning for improvement or reflect on failure concepts, which seems to be a shift from the vast body of literature that earlier focused on identifying causes of failure.

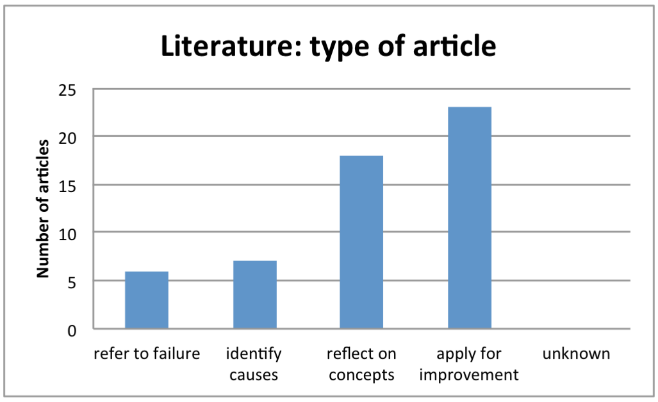


Figure 4.7 Literature by type of article

Summary per field of application

Table 4.4 Summary of literature per field of application

Field of Application	Geography (% per area)						Type of Article (% per type)					
	Afr	Asia	S Am	Unkn	Any	Total	Refer	Id	Refl	Apply	Unkn	Total
Any	17		0	0	83	**100**	8	8	50	33	0	**100**
Access / telecentres	58	25	8	0	8	**100**	8	3	8	50	8	**100**
Health	55	0	11	33	0	**100**	0	11	22	57	11	**100**
E-governance	57	29	0	0	14	**100**	42	0	42	14	0	**100**
Agriculture	100	0	0	0	0	**100**	0	25	0	75	0	**100**
Education	100	0	0	0	0	**100**	0	0	33	66	0	**100**
Other	67	22	11	0	0	**100**	11	11	55	22	0	**100**
Unknown	0	0	0	100	0	**100**	0	0	0	0	100	**100**

Key: Afr – Africa; S. Am – South America; Unkn – Unknown; Refl – reflect on concepts; Refer – refer to failure; Id – Identify causes; Apply – apply for improvement

4.3.4.2. Recent themes in failure of ICT4D

The analysis of articles in section 4.3.4.1 highlights that there is an emphasis in recent research to *reflect* on ICT4D failures, as well as to *apply* the concepts of failure to reduce ICT4D project failure. While some work is still focused on identifying the causes of failure related to specific implementations, this is not the predominant focus of the reviewed articles. This shift, seen in this sample of articles, is to some extent in line with a call to move away from work that is applicable in specific contexts, to reaching a general understanding of the underlying issues that cause ICT4D failures (Bolivar et al., 2016) and cumulative knowledge building (Gregor, 2014). The following themes were identified from the literature review.

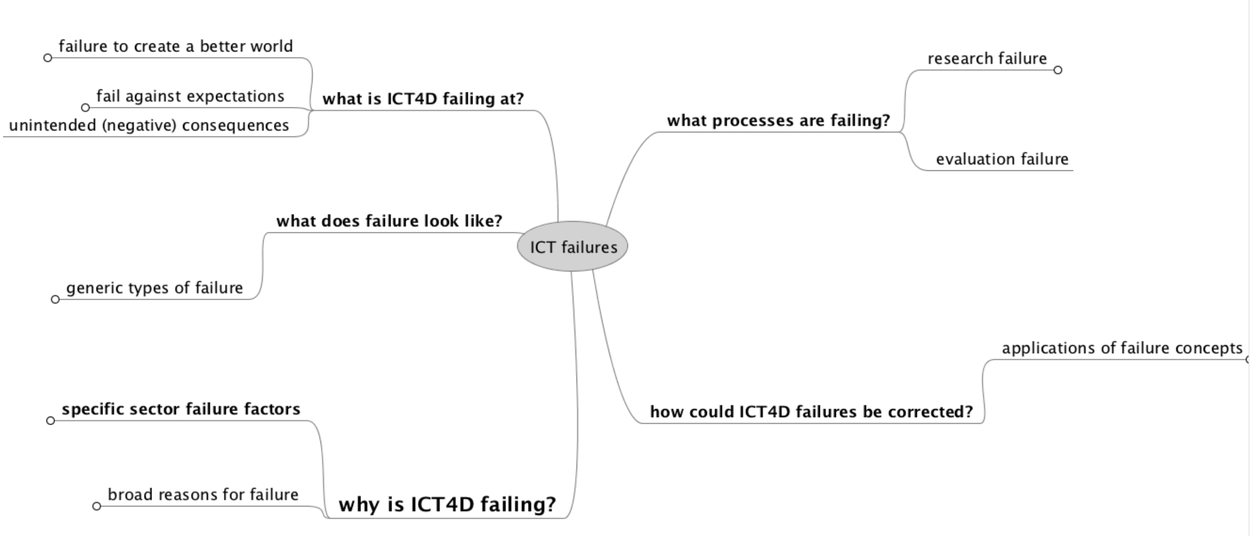


Figure 4.8 Themes in ICT4D failures

Authors reflect on failure from perspectives that range from broad, holistic interpretations to sector-specific failure factors. These themes are summarised below, highlighting some of the key lines of thought.

A. What is ICT4D failing at?

Some authors deal with failure in the broadest sense, namely that ICT4D is failing to make its expected change in the world. Sahay (2016:168) reflects on the inherent obstacles that prevent ICT4D from 'creating a better world'. This view begs reflection on the appropriate role of ICTs in development (Clarke et al., 2013). This question is to some extent addressed by authors who reflect on the expectations against which failure takes place: what are the expectations, and are they realistic? (Gigler, 2015).

B. What does failure look like?

Some literature builds on, and refers to, the Heeks' definitions of failure as being complete, partial, etc. (Dodson et al., 2013; Gigler, 2015; Musiyandaka et al., 2013; and others). Other perspectives include implementation failure, defined as failure against objectives (Osah et al., 2014), as well as failure to scale (Foster & Heeks, 2013).

C. Why is ICT4D failing?

Recent literature still enumerates the causes of failure of ICT4D interventions as they apply to specific fields of application. The focus is on health (Fornazin & Joia, 2014; Matavire & Manda, 2014); agriculture (Isabirye et al., 2015; Ngowi et al., 2015; Wyche & Steinfeld, 2015); e-governance (Johnston et al., 2015; Kettani & Moulin, 2015; Matavire & Manda, 2014); education (Musiyandaka et al., 2013; Wardayo & Mahmud, 2013); and telecentres (Attwood et al., 2013; Gomez, 2014; Ngowi et al., 2015).

A positive enhancement to the work outlined above, is work that moves beyond specific applications of ICT4D to reflect on general reasons for failure. These take a broader perspective, and include strategic aspects such as the integration between theory and practice (Heffernan et al., 2016), as well as policy conflicts (Vandeyar, 2013) and policy failure (Krauss, 2013). *Failures of approach* include goal-diffuse, top-down methods (Blake et al., 2014), a lack of social embeddedness (Okon, 2015), and technology that is viewed as fixed rather than the malleable result of innovation (Blake et al., 2014). Failure of systemic capacity includes the lack of skills to deal with Big Data (Hilbert, 2013). From a *design perspective*, Heeks' Design-Reality gap (Heeks, 2002) is quoted and applied in specific contexts (Kettani & Moulin, 2015), while other work highlights the lack of participatory design (Shiang et al., 2016). At the *implementation level*, failures include the inappropriateness of translating international best practice to developing countries (Gregor et al., 2014), as well as adoption failure due to poor user requirements specifications (Isabirye et al., 2015), lack of policy and capacity (Kayisere & Wei, 2015) and the inability to adapt to or incorporate the development intervention into the recipient organization (Bentley, 2014).

D. What supporting processes are failing?

In addition to aspects pertaining to the implementation itself, the failure of supportive processes, such as research and evaluation, are seen as contributors to ICT4D failure.

Research-related failure includes the lack of an open research framework (Loudon & Rivett, 2011); a reflection on individual case remedies rather than an understanding of underlying issues (Bolivar et al., 2016); and (similarly) no cumulative knowledge building from solutions (Gregor et al., 2014). In addition, researchers are not engaging with activities that would influence policy and practice (Harris, 2016; Qureshi, 2015). Evaluation failure includes the inability of evaluation processes to learn from failures (Dodson et al., 2013).

E. How are concepts of failure applied?

This theme addresses the second question to be answered by this review, and is discussed in Section 4.3.4.3.

4.3.4.3. How is the understanding of failure applied?

An understanding of the application of concepts of failure provides insight into the extent to which ICT4D researchers and practitioners have been able to develop new knowledge that could aid in reducing failure. The following themes have been identified:

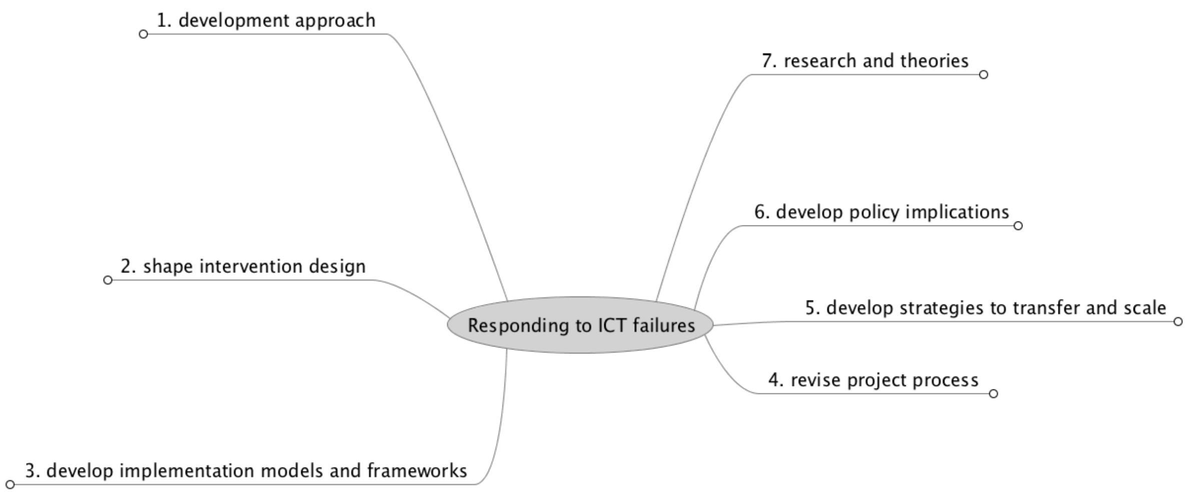


Figure 4.9 Responses to ICT4D failures: themes from literature review

Concepts are applied over a broad spectrum, which includes aspects from the development approach, through project or programme design and implementation, to research and theory development. Some authors use their analyses to develop recommendations that have been applied in practice, while others have developed models, methods, or processes for improved practice.

The types of applications are summarised in Table 4.5:

Table 4.5 Applications of failure concepts for improvement

Concept	Type of application	For example	Reference
Align with development approach	**Definition of realistic, relevant development objectives**	Assess sustainability of implementation based on indicators (after the fact)	Clarke et al., 2013.
Shape intervention design	**Develop design principles and approaches**	For change strategy For frugal information systems Aspects of structure and agency Ecology approach to design	Gregor et al., 2014 Watson et al., 2013 Attwood and Braathen, 2013 Wyche and Steinfeld, 2015
	Address the design-reality gap	Critical success factor model Participatory design combined with design science	Musiyandaka et al., 2013 Barjis et al., 2013
	Align with local context	'Grafting' Social embeddedness and co-design	Sanner et al., 2014 David et al., 2013
	Reconsider technology design	Newer technologies Design for resource constraints Participatory design considering technology as malleable	Steyn et al., 2013 Chen, 2015 Blake et al., 2014
	Participatory design	Open research approaches Role modelling Participatory action research	Loudon and Rivett, 2011 Shiang et al., 2016 Steyn et al., 2013
Develop implementation models and frameworks	**Critical success factors**	Definition of critical success factors Critical success factor models	Hage et al., 2014 Gomez, 2014
	Risk identification model	Risk identification specific to ICT4D environments	Kemppainen et al., 2014
	Failure identification models	Sustainability failure / root causes Breakdown analysis and articulation	Masiero, 2016 Matavire and Manda, 2014
Revise project process	**Implementation roadmap or framework**	Project roadmap Technology feasibility and acceptance Framework to guide development	Kettani and Moulin, 2015 Ngassam et al., 2013 Mamba, 2015
	Consider sustainability in project planning	Participation as a means of including sustainability in project planning Knowledge management as a means of skills transfer for sustainability	Steyn et al., 2013 Conger, 2015
	Design for trust	Process to build trust and credibility Elicit user requirements to build trust	Walton, 2013 Isabirye et al., 2015
Develop strategies to transfer and scale	**Scaling strategies**	Develop strategies to ensure scaling	Foster and Heeks, 2013
	Transition strategies	Stakeholder alignment with project goals Trust and credibility in technical communication	Walton, 2013 Walton, 2013
Develop policy implications	**Policy recommendations**	Align with local context Institutional collaboration Address conflict between policy and practice Operationalise agency Analyse causes of failure to inform policy	Buhigiro, 2013 Ngowi et al., 2015 Krauss, 2013 Chew et al., 2015 Gigler, 2015
Research and theories	**Research framework**	Develop unifying framework of theories	Heffernan et al., 2016

4.3.5. Interpretation

The themes ***what is failure*** and ***why ICT4D fails*** have been addressed extensively in earlier literature, and is well researched and understood. The focus of that work is on characterising failure, for example in terms of types of failure (e.g., Heeks, 2002) and critical failure or success factors (e.g., Kumar & Best, 2006). However, the literature review also indicates a recent focus on engaging with ways in which to reduce ICT4D failures, rather than merely identifying causes of failure.

Authors develop recommendations over a broad spectrum of aspects, as represented in the following map of knowledge application:

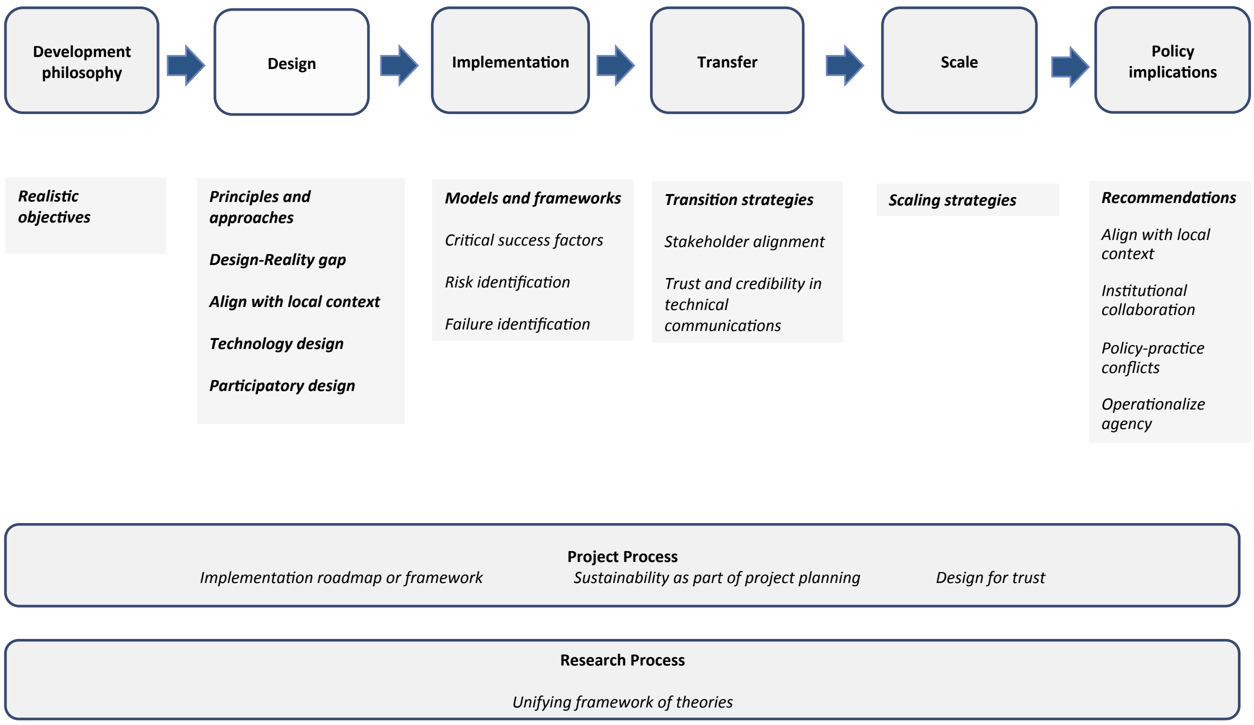


Figure 4.10 Applications of knowledge to reduce ICT4D failures

The map in Figure 4.10 highlights the somewhat fragmented application of failure concepts, but also the trend towards integration. The majority of work still emphasizes individual aspects of the process of delivering an ICT4D implementation.

From the chain in Figure 4.10, it is clear that researchers have developed frameworks, recommendations, and models that are applicable to a specific aspect of the process, such as designing technology that is appropriate to the ICT4D environment, or using participatory approaches to engender trust in such a way that project transfer will be more sustainable. Cross-cutting views include applications that concern themselves with the ***project process*** or the ***research process.*** In these instances, the tendency is towards developing more generic or unifying frameworks.

Based on the representation in Figure 4.10, the researcher proposes that failures and remedies could be interpreted along a chain of delivering value in ICT4D interventions, and that failure could occur at any one or more points along the chain. While individual authors mostly focus on elements of the chain, value could be derived from considering the entire chain of value creation. This is a ***value-focused*** conceptualisation. Based on this conceptualisation, it is further proposed that failure *at any point* could result in benefits not being realised; models that address failure should therefore take a holistic view along the entire process of value creation, from development philosophy to adoption, rather than addressing singular points along the chain.

Similarly, from the discussion of *Why is ICT4D failing* (Section 4.3.4.2), it is noticeable that many authors focus on specific (single-perspective) failure factors, and as such come up with solutions that have a singular focus (e.g., participatory design OR social embeddedness OR revised technology design). Integrative solutions, which accommodate 'and-and' rather than 'either-or' solutions, are lacking. This is in contrast to the earlier work by Kumar and Best (2006), which emphasizes multiple factors or dimensions of sustainability.

In addition to the above, a focus on the systemic nature of ICT4D implementations, and a systems approach to failure, is not clear from the literature. While some elements of a system are addressed, a complete, holistic, systemic perspective on failure is rare.

While a trend (compared to earlier work) is observed towards generalization and the development of frameworks and theories, with a lesser focus on identification of case-specific critical success factors, this trend is relatively recent. The outcome still needs to mature towards generalization, integration, and the creation of new knowledge, as well as towards systemic and value creation perspectives. This is in agreement with the findings of Bolivar et al. (2016:63) on e-government that 'In some cases, advice and recommendations have been given on best practices, but earlier theories were not tested, nor new ones produced, nor any advances made in existing ones'. The challenge remains to produce general frameworks that would enhance the capacity of decision-makers towards successful ICT4D implementations.

4.3.6. Implications for decision framework

The systematic literature review was aimed at providing information on the nature of the problem to address when designing a decision framework towards sustainability. Based on the literature review and subsequent discussion, it is proposed that the following interpretation of ICT4D failures informs the decision framework:

Table 4.6 Learning from ICT4D failures, to inform decision framework

Characteristic	A view that resolves ICT4D Failures	Reference to discussion
Complex	Should consider value-chain or systemic perspectives	Section 4.3.5
	Should consider success or failure as the result of multiple integrated processes (research, design, implementation, etc.)	Section 4.3.4.2 C; D
Holistic and integrative	Should take a holistic, integrative perspective	Section 4.3.5
	Should focus on integration of perspectives to reduce failure, rather than on understanding failure	Section 4.3.5
Goal-focused	Should facilitate realism in terms of the role and objectives of ICT4D in development	Section 4.3.4.2 A
	Should guide towards clear objectives and reduce goal-diffusion	Section 4.3.4.2 A; C
	Should support a process of value creation	Section 4.3.5
Generic	Should be based on generic principles rather than being case-specific	Section 4.3.5

These decision framework characteristics, based on the collective understanding in literature of ICT4D failures, emphasize that a proposed framework should deal with a complex problem environment, take a holistic and integrative approach, facilitate a goal focus, and be sufficiently generic to be applicable across different implementation environments.

4.4. SUMMARY

The literature review in this chapter was aimed at identifying characteristics of the decision framework, based on an understanding of the literature of ICT4D failures. A systematic literature review process was followed.

The chapter addressed research sub-question 2:

How can the understanding of ICT failures be used within a decision framework to reduce the failure of ICT4D interventions?

The question is answered by identification of the themes in ICT4D failure (Figure 4.8), the application of failure concepts for improvement (Table 4.5), and learning to inform the decision framework (Table 4.6).

The review showed that ***ICT4D failures*** are widely discussed, with high failure rates being the norm. Earlier literature focused on characterising ICT4D failures and finding root causes. Recent literature provides evidence that researchers are acting on their understanding of failure. They generate knowledge by developing a variety of models, frameworks, and principles to reduce ICT4D failure. While these models do not necessarily have an integrated, holistic, systemic focus, they are a step towards operationalising the knowledge of failure.

The two literature reviews (this chapter, and Chapter 3) allowed a number of aspects to be identified that could be applied in operationalising sustainability and ICT4D failures (see Section 3.4.5 and 4.3.6). These principles are integrated and summarised in Table 4.7 as characteristics of the proposed decision framework:

Table 4.7 Characteristics of decision framework, derived from aspects of sustainability and failure

Charac-teristic	The decision framework
Complex	Should be multi-dimensional
	Should consider value chain or systemic perspectives
	Should consider success or failure as the result of multiple integrated processes (research, design, implementation, etc.)
Dynamic, holistic, integrative	Should accommodate a dynamic / progressive sustainability concept Should focus on integration of perspectives to reduce failure, rather than on understanding failure Should be based on generic principles rather than being case-specific
Goal focus	Should facilitate realism in terms of the role and objectives of ICT4D in development
	Should guide towards clear objectives and reduce goal-diffusion
	Should support a process of value creation
Plan and align	Should be context-specific
	Should allow for alignment with (any) underlying development approach
	Should consider sustainability up-front as part of the design, while allowing for both intended and unintended benefits.
	Should consider sustainability at the outset of the implementation, in terms of: • What needs to be sustained • For how long • By whom • For whom • Relative priorities of different types of benefits
Opera-tional	Should consider sustainability as embedded in the way of work

The summary in Table 4.7 calls for a decision framework that can incorporate complexity, and that is dynamic, holistic, and integrative. It should facilitate a goal focus, should enable planning and alignment for and with sustainability, and should allow sustainability to be incorporated at a very operational level. These principles will be incorporated in the development of the decision framework, along with learning from other sources (including case studies), as is outlined in the remainder of this document.

These characteristics will be used as guidelines for the development of a framework that is relevant and appropriate to the complexity of decision-making in ICT4D. Specifically, it is expected to contribute to pragmatically operationalising the complex concept of sustainability of a technology intervention in socially complex environment. The following chapter explores literature on decision-making in ICT4D. The outcome of that review will be read in conjunction with Table 4.7 when developing the initial framework (Chapter 6).

CHAPTER 5. LITERATURE REVIEW: DECISION-MAKING AND ICT4D

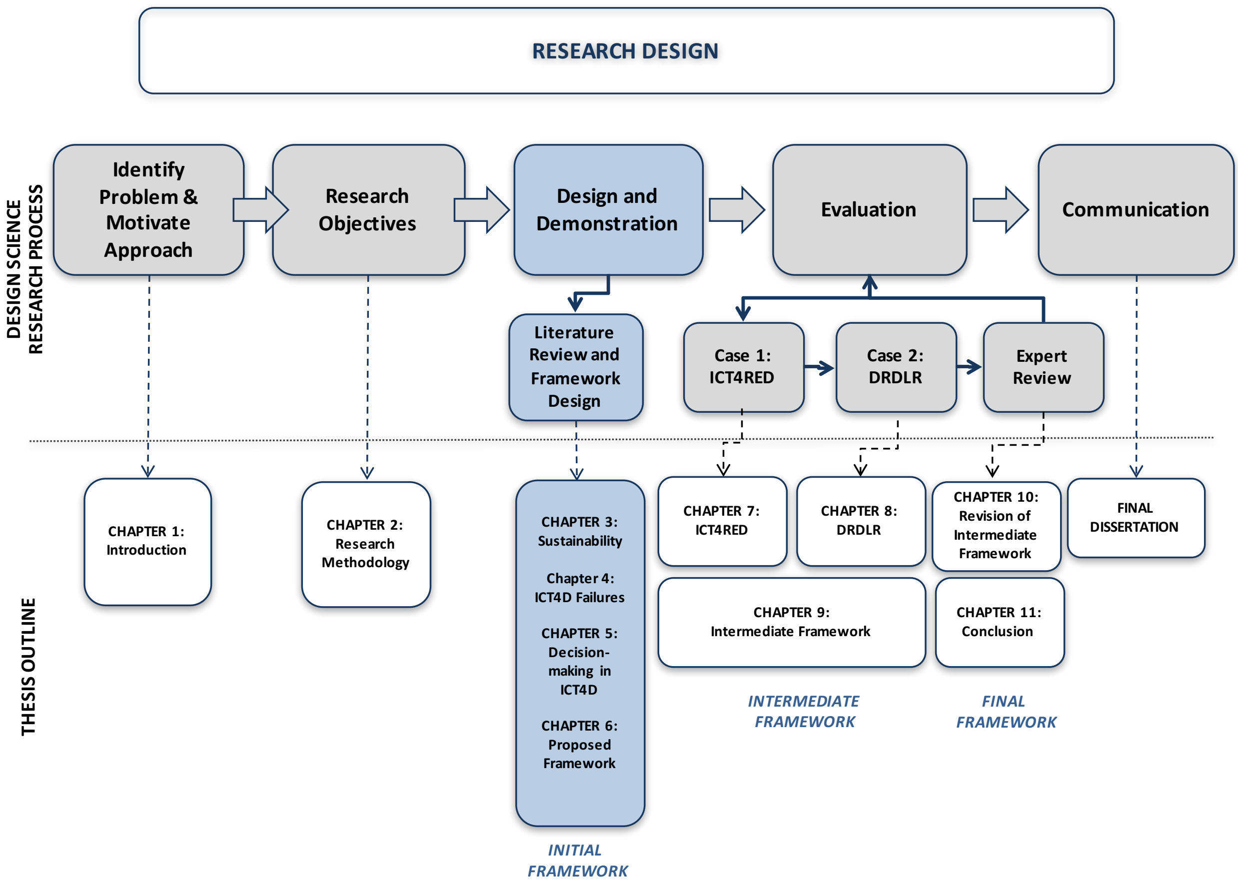


Figure 5.1 Research process and thesis outline: Chapter 5

5.1. INTRODUCTION

The systematic literature reviews in the previous chapter focused on the *problem space* by reviewing sustainability and ICT4D failures, so as to identify key aspects that should be addressed by the decision framework. In this chapter, the *solution space* is explored – specifically, the extent to which decision modelling and decision support have been applied in ICT4D to date. The intention is to identify gaps and opportunities in the current approaches to decision support in ICT4D.

Decision Science (also: Management Science, Operations Research) is described as 'an approach to decision-making based on the scientific method' (Anderson et al., 2016:2). The discipline is aimed at resolving a wide spectrum of decision problems that are defined relative to the field in which they are formulated. Approaches range from *normative or prescriptive* decision theory that develops *decision models* to arrive at optimal choices within a rational worldview, to *positive* or *descriptive* decision theory that deal with decision-making in complex and ill-described environments. Those approaches of Decision Science that are specifically suited messy problems, as the application of ICT in the context of development has been described (see Chapter 1), are specifically relevant to this study.

In Chapter 2, the following roles were identified for the bodies of knowledge that are explored in the literature reviews:

Table 5.1 Role of literature review

Body of Knowledge	Contribution
Sustainability and sustained benefit	A usable definition of sustained benefit. A means of translating the definition to a practical framework in support of sustained benefit.
Failure of ICT4D projects	Scope and characteristics of the problem that need to be addressed by a decision framework in support of the design of interventions for sustained benefit.
Decision-making in ICT4D	Classification of the types of models that relate to the characteristics of decision-making in ICT4D interventions, and that would be useful in a decision framework. Definition of a construct of value creation (e.g., decision process) that could be used to contextualise the decision tools or models for sustained benefit.

This chapter explores the third topic, by means of a scoping literature review. In contrast to the *systematic reviews* of the previous chapters that sought to provide a detailed view on work related to sustainability and failure in ICT4D, this literature review is aimed at obtaining a broad overview of decision support in ICT4D and identifying gaps in the current application of decision support to ICT4D. To this end, a *scoping review* is undertaken.

According to Dijkers (2015), the scoping review was first defined as such by Mays, Roberts, and Popay (2001). Arksey and O'Malley (2005) – who are accredited with the first formal framework for a scoping review – highlight that scoping studies are aimed at 'mapping rapidly the key concepts underpinning a research area' (Arksey & O'Malley, 2005:5). They differentiate it from systematic reviews through the broader set of topics that is addressed, as well as the lesser focus on quality assessment of the literature under consideration (Arksey & O'Malley, 2005).

This chapter firstly provides some background on decision-making in ICT4D (Section 5.2), after which it summarises the scoping literature review method (Section 5.3), followed by a description of the application of each of the steps of the review process (Sections 5.4–5.7). Thereafter, the implications for the decision framework are outlined (Section 5.8), and the chapter is summarised (Section 5.9).

5.2. DECISION-MAKING IN ICT4D

Significant focus has been placed in ICT4D literature on reasons for failure, critical success factors, development philosophies, and approaches to make ICT4D work. However, as outlined in Chapter 1, the problem is complex, as such providing scope for multiple approaches:

> *The implementation of ICT4D projects constitutes, from many perspectives, a 'messy' problem, which is characterised by 'a large degree of uncertainty with respect to how the problem should be approached and how to establish and evaluate the set of alternative solutions'*
>
> (Pries-Heje & Baskerville, 2008:1).

Various ICT4D research focus areas attempt to provide structure to this messy problem from different perspectives. This research project adds to existing work by considering *decision-making* as a focal point in making ICT4D implementations work. It seeks new ways to create value in ICT4D practice, and is rooted in the notion that 'the value that an organisation creates is ultimately no more or no less than the sum of the decisions that it makes and executes' (Blenko et al., 2010) – where in this case a broader view is taken on 'company' as the collective of individuals and organisations that are involved with, and affected by, an ICT4D implementation. A framework that focuses on collective decisions intends to provide structure to this complex problem.

For the purpose of this research, the definition of *problem solving* of Anderson et al. (2016:3) is adopted, namely ‘the process of identifying a difference between the actual and desired state of affairs and then taking action to resolve the difference.’ This generic definition accommodates the discrepancy between the intent behind ICT4D implementations and the way in which such intent plays out in practice. The *decision framework* of this research will then be considered a guideline to in the resolution of such differences.

A number of authors recognise the role of decision-making in ICT4D implementations. Conger (2015) highlights the role of a Knowledge Management strategy in providing decision information across projects, and as such in contributing to the financial and socio-technical sustainability of the project. Further, stakeholder analysis is seen as key to intervention success, since it ‘does not let decision-makers make naïve assumptions’ (Ali & Bailur, 2007:76). Easter and Ewins (2010) refer to the importance of defining a decision-making structure in e-learning projects, so as to ensure appropriate investment of funds, while Ezz et al. (2009) discuss the role of interdepartmental decision-making processes in the adoption of e-government initiatives. In addition, decision-making is seen as a clear indicator of true participation, and failure is likely to occur when ‘consultation with community members bears no reflection on final decisions’ (David et al., 2013:160). At the programme level, the role of big data and data-driven decision-making is recognised in strategic and tactical decisions (Cobo & Lundberg, 2017; Hellen, 2017).

This work is specifically concerned with the role of decision models and frameworks in ‘making things work,’ that is, in facilitating improved decision-making around the process of delivering an ICT4D implementation and sustaining its benefit. However, other interpretations of decision-making in the context of ICT4D need to be recognised. Tarafdar et al. (2012) describe three roles for ICT in bottom-of-the-pyramid implementations, namely to ‘automate, informate, and transform’, where ‘informate’ refers to ICT’s role to ‘augment human decision-making’ (Tarafdar et al., 2012:311). Similarly, Duncombe (2006) calls for the role of ICT4D in strengthening the day-to-day decision-making needs of the poor. This can be interpreted as the ICT4D implementation or artefact being a decision support solution in itself, which supports decision-making processes in various ways. Examples include a wireless sensor network that facilitates agricultural decision-making in India (Panchard et al., 2008), and group decision models that facilitate collaborative learning in higher education (De Vreede, 2006).

The latter view is different from this research, in which the focus primarily requires that the extent is understood to which decision-making has been incorporated into, or addressed by, models and frameworks pertaining to ICT4D implementations. In exploring the literature, the focus on ICT4D literature is enhanced by literature from disciplines in which decision-making is rooted such as decision analysis and management science in general.

In summary, the purpose of this review is to assess the extent to which decision-making has been considered and applied in ICT4D, and to assess gaps in this area of work. It intends to provide information that could inform the nature of the decision framework that is developed. The purpose is to explore the following research sub-question (Section 1.4.3):

QN 3. What are the categories of decisions that should be considered when developing an ICT4D intervention, in order to catalyse the delivery of sustained benefit?

5.3. SCOPING LITERATURE REVIEW METHOD

5.3.1. Overview

A scoping review is seen as a means of mapping a broad research area, rather than doing an in-depth analysis of quality-assessed research as is the case with systematic reviews (Arksey & O'Malley, 2005). It 'addresses an exploratory research question aimed at mapping key concepts' (Colquhoun, 2016:5) and is used to 'collect and organise important background information and develop a picture of the existing evidence base' (Armstrong et al., 2011:147).

Armstrong et al. (2011) identify the following differences between scoping and systematic reviews:

Table 5.2 Role of literature review (summarised from Armstrong, 2011)

Aspect	Systematic review	Scoping review
Research question	Focused with narrow parameters	Often broad
Inclusion/exclusion	Defined at outset	Can be developed *post hoc*
Quality	Filters often applied	Not an initial priority
Synthesis	Often quantitative	More qualitative, typically not quantitative
Use	Formally assess quality and generates a conclusion related to the focused research question	Used to identify parameters and gaps in a body of literature

The focus is on (rapidly) making sense of a broad body of knowledge, and then contextualising this understanding to inform the study at hand.

Boyd and Bastian (2011) summarise the following definitions of scoping studies:

- Preliminary assessment of potential size and scope of literature (Grant & Booth, 2009);
- Map rapidly the key concepts underpinning a research area and the main sources and types of evidence available (Arksey & O'Malley, 2005);
- Synthesis and analysis of a wide range of research and non-research material to provide greater conceptual clarity about a specific topic or field of evidence (Davis et al., 2009); and
- Contextualise knowledge by identifying what is known and what not, and then setting this within policy and practice contexts (Anderson et al., 2008).

The aspect of 'mapping' the knowledge (Armstrong et al., 2011) is inherent in most definitions. Arksey and O'Malley are often accredited with the first formal framework for scoping reviews. However, elements of the framework are still disputed – in particular, the exact methodology, whether or not quality assessment should be included, and the way in which review results are mapped (Dijkers, 2015).

For this review, the purpose is to understand the extent to which decision support and modeling have been applied in ICT4D to date, so as to understand how decision support in ICT4D is currently viewed, how to position the decision framework relative to this work, and the scope for inclusion of new concepts. As such, the review will be 'used to identify parameters and gaps in a body of literature' (Armstrong et al., 2011:148). The intention is to obtain an overview of this area, and highlight aspects to consider when developing the framework. To this end, a scoping rather than a systematic review is deemed relevant.

5.3.2. Method

This research takes a pragmatic approach to the scoping review. It is based on the method described by Arksey and O'Malley (2005), which includes the following steps (Arksey & O'Malley, 2005; Armstrong et al., 2011):

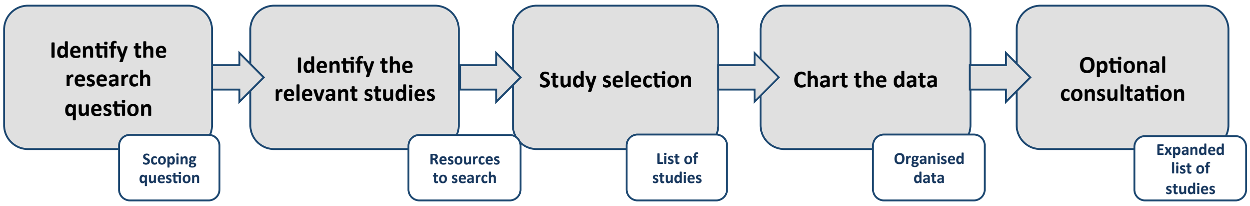


Figure 5.2 Scoping review methodology

In this methodology, the first four steps comprise a structured method to identify and assess the data. The final step refers to a process to 'inform and validate findings from the main scoping review' (Arksey and O'Malley, 2011). In this research, the first four steps of the method was applied, as outlined in Sections 5.4 to 5.7.

5.4. RESEARCH QUESTION

5.4.1. Objective of this review

The following research question has been defined in Chapter 1:

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

This scoping review is intended to provide information regarding the following sub-questions:

QN 3 *What are the categories of decisions that should be considered when developing an ICT4D intervention, in order to catalyse the delivery of sustained benefit?*

QN 4 *What strategies for decision support could be useful to support decisions that influence sustained benefit?*

QN 5 What decision process, or other concept of value creation, should be used for contextualisation of the decision tools or models for sustained benefit?

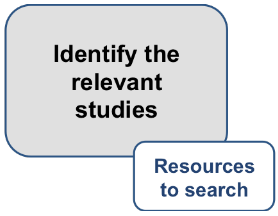
5.4.2. Specific research question

In Section 5.2, decision-making in the context of ICT4D is positioned as taking place in a complex environment. It has to deal with complexity in terms of the objectives that are pursued, as well as in terms of the dimensions of the problem that need to be considered. The potential for decision-making as a means of supporting sustainability is highlighted. Based on this, the following research question is defined for this scoping review:

What are the approaches that are used in decision-making or decision support in ICT4D?

The intention is to scope the field and map *the nature of the approaches and concepts* that are currently considered in decision-making in ICT4D.

5.5. IDENTIFICATION OF RELEVANT STUDIES



Literature relevant to the research question needs to be identified through the search of multiple sources (Arksey & O'Malley, 2011). Since the field to be searched is narrow and specific, it was decided to take multiple perspectives on the literature sources. First, leading journals in *ICT4D* were identified and searched for applications of decision support or decision modelling. Similarly, leading journals in *decision modelling* were identified and searched for ICT4D applications. Finally, a *business management* perspective on decision support and decision modelling was taken.

In each case, leading journals were identified. This approach to some extent compensates for the lack of quality screening of the scoping review protocol. Journals were selected by identifying high-ranking journals according to the current (2017) values for Harzing's H-Index and the Scimago Journal Rank (SJR) (Scimago Journal and Country Rank, 2017). Full text availability influenced the selection. To ensure that relatively recent work is considered, while not excluding fundamental approaches, the search period was defined to review work between 2006 and 2017.

The search protocol is summarised in Table 5.3:

Table 5.3 Scoping review protocol: decision-making in ICT4D

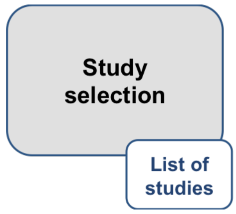
Item	Description	
KEYWORDS		
For ICT4D journals	((decision framework) OR (decision model) OR (decision support)) AND (ICT4D)	
For Decision Support and Business Management journals	(ICT4D) OR (ISDC[1])	
JOURNALS		***SJR and H-Index***
ICT4D	Information Technologies and International Development	Not known; 4
	Information Technology for Development	0.365; 17
	Electronic Journal of Information Systems in Developing Countries	0.265; 5
Decision support	**MIS Quarterly: Management Information Systems**	6.984; 163
	Information Systems Research	4.397; 116
	European Journal of Operations Research	2.595;
	Organisational behaviour and human decision processes	2.564; 107
	Decision Support Systems	2.262; 95
	Journal of Behavioural Decision-making	1.909; 55
	Decision Sciences	1.586; 82
	Decision Analysis	1.022; 12
Business management	Harvard Business Review	0.401; 130
	Journal of Organisational Behaviour	2.412; 119
SCREENING		
Include	Work published since 2006. Articles related to decision-making in ICT4D, at a project or programme level	
Exclude	Exclusion criteria were developed as the searched progressed (*post hoc*). These included: any work not directly in support of decision-making; evaluations of ICT4D project results; studies reflecting on country-level patterns in use of ICT4D; in summary: work not related to implementation-level decision-making	
Mapping	Tag articles according to: • Demographics: date, geography, field of application • Extent to which decision is addressed • Decision that is addressed • Sphere of influence of decision (strategic, tactical, operational) • Modelling or decision-making approach • Value addition against a framework of value creation	

The selected ICT4D journals are similar to those identified by Heeks (2010a) and Turpin and Alexander (2014). The selection of keywords reflects the intention to search a narrow and specific field of application. Exact phrases were searched, delivering a relatively small set of results. To ensure that critical work was not excluded, the search was broadened to include the search phrases without exact specification. In some

[1] Information Systems in Developing Countries.

instances, this resulted in too broad a selection of work, which was then narrowed down by adding 'ICT4D' to the search term. The results are discussed in section 5.6.

5.6. STUDY SELECTION



The database search yielded a preliminary list of articles. This was enhanced with publications that were known to the researcher, and duplicates were removed. The remaining list of articles was screened for relevance, and articles that did not specifically relate to decision-making in the process of delivering an ICT4D intervention were removed. This was followed by a full text review, and removal of unrelated articles. Results are summarised in Table 5.4:

Table 5.4 Search results

	Publication	Keywords	Before screening	After duplicates removed	After first screening	After full text screening
ICT4D	Electronic Journal of Information Systems in Developing Countries	'decision model' 'decision support' 'decision framework'	5	5	**21**	**32**
	Information technologies and international development		3	3		
	Information technology for development		33	32		
	Total		**41**	**40**		
	Electronic Journal of Information Systems in Developing Countries	Without quotes: decision model decision support decision framework (AND ICT4D)	20	20	**22**	
	Information technologies for international development		115	67		
	Information technology for development		112	41		
	Total		**247**	**128**		
	Own list		**24**	**24**	**18**	
Decision support	MIS Quarterly	'ICT4D' 'Information Technology for Development' 'ISDC' 'Information Systems in Developing Countries'	7	7	**0**	**0**
	European Journal of Operations Research		0	0		
	Decision Analysis		0	0		
	Decision Support Systems		1	1		
Manage-ment Science	Harvard Business Review		1	1		
	Journal of Organisational Behaviour		1	1		
	Total		**10**	**10**	**61**	**32**

As before, the process can be summarised according to the PRISMA methodology:

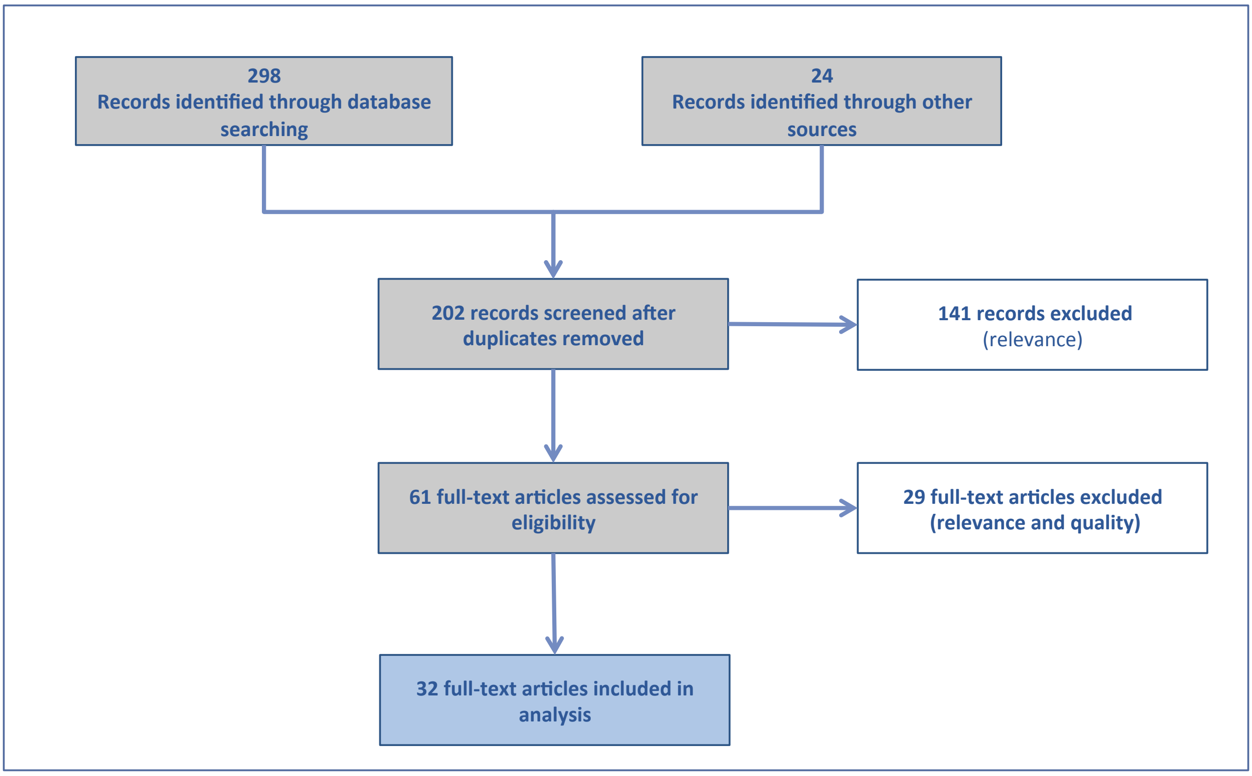
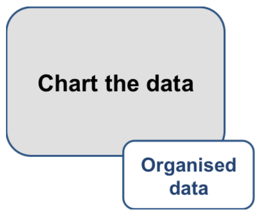


Figure 5.3 PRISMA diagram of scoping review: decision-making in ICT4D

The review of full-text articles for relevance was to some extent subject to the researcher's bias.

5.7. DATA MAPPING



First, descriptive data were collected to describe the date of publication, field of application, and geographic area where the work took place.

Thereafter, concepts pertaining to decision-making were mapped for each publication:

- To what extent is decision-making addressed?
- Which decision is addressed?
- What is the sphere of influence of the decision? (strategic, tactical, operational)
- What decision model or approach is used?
- Where does the decision fit in the process by which the intervention creates value?

In line with the scoping nature of the review, the quantitative interpretation of the data is restricted to the descriptive data; the remainder of the mapping is represented in a qualitative manner (i.e., *what* is addressed, rather than *how often*). The results are summarised in section 5.7.1.

5.7.1. Descriptive review of articles

Geography

- The majority of articles are related to work in Africa (53%) the Middle East / Asia (31%).

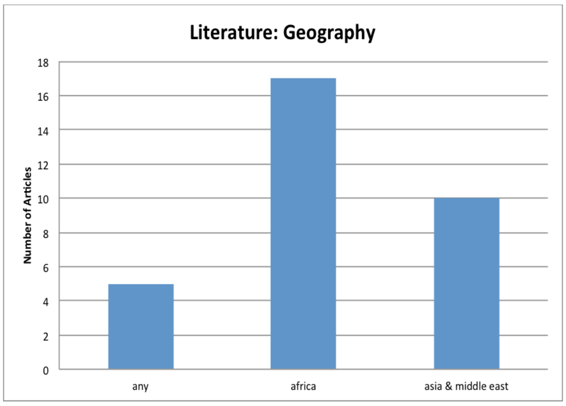


Figure 5.4 Literature by geographic location

Date of publication

- More than half of the articles discussing the concept of decision-making over the sample period, have been published since 2012.

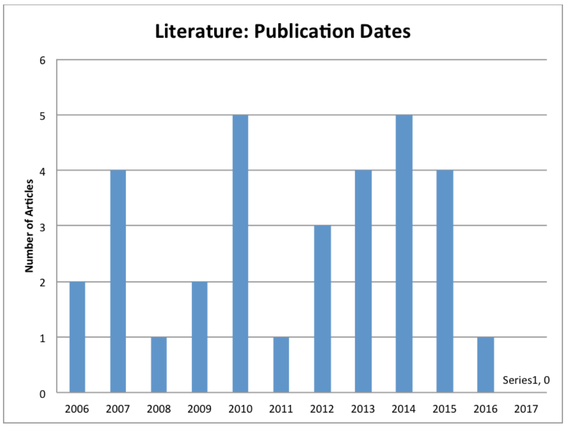


Figure 5.5 Literature by date of publication

Field of application

- Decision support is discussed in a broad variety of fields, with an emphasis on healthcare, e-government, and telecentres.

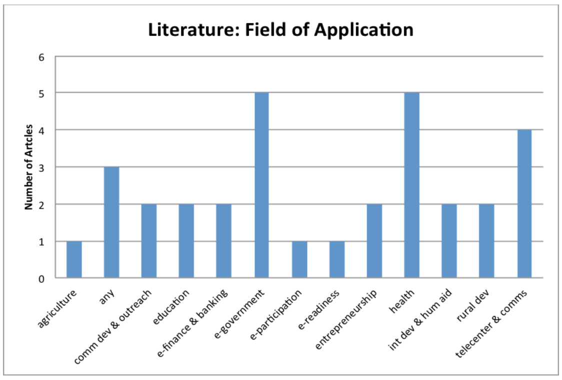


Figure 5.6 Literature by field of application

5.7.2. Mapping of decision concepts

This section describes the decision-making concepts that were found in the literature, from various perspectives. The purpose is to understand scope and identify gaps.

5.7.2.1. To what extent is decision-making addressed?

The extent to which decision-making is addressed can be categorised into the following themes:

Table 5.5 Themes in decision-making in ICT4D

Theme	Explanation	Examples	Technique or approach used
A. Decision model	Application of a model that supports decisions or solves problems in the process of implementing the ICT4D intervention	An ethnographic decision tree model of telecentre usage (Bailey & Ngwenyama, 2013)	Decision trees
		Leveraging e-health for future-oriented healthcare systems in developing countries (Kalema & Kgasi, 2014)	Multi-criteria decision modelling: Analytical Hierarchical Process (AHP)
		Morphological analysis: A method for selecting ICT applications in South African government e-service delivery (Plauche et al., 2010)	Morphological analysis
B. Decision approach	Discussion of approaches that could be used to support decision-making in ICT4D	Knowledge Management for Information and Communications Technologies for Development (ICT4D) Programmes in South Africa (Conger, 2015)	Knowledge management
		Sense making and Implications for Information Systems Design: Findings From the Democratic Republic of Congo's Ongoing Crisis (Muhren et al., 2008)	Sense-making as a lens on the nature of organisational decision-making
		Using Actor-Network Theory to Analyse e-government Implementation in Developing Countries (Stanforth, 2006)	Actor-network theory as a means of understanding and improving IS implementation
C. Decision support solution	Systems that are delivered as part of the solution, rather than as a means of improving the implementation	COMMONSense Net: A Wireless Sensor Network for Resource-Poor Agriculture in the Semiarid Areas of Developing Countries (Panchard et al., 2008).	ICT tools that enable resource-poor farmers to develop improved farming strategies
		Technology Supported Collaborative Learning for Higher Education: Comparative Case Studies in Tanzania (De Vreede & Mgaya, 2006)	Use of group decision support systems to enhance classroom communication
D. Evaluation framework	Decisions resulting from an evaluation process	Impact Assessment of ICT-for-Development Projects: A Compendium of Approaches (Heeks, 2009)	Review of various approaches, including cost-benefit analysis
		The rural ICT comprehensive evaluation framework (Pade-Khene & Sewry, 2012)	Evaluation framework for rural ICT implementations
E. Comments only	Some comments pertaining to the decision problem or the need for decision support	Co-design with communities. A reflection on the literature (David et al., 2013)	Collaboration only has an effect if it influences decision-making
		Funding for E-learning in Africa: A Question of Sustainability (Ezz et al., 2009)	The need for, and nature of, interdepartmental decision process is highlighted
		Participatory development of ICT entrepreneurship in an informal settlement in South Africa (Steyn et al., 2013)	True participation is a prerequisite for decision-making

Note that Table 5.5 contains examples only. The complete list of full-text articles is contained in Tables 5.7 to 5.9.

Five themes reflected the extent to which decision-making is addressed. These range from the application of a *decision model or technique* to improve the manner in which an ICT4D implementation is addressed (Theme A), to *only comment on* the need for decision support in a specific ICT4D context (Theme E). Some articles refer to *approaches* that can be used for improvement of ICT4D applications (Theme B).

Articles were included in Theme A if they described the application of any decision model or technique that assisted with the resolution of a decision problem. These mostly included methods and techniques from Operations Research, Decision Analysis, or Management Science. In the case of Theme B, the definition was somewhat broader, in the sense that the discussion (rather than application) of any approach that could contribute to some extent to the resolution of a decision problem was included.

This study considers literature on *evaluation frameworks* (Theme D) as a separate field of inquiry, but these articles were retained here to indicate that appropriate use of evaluation frameworks could enable improved decision-making in an implementation.

Finally, some articles describe the implementation of a *decision support solution* in the field. This work is outside the scope of this research, since it does not contribute to improved decision-making *about* the implementation, but rather the decision model *is the implementation itself*. This theme is highlighted here for completeness of the review.

5.7.2.2. Which decisions are addressed, and what is their influence?

The nature of decisions that are addressed, and their sphere of influence, are indicative of the scope and comprehensiveness of the current practice of decision support in ICT4D. It also provides an indication of what is addressed and what not.

In this research, the *sphere of influence* is defined as the strategic, tactical, or operational focus of the decision. This three-level concept was first used by Antony (1965) in the manufacturing environment, and is related to organisational planning and control. It aims to capture the interaction between different levels of decision-making in a hierarchy, and has subsequently become the basis for classification of decision-making in various contexts, including information systems design and investment (e.g., Gunsekaran, Love, Rahimi, & Miele, 2001; White, 1986) and strategic planning (e.g., Pinson & Moraïtis, 1997).

For articles that address decision-making (Theme A), or that recommend an approach to resolving decision problems in ICT4D (Theme B), the type of decision and its sphere of influence are mapped in Table 5.6. Evaluation framework articles (Theme D) were also included. The remainder of the 32 full-text articles were excluded from this mapping, since not all articles address a specific decision problem. Work related to decision support solutions for ICT4D beneficiaries (Theme C) were excluded (e.g., De Vreede & Magaya, 2006; Panchard et al., 2008; see Section 5.7.2.1). Work that contained comments pertaining to decision-making (Theme E) mostly defined problems that needed to be addressed, and were discussed elsewhere (see Section 5.7.2.3).

Table 5.6 Types of decisions and spheres of influence that are (or could be) addressed

Strategic decisions (long-term, relates to overall objectives)	**Tactical decisions** (medium term, planning and implementation)	**Operational decisions** (execution)
Inter-organisational financial decision-making	Technology choice	Consumer choice
Select intervention	Design	Adoption / uptake
Stakeholder identification and management	Design: roles and software configuration	
Project risk identification	Implementation process improvement	
Readiness assessment	Project-level resource allocation and use	
Project continuation and scaling	Insourcing model	
Acquisition and scaling	Sustainable introduction of ICT	

Table 5.6 indicates that authors address decision-making and modelling at the strategic, tactical, as well as the operational level. Supporting these decisions has the potential to affect different aspects of the sustainability of the implementation (keep in mind that it is mostly a single decision that is addressed by a specific model or approach). For example, models that assess readiness could ensure that interventions have the best possible chance to be sustainable against a number of dimensions. Similarly, decision support for technology choices could ensure that investment is made in technology that would be used, and that would be appropriate for resource-poor, rural environments.

A review of the articles indicates that work is mostly concerned with a single decision or group of decisions at a time. While some of the work address decisions that are of an collaborative nature (e.g., stakeholder management, inter-organisational decision-making, design, implementation process improvement), it is not evident that integration *of decision-making* is sought between the various levels of the hierarchy and decision support can be considered to be somewhat fragmented relative to the broader context of the ICT4D implementation. Since conflicting and isolated decision-making is a hallmark of problems that require an overall strategic view (Pinson & Moraitis, 1996), this aspect warrants further consideration.

5.7.2.3. Which decision models or approaches are addressed?

Decision techniques or approaches are summarised here. For Themes A and B, and separately for Themes C and D, the decision that is addressed, as well as the technique or approach used to support the decision, is listed (Tables 5.7 and 5.8, respectively). For Theme E, sub-themes are identified from the comments or references to decision-making in the relevant articles (Table 5.9).

Table 5.7 Decision techniques or approaches, per decision type: Themes A and B

Theme	Decision	Reference	Technique or approach used
A.	**Strategic**		
	Intervention selection	Plauche et al., 2010	Morphological analysis, predictive
Decision model		Ravishankar, 2013	Garbage can model of decision-making
	Stakeholder identification and management	Bailur, 2006	Stakeholder theory
	Readiness assessment	Kalema and Kgasi, 2014	Multi-criteria decision-making (MCDM); Analytical Hierarchical Process
	Project risk identification	Kemppainen et al., 2014	Reliability analysis
	Acquisition and scaling	Leon & Schneider, 2012	Analysis of critical dimensions
	Tactical		
	Technology choices	Hussain and Tongia, 2010	Cost analysis (efficiency, effectiveness)
	Design	Mengesha, 2010	Actor-network theory
	Design: roles and software configuration	Nielsen & Saebo, 2016	Functional architecting
	Operational		
	Adoption / uptake	Amin and Abdul-Rahman, 2014	Technology acceptance model, partial least squares
		Bailey and Ngwenyama, 2013	Decision tree; predictive modelling
		Gregor et al., 2014	Causal maps, systems theory
		Zainudeen and Ratmadiwakara, 2011	Regression modelling
	Consumer choice	Mwangi & Brown, 2015	Ethnographic decision trees
B.	**Strategic**		
	Sustainable introduction of ICT	Ziotnikova, 2015	Stakeholder theory, systems description
Decision approach	**Tactical**		
	Design, implementation, resource use	Conger, 2015	Knowledge management
	Design	Muhren et al., 2008	Sense-making as a lens on organisational decision-making
		Sahay et al., 2010	Institutional logics, de-institutionalisation
	Implementation across value chain	Stanforth, 2006	Actor-network theory

Themes A and B

A variety of techniques are represented in Table 5.7. Descriptive models include actor-network theory (Mengesha, 2010; Stanforth, 2006), causal maps (Gregor et al., 2014), and stakeholder theory (Bailur, 2006). Analytical models and approaches include decision trees (Bailey & Ngewnyama, 2013; Mwangi & Brown, 2015), reliability analysis (Kemppainen et al., 2014), and cost analysis (Hussain & Tongia, 2010). Models that address adoption have a causal or predictive focus (Gregor et al., 2014; Zainudeen & Ratmadiwakara, 2011; Bailey & Ngwenyama, 2013), as is the case with morphological analysis for technology selection (Plauche et al., 2010). Models that optimise against objectives include multi-criteria decision-making (Kalema & Kgasi, 2014).

While a number of models focus on single aspects (e.g., technology choice), some approaches are addressing complex, systemic, integrative perspectives. These include systems theory (Gregor et al., 2014), garbage can decision-making (Ravishankar, 2013), stakeholder theory (Bailur, 2006), MCDM (Kalema & Kgasi, 2014), actor-network theory (Mengesha, 2010; Stanforth, 2006), and sense making (Muhren et al., 2008).

The importance of models that can address a systemic perspective is linked to the extent to which change can be facilitated, and (by implication) the extent to which change can be sustained. Gerhan and Mutula (2007) quote Heeks as differentiating between 'deeply and shallowly inscribed development', and identify decision support as a deeply inscribed application that brings change to 'processes, values, competences, systems, etc.' (Gerhan & Mutula, 2007:183).

Themes C and D

Decisions associated with evaluation frameworks and decision support systems are outlined in Table 5.8:

Table 5.8 Decision techniques or approaches: decision support solutions (C) and evaluation frameworks (D)

Theme	Decision	Reference	Technique or approach used
C. Evaluation framework	**Strategic**		
	Continuation and scaling	Heeks, 2010	Various evaluation frameworks, including cost-benefit analyses
		Pade-Khene & Sewry, 2012	Rural evaluation framework
D. Decision support solutions	**Strategic / tactical**		
	Group decision-making capacity	De Vreede & Mgaya, 2006	Group decision support systems
	Farming strategies under uncertainty, including risk management	Panchard et al., 2008	Simulation models, heuristics, forecasting

Evaluation frameworks are highlighted here to emphasize their role in supporting strategic or tactical decisions pertaining to continuation or scaling of interventions, and acquisitions. Decision support solutions can take a variety of forms. In the work under consideration, Group Decision Support systems, as well as risk management approaches such as simulation modelling and forecasting, have been employed (see Table 5.8).

Theme E

An analysis of articles that mention decision-making proved to contain a number of themes that are indicative of decision support requirements or needs in ICT4D.

Table 5.9 Comments pertaining to decision-making or decision support needs

Theme E Sub-theme	Reference	Interpretation
ICT4D has an enabling role in decision-making	Tarafdar et al., 2012	ICT4D has an 'informate' role, which is aimed at improving decision-making
	Gerhan and Mutula, 2007	ICT4D has different reaches in terms of facilitating progress, some of which enables improved decision-making
	Duncombe, 2006	In developing livelihood strategies, information has a role in strengthening the short-term decision-making capacity of the poor, and the longer-term decision-making capacity of the infomediaries. It also has a role in supporting de-centralized decision-making.
	Larsson and Grönlund, 2014	Decision-making is a cross-cutting theme in a survey of e-governance literature, and ICT has a role In supporting decision-making (amongst others, through decision support systems)
Decision processes and structures	Ezz et al., 2009	Well-defined inter-organisational decision processes are critical to successful ICT4D implementations
	Ochara and Mawela, 2015	Local organising forms, bricolage and social networks provide a means of facilitating decision-making around the use and adoption of e-governance
	Easter and Ewins, 2010	Definition of decision-making structures is required at the local level, to ensure appropriate resource allocation
Align decision-making across structures	Larsson and Grönlund, 2014	Local decision-makers must take global standards into account
Coordination is required	Larsson and Grönlund, 2014:144	'Achieving such (societal) goals requires coordination of decisions across actors so that they each can focus on parts where they can find both business benefits for their own part and contribute to the overall greater societal good.'
Participation should influence decision-making	David et al., 2013	Collaboration has no effect unless it influences decision-making
	Steyn et al., 2013	True participation is necessary to enable decision-making
	Duncombe, 2006:97	'Decision-making processes that guide livelihood strategies take place within organisational environments at all levels, including local, sectorial, national, and even global.'
	Larsson and Grönlund, 2014	Different role players (political and non-political) must be involved in decision-making

This analysis confirms the role of decision-making in ICT4D. It emphasizes the need for decision processes and structures, as well as alignment and coordination across structures. Finally, it emphasizes that the focus on participatory approaches are meaningless unless it contributes to improved decision-making, and that coordinated decision-making is required to facilitate livelihood strategies. The key message of this last analysis is one of the need for, and importance of, *coordination of decision-making.*

5.7.2.4. Decision-making in support of value creation

Each ICT4D implementation has an implicit premise of creating value for a community of participants, and an implicit manner of doing so. The concept of a 'value chain' or, more generally, a 'construct of value creation,' is chosen to represent this premise (see Chapter 6 for a more detailed description). To establish the contribution of decision-making within a broader perspective, the role of the decision models that were identified in the literature is mapped against such a construct of value creation.

As a first representation of a construct of value creation, and as a means of mapping the results of the literature review, the ICT4D value chain as defined by Heeks (2014b) is adopted. This representation describes value creation from precursors, through the outcomes chain, to development impact (See 5.7).

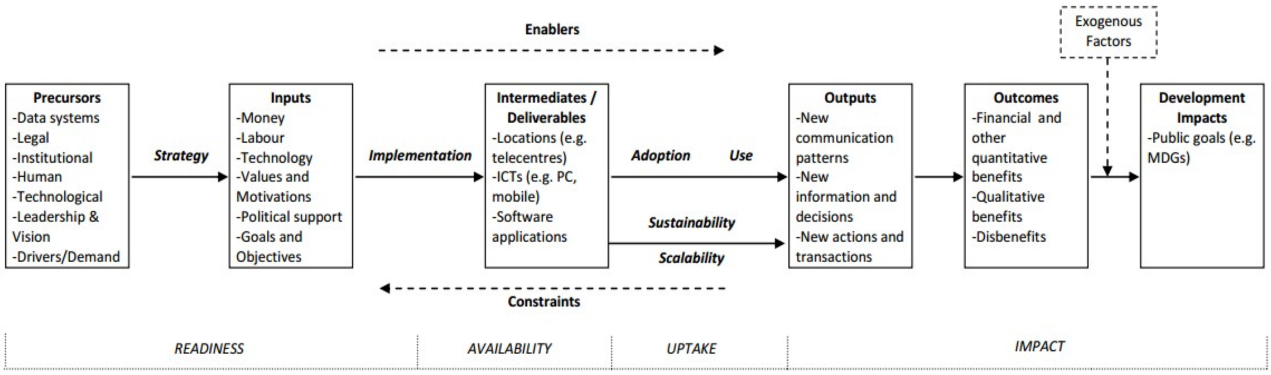


Figure 5.7 ICT4D value chain (Heeks, 2014b).

The decision models, decision approaches, evaluation frameworks, and decision support solutions as identified from the literature (Tables 5.4, 5.5 and 5.6), as well as the gaps in decision-making in ICT4D that were commented on in some of the literature (Table 5.7), are mapped. The purpose of the mapping is to take an integrative view on decision-making as a means of value creation, and to assess the extent to which decision models have been, and could be, used to support value creation.

The mapping is represented in Figure 5.8.

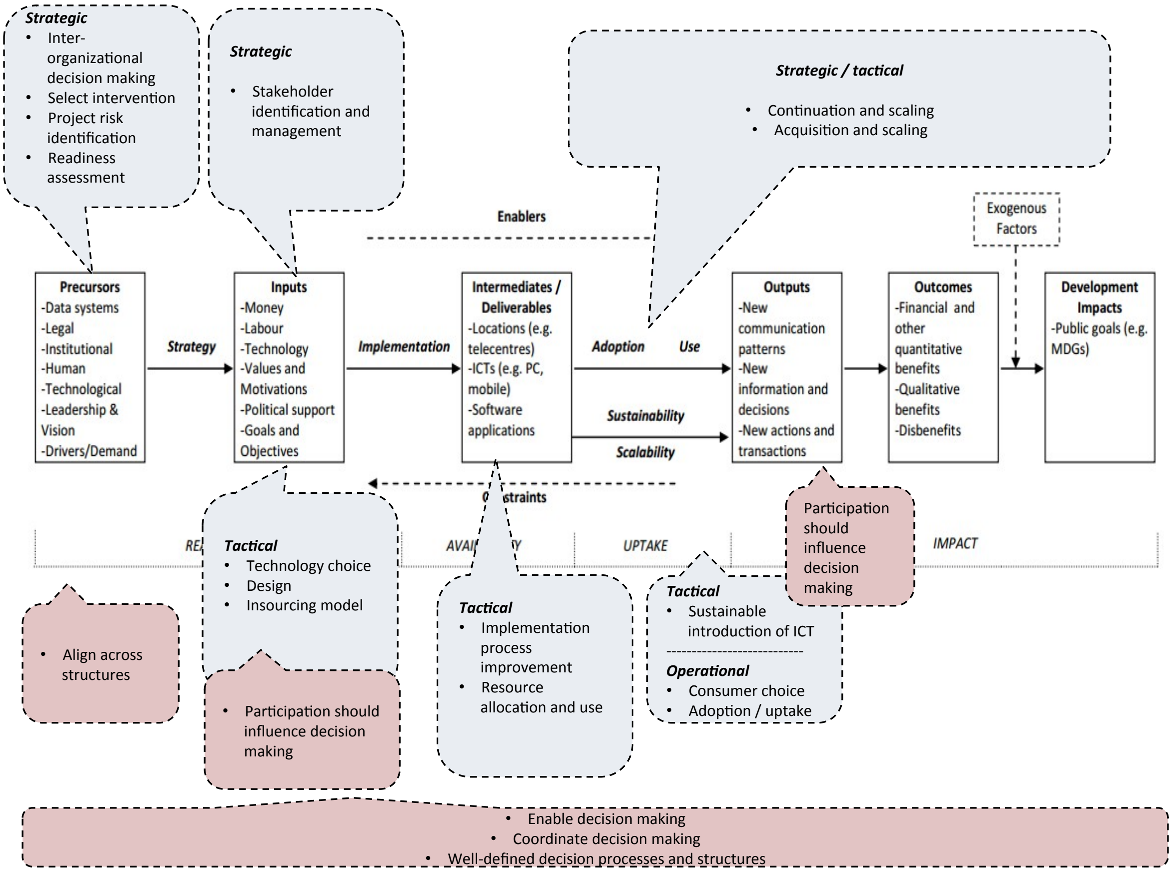


Figure 5.8 Map of decision models against the ICT4D value chain (modified from Heeks 2014b)

In Figure 5.8, decision models are mapped to indicate their appropriate role in the value chain (grey blocks), and their sphere of influence (strategic, tactical, and operational).

This representation indicates that decision models are employed along almost all elements of the value chain, but with an emphasis on the earlier parts of the chain (except for evaluation frameworks, models do not focus on the impact part of the chain). Operational models are limited to consumer choice and uptake decisions, while strategic and tactical models focus on the precursor, inputs, and deliverables of the chain. Scope exists to explore the role of models in the later sections of the chain.

The subthemes that were identified in Theme E were similarly mapped. These subthemes mostly highlight aspects that authors feel should be addressed by decision-making in ICT4D. The focus is strongly on providing the structures and processes across organisational boundaries that would facilitate decision-making, on aligning decision-making across levels of the (inter)-organisational hierarchy, and on coordinating decision-making across role players. The validity of these comments are reinforced by the fact that the various models outlined in literature are used to support single decisions in a specific implementation, and that (while some approaches can engage with complexity and systemic perspectives), the focus on integration and coordination across decision-makers, and alignment of decision-making, is limited. Further, these views are in support of the premise of this research, namely that (inter)-organisational performance results from the sum of multiple decisions (see Section 5.2).

5.8. IMPLICATIONS FOR DECISION FRAMEWORK

As for previous chapters, implications for the decision framework are deduced from the literature review and the subsequent discussion. Based on the extent to which decision-making is currently employed (i.e., what is possible) and the gaps that were identified, it is proposed that the following principles inform the decision framework:

Table 5.10 Concepts of decision-making in ICT4D, to inform decision framework

	The decision framework should:	Reference to discussion
Multiple perspec-tives	Support decisions at multiple levels of an organisation or collective (e.g., strategic, tactical, operational).	5.7.2.2
Technique indepen-dent	Be independent of technique, and allow for decision models of different types and from different perspectives (e.g., single decision view vs. systemic views; analytical, predictive, optimal, etc.)	5.7.2.3
Align-ment	Facilitate alignment of decision-making across multiple levels of an organisational system or collective.	5.7.2.3 5.7.2.4
Integration and coordina-tion	Facilitate integration and coordination of decision-making between decisions and decision-makers	5.7.2.3 5.7.2.4
Process and structure	Be cognisant of the decision processes and structures that are required across different levels of organisations and role players for successful decision-making	5.7.2.3 5.7.2.4
Systemic perspec -tives	Allow for systemic and integrative perspectives on the complexity of ICT4D implementations	5.7.2.3
Value crea-tion	Support a process of value creation	5.7.2.4

As in Chapter 3, this analysis of the current application of decision models and associated gaps emphasize that a proposed decision framework should be able to deal with decision-making from multiple and systemic perspectives, facilitate integration and coordination, recognise and/or enable processes and structures, be technique-independent and, importantly, support a process of value creation.

5.9. SUMMARY

This literature review contributed a perspective on the current approaches to decision-making in ICT4D. It set out to answer the following derived question (Section 5.4.2):

What are the approaches that are used in decision-making or decision support in ICT4D?

This question was answered by mapping the results of the review from various perspectives. First, literature was divided into themes that indicate the extent to which decision support is applied or discussed (Section 5.7.2.1). The types of decisions and their sphere of influence were outlined in Section 5.7.2.2; the question was then answered in Section 5.7.2.3, where models and approaches were summarised. Approaches were then contextualised against their role in value creation (Section 5.7.2.4).

The question outlined above was defined so that a number of sub-questions of the main research question could be answered. These sub-questions, and the extent to which they were answered by this chapter, are as follows:

Sub-question 3

What are the categories of decisions that should be considered when developing an ICT4D intervention, in order to catalyse the delivery of sustained benefit?

The literature survey indicates that decisions should be categorised in a manner that facilitates decision-making across different levels of an (inter)-organisational hierarchy. A classification of decision models and approaches according to their sphere of influence (strategic, tactical, and operational) proved possible, and could be potentially useful in aligning decision-making across various hierarchical levels.

Sub-question 4

What strategies for decision support could be useful to support decisions that influence sustained benefit?

This survey culminated in recommendations for the decision framework (Section 5.8), which emphasize that the framework should be technique-independent, and should focus on integration and coordination across hierarchies and between decision-makers. The latter is a key consideration for sustainability, since uncoordinated decision-making has the potential to invalidate progress and frustrate impact (see for example Larsson, 2014). Decision support strategies should therefore in the first place focus on integration and alignment, while being sufficiently flexible not to discard any decision approach that could contribute to sustainability.

Sub-question 5

What decision process, or other concept of value creation, should be used for contextualisation of the decision tools or models for sustained benefit?

This chapter proposed that a ‘construct of value creation’ be used against which the decision models should be mapped. As a first application of such a construct, the ICT4D value chain of Heeks (2014b) was used. It proved helpful as a framework against which the focus of, and gaps in, decision-making could be positioned. The value thereof lies in the fact that (in a specific implementation) the completeness of decision support, as well as alignment between decisions, could be emphasized. In addition, it could be useful in focusing decision-makers on their role within the bigger premise upon which the implementation is striving to create value. This first application will be explored further in Chapter 6, amongst others by testing alternative constructs of value creation (e.g., logistics value chains) against which to position decision-making.

In addition to answering these three sub-questions, implications were derived for the decision framework, based on a review of decision support in ICT4D. These implications will be combined in Chapter 6 with the implications derived from the earlier literature reviews, to provide a basis from which the decision framework will be conceptualized.

CHAPTER 6. DECISION FRAMEWORK

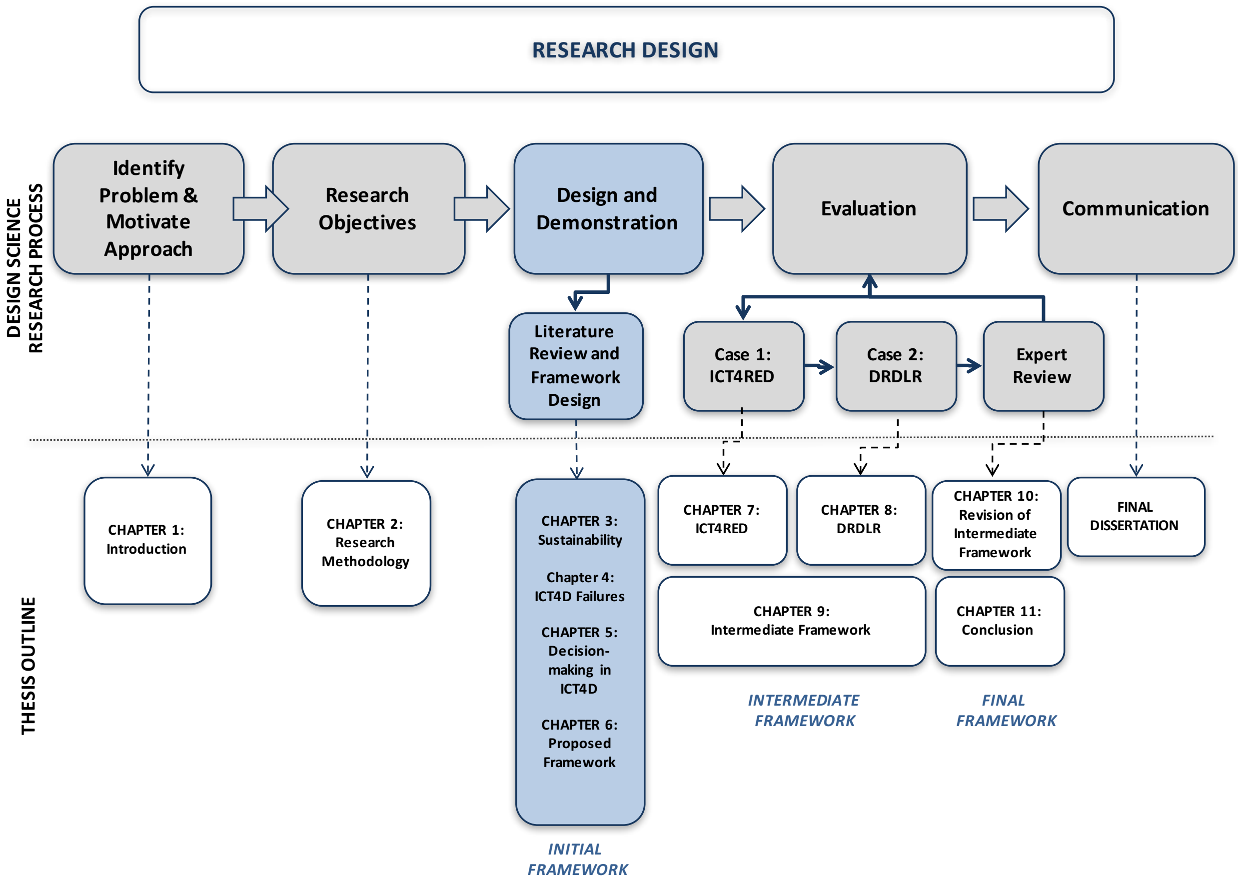


Figure 6.1 Research process and thesis outline: Chapter 6

6.1. INTRODUCTION

This chapter develops an initial decision framework, which constitutes the first deliverable of the Design Science Research framework of Peffers et al. (2007) (Figure 2.5). This initial framework results from the literature reviews described in the previous chapters, which culminated in implications for a decision framework based on an exploration of sustainability and sustained benefit, failures, and decision-making in ICT4D (see Figure 6.1). These implications indicate that the framework should accommodate complexity, multiple perspectives, integration, coordination, and systemic perspectives. It should be cognisant of decision processes and structures, have a goal focus, and support a process of value creation (see Section 6.2.2 for a summary).

This chapter defines the decision framework to meet these requirements. It provides an initial answer to the main research question of the thesis, namely:

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

Following a summary of framework requirements, decision-making in ICT4D is defined (Section 6.3.2). Such a definition is necessary, since the constructs that are used to resolve a decision problem depends on the nature of the problem under consideration. The literature review of decision-making in ICT4D indicates that the current focus is on resolving very specific sub-problems of an ICT4D intervention through decision analysis or decision modelling (for example, how to scale a project or how to select technology; see Chapter 5). The definition of decision-making in ICT4D that is developed in this chapter is in accordance with the requirements to coordinate, integrate, and align across complexity. It therefore seeks to integrate across the decision sub-problems that occur within an ICT4D intervention. The definition is developed by exploring the different dimensions of the messy ICT4D problem environment (Sections 1.3.3, 5.2), and by defining the decision problem relative to such dimensions.

This chapter adds an exploration of additional decision-making literature to the knowledge base of the design phase. Specifically, given the role of the framework in addressing complexity, approaches to complexity as applied in the fields of Decision Science, Operations Research, and Management Science are considered (see Section 6.4). This literature is introduced in this chapter, rather than as a complete literature review earlier in the document, since the building blocks of the decision framework were required before further relevant decision literature could be identified. A number of decision approaches are discussed and their relevance to the decision framework is summarised. The intention is not to provide a holistic review of decision-making in complexity; rather, to establish the way in which formal techniques could be used to support decision-making in the context of the decision framework. The chapter therefore proceeds as follows (Figure 6.2).

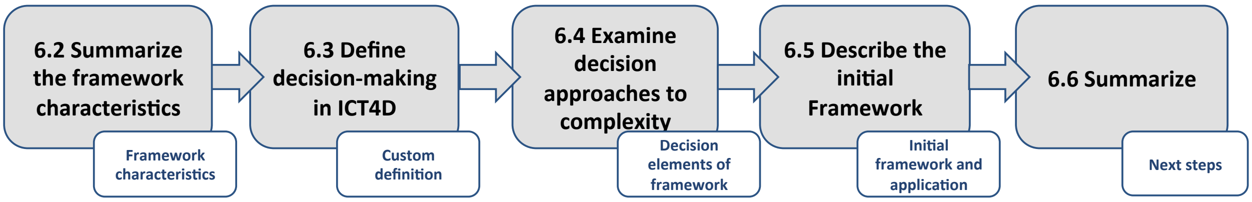
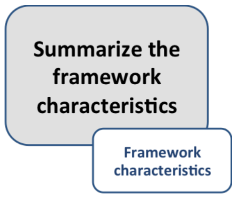


Figure 6.2 Process to derive initial decision framework

Section 6.2 discusses the role of the decision framework and summarises its characteristics, based on the earlier literature reviews. Section 6.3 then develops a custom definition for the decision problem in ICT4D for the purpose of this study. In Section 6.4, selected decision approaches to complex problems, and their relevance to the decision framework, are discussed. Section 6.5 describes the initial decision framework and its practical application, and Section 6.6 summarises.

6.2. THE ROLE OF THE DECISION FRAMEWORK

6.2.1. Role



Zlotnikova and Van der Weide (2016) define a framework as a set of ideas or facts that provide support for something. In Chapter 1, a differentiation was made between conceptual, theoretical, and research frameworks (Hassan, 2014), and it was indicated that this research would develop a conceptual framework (Section 1.2). As such, the framework would represent ‘ways of thinking about a problem or study, or ways of representing how complex things work’ (Bordage, 2009; Section 1.2).

In Chapter 5, the proposed ***decision framework*** is positioned relative to the definition of *problem solving* of Anderson et al. (2016):

‘the process of identifying a difference between the actual and desired state of affairs and then taking action to resolve the difference.’

This generic definition accommodates the discrepancy between the intent behind ICT4D interventions and the way in which such intent plays out in practice. The decision framework will be considered a guideline that could assist in the resolution of such differences (Section 5.2). Considering Zlotnikova and van der Weide (2016), the decision framework would then be a set of ideas or facts in support of decision-making in ICT4D. It is therefore seen as a bridge between complex and often conflicting decisions, and the value that the ICT4D intervention seeks to deliver.

6.2.2. Characteristics

The literature reviews in Chapters 3, 4, and 5 resulted in the definition of characteristics of a decision framework. The first two reviews (Chapters 3 and 4) examined approaches to sustainability and failures in ICT4D, and determined the characteristics of a framework to overcome failures and support sustainability (or: sustained benefit).

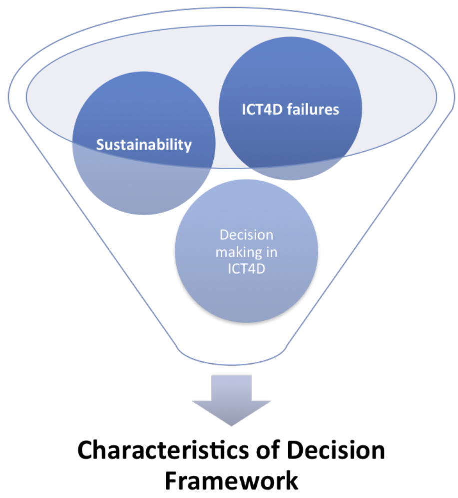


Figure 6.3 Process to derive characteristics of decision framework

The review in Chapter 5 examined current approaches in decision-making in ICT4D and identified, based on current approaches and gaps in decision approaches, elements of the decision framework.

These two sets of characteristics jointly define the characteristics of a decision framework in ICT4D. The characteristics are depicted in Table 6.1; similar characteristics are grouped and aligned to provide a comprehensive overview. For example, ‘goal focus’ and ‘value creation’ are aligned to reveal the concept of pursuit of an objective, while ‘complex’ is aligned with ‘technique-independent’ and ‘multiple perspectives’ to denote some of the characteristics that point towards complexity.

Table 6.1 Characteristics of decision framework, based on the literature reviews of Chapters 3, 4, and 5

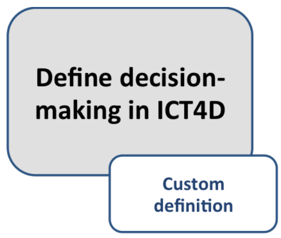
Charac-teristic	Based on sustainability and failure considerations, the decision framework should: (see Table 4.7)	Charac-teristic	Based on current decision approaches and gaps, the decision framework should: (see Table 5.10)
Complex	Be multi-dimensional	Technique-independent	Be independent of technique, and allow for decision models of different types and from different perspectives (e.g., single decision view vs. systemic views; analytical, predictive, optimal, etc.)
	Consider value chain or systemic perspectives	Multiple perspectives	Support decisions at multiple levels of an organisation (e.g., strategic, tactical, operational).
	Consider success or failure as the result of multiple integrated processes (research, design, implementation, etc.)		
Dynamic, holistic, integrative	Accommodate a dynamic / progressive sustainability concept Should focus on integration of perspectives to reduce failure, rather than on understanding failure Should be based on generic principles rather than being case-specific	Systemic perspectives	Allow for systemic and integrative perspectives on the complexity of ICT4D interventions
Goal focus	Facilitate realism in terms of the role and objectives of ICT4D in development	Value creation	Support a process of value creation
	Guide towards clear objectives and reduce goal-diffusion		
	Support a process of value creation		
Plan and align	Be context-specific	Alignment	
	Allow for alignment with (any) underlying development approach		Facilitate alignment of decision-making across multiple levels of an organisational system.
	Consider sustainability up-front as part of the design, while allowing for both intended and unintended benefits.		
	Consider sustainability at the outset of the implementation, in terms of: • What needs to be sustained • For how long • By whom • For whom • Relative priorities of different types of benefits	Integration and coordination	Facilitate integration and coordination of decision-making between decisions and decision-makers
Opera-tional	Consider sustainability as embedded in the way of work	Process and structure	Be cognisant of the decision processes and structures that are required across different levels of organisations and role players for successful decision-making

The characteristics outlined here position the decision framework within a decision process that is aimed at facilitating sustainability, and highlight its role. Based on these characteristics, the decision framework should:

- Assume that decision-making in ICT4D is complex
- Take a holistic, integrative, and systemic perspective on decision-making;
- Take a holistic, integrative and systemic perspective on sustainability;
- Allow for multiple decision-making perspectives (strategic, tactical, operational);
- Re-think decision goals and alternatives in terms of a process of value creation;
- Allow for multiple, technique-independent decision models;
- Facilitate integration and coordination between decisions and decision-makers.
- Facilitate planning *for* sustained benefit;
- Facilitate planning and alignment across development perspectives;
- Facilitate planning and alignment across different levels of a decision hierarchy;
- Consider sustainability as inherent in operations; and
- Consider decision processes and structures as part of decision-making.

The literature reviews indicate that the decision framework should be based on these points. As such, it provides a baseline from which to construct the definition of decision-making in ICT4D (Section 6.3), the nature of decision approaches that are considered (Section 6.4), and the nature of the initial framework (Section 6.5).

6.3. DEFINING DECISION-MAKING IN ICT4D



This section defines decision-making in ICT4D. The definition serves two purposes. First, it delineates the decision problem that is addressed by the framework (i.e., what is included and what is excluded by the framework). Second, it assists with defining the manner in which the framework should integrate the various elements to guide and support decision-making. The definition is constructed by first defining the concepts related to decision-making, as background (Section 6.3.1). This is followed by an exploration of the various dimensions of the decision problem in ICT4D (Section 6.3.2), after which the information is integrated to define decision-making in ICT4D (Section 6.3.3).

6.3.1. Decision concepts

In its simplest form, decision-making refers to a choice between alternatives, in order to achieve a goal (Turban & Anderson, 2005). Much has been written about the way in which decisions are made in practice – the spectrum ranges from intuition and *gut feel*, to analytical methods that follow a rational process to seek the *optimal* or *best* solution from a set of alternatives (Blenko et al*.,* 2010; Fainberg, 2009; Moore & Thomas, 1988; Russo & Schoemaker, 2002; Snowden & Boone, 2007). Two opposing approaches can be identified, namely *classical* or ***perfect rationality*** and ***bounded rationality*** (Turpin & Marais, 2004)*.* In *classical rationality*, knowledge is perfect and the capacity exists to process all relevant information and make an optimal choice from all possible alternatives (which are known to the decision-maker). In *bounded rationality*, the decision problem is complex, and decision-makers search for the 'right' course of action in a complex situation (Turpin & Marais, 2004). In this case, programmed decision-making is not possible, since the decisions are novel, complex, and value-laden (Pries-Heje & Baskerville, 2008). Alternatives are limited, and a 'satisficing' solution is sought (Turpin & Marais, 2004).

In ***complex decision problems*** such as those of business and government, it has been claimed that decisions are mostly based on intuition or past leadership styles, rather than on rationality (Moore and Thomas, 1988; Turban et al., 2005; Turpin & Marais, 2004; Snowden & Boone, 2007). Alternatively, the resolution to complex decision-making is seen as rooted in the integration of knowledge from disciplines, societies, organisations, and individuals, and the interactions between them (Raadschelders and Whetsell, 2017), or in the manner in which social networks function (Chaki et al., 2017). Regardless of these views, increasing complexity leads to increased uncertainty and increasing costs of potential errors, and demands quicker decisions – all of which call for structure and support (Turban & Aronson, 2005; Tremblay et al., 2017).

The ***complexity of decision-making*** increases as the number of decision-makers or agents increase from single to multiple; the number of objectives increase (and are possibly conflicting); and uncertainty about decision parameters increases. Further, complexity is associated with decision problems that are ill defined or unstructured (Checkland, 1981), as well as with a decision environment in which there is an information overload, where decisions are more important and stakes are higher, and where opportunities to correct mistakes are fewer (Russo & Schoemaker, 2002).

Decision modeling provides a means of making sense of decisions, and assists decision-makers to move forward with a decision problem. It comprises the process of conceptualising a problem, formulating it to enable the development of a quantitative model (if appropriate), analysing results and sensitivities, and considering implementation issues (Daellenbach, 1998). A ***decision model*** is defined as a method or technique that helps decision-makers to choose among a discrete set of alternatives (Triantaphyllou, 2000). Decision modeling includes a wide range of techniques and methods, such as systems modeling; mathematical modeling (e.g., linear programming, multi-criteria decision-making); stochastic systems and models; discrete event simulation; decision analysis (Daellenbach, 1998); and, finally, problem structuring methods, such as soft systems methodology (Checkland, 1981).

The majority of decision problems are subject to some form of uncertainty or complexity, and ***problem structuring****,* which forms part of decision modeling, refers to approaches that reduce complex decisions to ones that could be addressed by analytical methods (Moore and Thomas, 1988). In many instances, the process of structuring and/or analysing the decision is seen as a learning process (Moore and Thomas, 1988), which in itself may lead to a solution before complex analytical or modeling work is done. The decision concepts outlined here specifically refer to complexity in decision-making, and are relevant to the analysis and definition of the ICT4D decision problem.

6.3.2. The decision problem in ICT4D

The *decision problem* in ICT4D, as it relates to this study, is examined in this section. An overview of the problem environment sets the context for the analysis (Section 6.3.2.1). Thereafter, the dimensions of the decision problem are defined, and used as a means of characterising the decision problem in ICT4D and of comparing a progression of decision problems, from simple to complex to the messy problems of ICT4D (Section 6.3.2.2). The purpose of the comparison is to illuminate differences between different types of decision problems, so that a customised and well-delineated definition can be derived.

6.3.2.1. Overview

Decision problems are defined in terms of their fundamental characteristics, and differ in different contexts. Snowden and Boone (2007) define a progression of decision problems – from simple through complicated, complex, chaotic to disorder – based on the relationship between cause and effect, and devise strategies for each context.

Implementing ICT in development has been described as a 'messy' problem (Section 1.3.3), which defines the context for the decision problem. Chapter 1 defined the characteristics of a messy problem (based on Hevner et al., 2004), and compared it with ICT4D problem and solution environments (see Section 1.3.3). The comparative table is expanded here, to highlight additional challenges in ICT4D, that may not be relevant in more structured first-world interpretations of messy problems, as referred to in Section 1.3.3. This more complex problem environment requires different approaches to messy problems, while also affording the possibility of extending the approaches that are traditionally considered appropriate to messy environments.

Table 6.2 Characteristics of ICT4D problems mapped to characteristics of messy problems

Characteristics of messy problems (Hevner et al., 2004)	ICT4D problem and solution environment
Ill-defined	
Unstable requirements and constraints based upon ill-defined environmental contexts.	Unclear, sometimes conflicting objectives Ambitious solution concept to be introduced in unfamiliar cultural and socio-economic environment Unknown decision-making structures, processes, and agendas, that may not be evident from limited interactions, and that may not be made available on request. Difficulty to assess the real development needs of the community (Krause, 2013).
Complex	
Complex interactions among subcomponents of the problem and its solution.	Multiple role players with differing agendas Multiple funders, fragmented budgets Unfamiliar implementation environment Resource-rich solutions for resource-poor environments A need to incorporate context-specific social and cultural issues in the design of the solution (Sarrica *et al*, 2017)
Requires flexible solutions, dependent on human abilities	
Inherent flexibility to change design processes as well as design artefacts (i.e., malleable processes and artefacts). A critical dependence upon human cognitive abilities (e.g., creativity) to produce effective solutions. A critical dependence upon human social abilities (e.g., teamwork) to produce effective solutions.	Unexpected implementation challenges Limited literacy Remote locations Low skills base Low technology base M&E approaches that focus on verifying transactions rather than informing delivery of value Assumptions that solutions are appropriate to the environment, without being cognisant of community value systems (Krause, 2013).

This comparison confirms the ‘messy’ nature of ICT4D decision problems, and identifies the *ill-defined* nature of messy problems as related to unclear and conflicting objectives. *Complexity* is embodied by fragmentation of resources, conflict between agendas, and a clash between environments of differing resources. Finally, the required *flexibility* relates to the characteristics of the implementation environment, and the need for implementations to adapt to the unfamiliarity of these environments. This confirmation of the complexity of the ICT4D decision environment, the next section explores the dimensions of decision problems, as they increase from simple to complex to messy.

6.3.2.2. Dimensions of decision problem

In defining the *dimensions* of a decision problem, the scope and nature of the problem, and the nature of approaches that should be followed, become clear. For example, a simple decision problem with a single *decision-maker* and a clear, quantifiable *objective* could be solved by assigning values to different outcomes, and choosing the most beneficial outcome. On the other hand, decisions with multiple *decision-makers* and multiple, conflicting *objectives* require decision approaches that enable participants to reach appropriate compromises.

The dimensions of a decision problem can be defined from various perspectives. For example, Moore and Thomas, 1988 defines the structure of a decision problem in terms of its objectives (single or multiple); a range of possible options, solutions, strategies or courses of action; the level of uncertainty associated with assumptions and information; and the value of each possible outcome. Similarly, Grüner and Kühn (2013) use dimensions that can be classified in terms of the inherent nature of the problem (i.e., degree of complexity, well- or ill-structured, problem character, and level); the structure within which it occurs (i.e., link to other decision problems); and the nature of decision-making (i.e., single or collective, number of goals, and ability to predict consequences).

By abstracting and integrating to these dimensions, it is proposed that the following dimensions are used against which to explore the characteristics of an ICT4D decision problem:

Table 6.3 Dimensions of decision-making in ICT4D, based on an integration of the dimensions listed above

	Dimension	Range
A	**Complexity**	Simple or complex, individual or linked?
B	**Goal**	Single or multiple?
C	**Decision-makers**	Single or multiple?
D	**Solution space**	Can an optimal solution be found, or are incremental solution strategies appropriate?
E	**Value of alternatives**	Against which concept of value are alternatives assessed, and how is value of alternatives determined?
F	**Constraints**	Limited or unlimited resources?
G	**Extent of uncertainty**	Predictable or unpredictable
H	**Alignment of decision-makers**	Which entities need to be aligned?
I	**Decision power and control**	In which (organisational) structure is decision power and control defined

Based on these dimensions, decision problems can be classified from simple to complex. In the paragraphs that follow, each dimension is explored along this progression, and the dimensions of an ICT4D decision problem is highlighted. These dimensions will now be discussed in further detail with evidence, use, and examples.

A, B, C: Complexity, goal, and decision-makers

In simple decision-making, the objective is clear, the gain between different alternatives is quantifiable (e.g., Daellenbach, 2002; Moore & Thomas, 1988; Snowden & Boone, 2007), and the decision is often made by single decision-makers. However, complexity is introduced as the *number of objectives* as well as the *number of decision-makers* increase. Multiple objectives require trade-offs between conflicts (e.g., Belton & Stewart, 2010; Daellenbach, 2002), while multiple decision-makers represent differing world views, which introduces conflict (Pries-Heje & Baskerville, 2008) that could potentially destroy value. Complexity is also related to aspects such as the clarity of the goal, and the ease with which problem boundaries can be defined.

D: Solution space

When decision problems are simple, or when complex problems have been conceptualised as quantifiable, the solution space becomes known and well-defined, and the alternatives are clear. For example, when a single decision-maker needs to decide which car to buy, based on the fact that the only objective is to obtain the cheapest car with a certain engine capacity, the solution space is limited to the cars of that engine capacity on the market, and a single optimal or 'best' solution exists. However, as complexity increases towards messy problems, the solution space becomes more ill-defined (e.g., Moore & Thomas, 1988) and unbounded; it is difficult to establish alternatives and evaluate solutions; and solutions are irreversible (Pries-Heje & Baskerville, 2008).

Similarly, constraints become unclear and the boundaries of the system under consideration becomes fuzzy. For example, if different stakeholders want to invest in a community project, each stakeholder may have a different objective (e.g., capacity building, profit) and hence each stakeholder woud have a different 'best' or 'feasible' solution, some of which may be mutually exclusive. The solution space is defined by the collection of all solutions that are deemed feasible as well as acceptable to all stakeholders. Agreement needs to be reached as to which solutions will be unacceptable, and boundaries may vary depending on the nature of agreements.

This raises the question of 'how much better' is possible. When clear, quantifiable alternatives are available, a 'best' can be chosen. In more complex environments, 'better' is subjective and driven by multiple perspectives, and a feasible rather than an optimal solution is sought. Similarly, messy problems do not have clear-cut solutions. Solutions can only be denoted as good or bad, instead of true of false (Pries-Heje & Baskerville, 2008). In his analysis of a better world as related to ICT4D, Sahay (2016) includes (amongst others) '*a recognition of the alternative paths that exist towards harmony*'. Similarly, sustainability as a maturity concept alludes to a process or pathway towards sustainability (e.g., Breytenbach, De Villiers, & Jordaan, 2013). Finally, Russo & Schoemaker (2002:3), state '*your best hope for a good decision outcome is a good decision process.*'

In this research, it is proposed that decision-making is not thought of as a choice from a number of options that exist within a pre-defined (or pre-negotiated) solution space. Instead, it is proposed that decisions are seen as milestones on a path towards value creation, and that choices between options are guided by the extent to which they contribute to, or detract from, long-term value creation (see Section 5.7.2.4).

E. Value of alternatives

In simple decisions, alternatives can be evaluated against a clear objective function. In an environment where multiple role players make multiple decisions, alternatives can be evaluated by approaches such as Multi-Criteria Decision Analysis (e.g., Daellenbach, 2002). However, in 'messy' problems, it is not clear how to evaluate alternative solutions (Pries-Heje & Baskerville, 2008). In this research, and in accordance with the previous paragraph, it is proposed that a mechanism of value creation is used to make the impact of alternatives visible (see Section 5.7.2.4 and Table 5.10).

F. Constraints

In an abundant environment, for example in resource-rich environments where finances, skills, and capacity to innovate are (almost) unlimited, a wide spectrum of solutions can be pursued without consideration of resource availability. In a constrained environment, a 'best' or merely 'better' solution is limited by the availability of resources.

G. Extent of uncertainty

Simple problems have lower levels of uncertainty related to the question to be answered, the data that is used, and the nature of solutions. In complex environments, multiple interactions introduce uncertainty. Uncertainty is introduced in messy problems by unstable requirements and constraints, and ill-defined contexts (Hevner et al., 2004).

H. Alignment of decision-maker(s)

In single-agent problems, decision power is rooted in a single individual, and the value of alternatives or the relative importance of multiple objectives is not collectively debated. However, with the introduction of multiple decision-makers (or decision-making units within an organisation), alignment and conflict management is critical. Conflict can arise in the decisions of multiple role players due to different views on objectives and how to achieve them. For example, strategic planning is described as a complex and ill-structured problem (Pinson & Moraïtis, 1997). A hallmark of this problem is that *'partial solutions are generated without having a complete view of the global objective…often generates incoherent and contradictory hypotheses and actions.'* The challenge is to *'find a way to achieve coherence and coordination among decisions made locally by different agents, at different levels*' (Pinson & Moraitis, 1997:77).

The need to integrate and align decision-making in ICT4D across a hierarchy has been highlighted (Chapter 5). For example, Larsson and Grönlund (2014) emphasize:

'Achieving such (societal) goals requires coordination of decisions across actors so that they each can focus on parts where they can find both business benefits for their own part and contribute to the overall greater societal good.'

I. Decision power and control

The people or structures within which power and control are seated have the potential to determine the outcome of a decision. In ICT4D, the unequal resources and power balance between funders and communities are often emphasized, as is the power balance between local organisations or local traditional leaders and communities. For equitable outcomes, inequity in decision power and control needs to be recognised and balanced, and inclusiveness becomes part of the decision problem.

The dimensions of decision problems are summarised in Table 6.4, in a progression from simple to complex. The dimensions of ICT4D problems are proposed in the last column.

Table 6.4 A progression of decision problems, based on the discussion in this section

	Dimension	Simple Decision Problem	Complex Decision Problem	Decision problem in ICT4D
A	Complexity	Simple	Complex	Messy
B	Goal	Single, clear goal	Multiple (conflicting) objectives	Value creation in complex environment
C	Decision-makers	Single	Multiple, known	Multiple, not all known
D	Solution space	Optimality is possible	A compromise is reached relative to optimality	Optimality (and a good solution) is difficult to define
E	Value of alternatives	Can be calculated definitively	Can be estimated, given uncertainty	Difficult to assess; requires discussion against an agreed construct.
F	Constraints	Defined by extent of resources relative to possible solutions		Resource-poor, relative to solution space
G	Extent of uncertainty	Low	High	High
H	Alignment of decision-making	Individual	Aligned within formal structure	Multiple formal and informal structures
I	Decision power and control	Single individual controls	Power and control plays out within formal structure	Power, control, and influence play out in a network of formal and informal role players

This research is concerned with decision-making for sustained benefit. In a complex, 'messy' environment, the ability to create benefit is affected at multiple levels, such as lack of clarity about objectives, isolated decision-making, insufficient access to resources, and resource-rich solutions in resource-poor environments. An integrative view on decision-making is expected to address sustainability by making these sources of unsustainability visible, and by aligning decision-making towards eliminating conflicts.

6.3.3. Definition: decision-making in ICT4D

The previous section delineated the scope and nature of the problem by defining decision-making in ICT4D against a number of dimensions. In this section, this information is summarised and integrated in a customised definition of decision-making in ICT4D. This is done by defining the decisions that are made, the nature of the objective (i.e., what can be achieved), the decision-makers, key considerations, and resource constraints, based on the different dimensions of the decision problem. For each of these questions, the relevant dimensions are indicated. Finally, given the focus of the thesis, the link to sustainability is considered.

A, B: *Which decisions?*

The literature review indicated that a number of decision support methods are employed in ICT4D, at the strategic, tactical, and operational levels of an implementation (see Chapter 5). It further indicated that opportunity exists to integrate and align across decisions. For this research, the decision under consideration is defined as a *process* rather than a *single decision* (see also Larsson & Grönlund, 2014; Pinson & Moraitis, 1997) – specifically as a process in which sub-decisions are integrated and aligned in accordance with the value that the implementation seeks to create.

C: *Who are the decision-makers?*

It is assumed that multiple decision-makers, who are formally and informally associated with the intervention, affect the outcome. This network of decision-makers functions at strategic, tactical, or operational levels. Their decision power depends on the environment in which they contribute, and decision powers and influences are unequal. In an ideal world, such influences should be understood, balanced, and influenced relative to overall value creation.

D, E: *What can be achieved (or what is a 'good' decision)?*

The concept of value is critical for good decision-making. Keeney (1992:9) states:

'What is missing in most decision-making methodologies is a philosophical approach and methodological help to understand and articulate values and to use them to identify decision opportunities and to create alternatives.'

The objective of a messy problem is difficult to define (Checkland, 1981). Complex or messy problems are subject to multiple interactions and uncertainties, and an optimal decision is therefore not possible. Indeed, the alternative solutions for each decision are so different that analytical criteria do not apply to all solutions, leading to the inability to apply conventional decision techniques (Pries-Heje & Baskerville, 2008). Further, an optimal solution to a sub-problem of the original may have negative implications on the overall capacity to arrive at a good decision. For example, the use of least-cost technology may minimise a specific part of the budget, but may result in technology choices that are not appropriate to the environment in which it is to be used.

However, all development interventions have an implicit or explicit basis upon which value is created. For example, implementations are aimed at delivering a 'Return on Investment' for funders, as defined by an assumed theory of change (e.g., Emmi et al., 2011). Similarly, an ICT4D value chain could be adopted as a manner in which value is created through an implementation (Heeks, 2014b). This study assumes that a construct of value creation underlies an ICT4D intervention, and that the objective of decision-making is to contribute to overall value creation by aligning decisions and decision-makers relative to a construct of value creation. A 'good decision' is therefore defined as one that supports the overall value creation of the implementation, without constraining the value contributed by other decisions relative to the value that is sought.

F. *How are resource constraints represented?*

Resource constraints influence the nature and extent of possible solutions, that is, the size of the solution space, and whether or not an 'optimal' solution can be achieved.

G, H, I: *What needs to be considered?*

The inherent complexity of the problem, high levels of uncertainty, multiple decision-makers, and the influences of their relative power positions need to be considered. In addition, an awareness of the influence of unaligned and conflicting decisions on overall decision outcomes is important. In complex systems, emergence refers to the fact that solutions (or other characteristics) arise from circumstances (and are not imposed)

(Snowden & Boone, 2007). These are the result of interactions between different subsystems, and create unpredictability and complexity. As such, the potential unintended consequences of decisions on a complex system and on other decisions need to be kept in mind when designing solutions (Snowden & Boone, 2007). Further, the temporal nature of outcomes (short, medium, long term) needs to be considered.

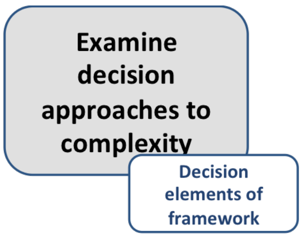
What about sustainability?

Sustainability is defined in the context of the capacity of the network of decision-makers to focus decisions towards sustained benefit, and to minimise the adverse effects of their decisions on the ability of others to contribute towards sustained benefit.

Based on the discussion in this section, decision-making in ICT4D is defined as follows for this study:

'A network of decision-makers seek solutions to an individual or collective decision by evaluating the decision outcome relative to its contribution to an agreed construct of value creation, within resource constraints'

6.4. DECISION APPROACHES TO COMPLEXITY



A key characteristic of the decision framework, as defined in the literature reviews, is that it should accommodate complexity. Earlier literature reviews focused on decision-making in ICT4D, but did not consider decision-making in other contexts. This section summarises approaches that could be relevant when resolving complex or messy decision problems. It was not addressed before as a separate literature review, since the nature of the problem had to be known before appropriate approaches could be explored. The intent is not to provide a comprehensive overview, but rather to gain insight into approaches that are relevant and useful in addressing complexity. Approaches were collated from literature in Operations Research and Management Science with which the researcher is familiar, as well as from literature obtained through the review of decision-making in ICT4D (Chapter 5).

Approaches are categorised relative to their role in addressing complexity, as follows: systems and complexity (Section 6.4.1), problem structuring (Section 6.4.2), organisational and decision structures (Section 6.4.3), constructs of value creation (Section 6.4.4), and project or decision processes (Section 6.4.5). In the discussion of each approach, the relevance for decision-making in complexity and ICT4D is highlighted. Approaches and their relevance to decision-making in ICT4D are summarised in Section 6.4.6.

6.4.1. Systems and complexity

6.4.1.1. Systems thinking

Systems thinking captures complexity by describing the world in terms of objects *as well as* the ways in which they are connected to each other. It '*embodies the idea of a set of elements connected together which form a whole, thus showing properties which are properties of the whole rather than properties of its component parts*' (Checkland, 1981). Its utility lies in these emergent properties, which can only be explored in the *interaction* between components, rather than by exploring components individually. It provides a means of representing individual roles and performance roles (that of each component) relative to the performance of the whole. The use of systems as a modelling construct ranges from the description of complexity (e.g., the soft systems methodology of Checkland, 1981), to the dynamic modelling of the performance of systems (e.g., the discrete event simulation modelling work of Pegdan et al., 1995).

Relevance: Turpin and Alexander (2014:1) outline the '*value of the holistic view and transdisciplinary methods*' of systems thinking in the description of complex systems, and highlight the lack (or fragmented application) thereof in ICT4D.

6.4.2. Problem structuring

In the field of Operations Research, problem structuring is classified as part of Soft Operations Research, that is, the sub-discipline that focuses '*not to provide optimal solutions, but provide insights to the decision-maker*' (Daellenbach, 1992:523). It contributes to '*make sure that the right problem is solved*' (Belton & Stewart, 2010), and its significance in contributing to the solution by defining the problem well. Belton and Stewart emphasize this point in quoting Dewey (1998) as follows:

> *'It is a familiar and significant saying that a problem well put is half solved. To find out what the problem and problems are which a problematic situation presents to be inquired into, is to be*

well along in inquiry. To mistake the problem involved is to cause subsequent inquiry to be irrelevant or go astray.'

Relevance: In messy and ill-defined problems such as those encountered in ICT4D, the importance of understanding and solving the correct problem is obvious.

6.4.2.1. Soft Systems Methodology

Various problem-structuring methodologies have developed over time. Of interest to this work is the *Soft Systems Methodology (SSM)* of Peter Checkland (1981). It is offered in response to the difficulty of applying hard systems thinking to human activity systems (Fan & Kuang, 2013); recognises the role of divergent views in complexity; and models the related *human activity systems*. It focuses on learning about a problem, which leads to a decision to take action, which in turn leads to '*a changed situation and new learning*' rather than problem solving (Checkland, 1981:17).

SSM describes systems in terms of 'rich pictures,' and its numerous methods have been applied in different fields, including Information Systems Development (Checkland, 2005). SSM as a learning system is described in Figure 6.4:

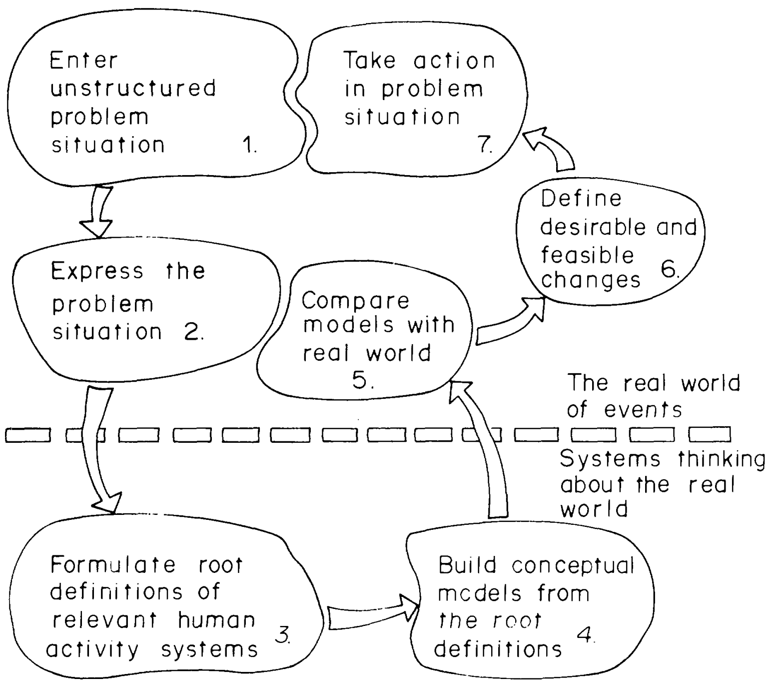


Figure 6.4 Soft Systems Methodology as a learning system (Checkland, 2005).

Relevance: Of particular interest to the complexity of ICT4D problems is the iterative nature of the problem solving process, the focus on facilitating change, and the focus on learning towards an improved state. As such, a path towards improvement is developed, with cognisance of the role of numerous human actors in the process.

6.4.3. Organisational and decision structures

A number of modelling approaches could be applied to describe the ‘organisation’ of role players (virtual or formal) within which the ICT4D intervention should be embedded. Such a description enables appropriate engagement with decision-makers and their sphere of influence. The constructs outlined below are used as examples, and are also applicable from perspectives other than as interpreted here.

6.4.3.1. Stakeholder theory

Stakeholder theory, of which the origins can be traced back to management literature of the Great Depression, can be defined as ‘*who stakeholders are and why they matter*’ (Bailur, 2006: 63). It provides a means of understanding the roles of all players associated with an ICT4D intervention, and has been applied in various ICT4D interventions (Bailur, 2006; Renken & Heeks, 2013; Tanner & Du Toit, 2015).

Bailur (2006) outlines three perspectives or roles for stakeholder theory, all of which are relevant in terms of the decision focus of this study. These include a descriptive role (what are stakeholder characteristics and behaviour, and how does an organisation interact with them); a normative role (giving stakeholders equal consideration in participating in decision-making); and an instrumental one (that success is related to successful interaction with critical groups) (Bailur, 2006).

Relevance: In this research, the relationship to stakeholder theory is the need to understand who the key decision-makers are, to provide fair access to all to influence decision-making, and to ensure success of the ICT4D intervention through successful stakeholder interaction.

6.4.3.2. Networks

The concept of a *network* resembles that of a system, in the sense that it describes an interconnectedness of nodes and links. Depending on the nature of the application, nodes could represent a wide variety of concepts, for example role players, decision-makers, resources, or assets, while links could represent the strength of connections, the frequency or size of transactions, the volume of information flows, etc. Tarafdar (2012) describes the network as a metaphor for social structure, with nodes representing role players (individuals and organisations), and links representing information flows. The latter enable role players to *participate in decision-making* due to access to information that flows in the network, and their relative power position.

Relevance: Development is influenced (positively or negatively) by intermediaries, through their influence on information flows in the network (Tarafdar, 2012).

Two network-related constructs, actor-network theory and social network theory, are outlined in the subsections that follow.

6.4.3.3. Actor-network theory

Actor-network theory (ANT) is a relatively stable, interpretive theory that is 'a complementary approach to information system studies' (Stanforth, 2006:38). The actor-network concept sees actors as developing networks of technical and social elements, in which they define relationships between each other through intermediaries (Stanforth, 2006), and in which the social and technical is treated equally (De Zoysa & Letch, 2013). ANT has been applied in 'many different and sometimes contradictory, ways' (Faik & Walsham, 2012:356), amongst others Organisation and Information Systems, where its use is increasingly critiqued (Faik & Walsham, 2012) and its language is seen as inaccessible to research processes (Heeks & Stanforth, 2007).

Heeks and Stanforth (2007:3), in their application of ANT as a means of describing how interaction between local and global networks define an e-government project trajectory, quote Law (1999) in describing ANT's role as having '*an interest in the uncertain processes that generate power and size.'* Similarly, De Zoysa and Letch (2013) use ANT to describe the effect of the relationships between actors on project sustainability.

These interpretations and applications point to the possible role of ANT in decision-making in ICT4D, namely as a means of understanding the influence of various actors on decision-making processes, as well as the influence of actors and their decisions on intervention success. Heffernan et al. (2016) emphasizes the relevance to decision-making further by quoting Young et al. (2010) as follows:

> *'The development of an actor network necessarily signals the pursuit of a goal ... which generally stimulates the development of counter networks, or 'anti programs,' with different goals or that seek to block the goal being sought. They compete for allies, institutional endorsement, public support, and tangible and intangible resources.'*

Relevance: This discussion highlights both the goal-seeking behaviour that is relevant to decision-making, as well as conflicts that are generated when conflicting goals are pursued.

6.4.3.4. Social network theory

While the work of Durkheim and Tönnies in the 1890's probably preceded the concept of social networks, Barnes (1954) is accredited with the work upon which social network analysis was subsequently based. A social network is '*a device for representing a social structure which depicts persons as points and relations as connecting lines*' (Granovetter, 1974). Social network analysis has been applied in numerous contexts to understand the role of social structure and exchange between people on behaviour, including social psychology, anthropology, political science, mathematics, and communications (University of Twente, 2017). The focus of social network theory and analysis is on the interaction and flows between people, and the structures within which such flows take place. Relationships are not studied in isolation, but in the context of the network of which it is part (Williams & Durrance, 2008).

Tarafdar highlights the role of social networks in development, as '*when participants, or nodes, have access to and can share information from diverse sources and can thus participate as actors in development-related decision-making*' (Tarafdar, 2012: 314).

Relevance: As with actor network theory, Social Network Theory is relevant here in its approach to understanding the structure (across or within organisational boundaries) in which decisions are made, and the influence of role players on decision-making.

6.4.4. Constructs of value creation

Each ICT4D intervention has an implicit or explicit principle upon which it bases the value that it wants to create in the community. This concept is important in decision-making since alternatives (or 'good' and 'bad' decisions) are inevitably evaluated against the value that it will add to the objectives of a decision problem (see Section 6.5.1).

Relevance: For the purpose of this study, these principles are named *constructs of value creation* (see Section 5.7.2.4). Some possible conceptualisations of value creation and their implications for decision-making are summarised below.

6.4.4.1. Value chains

The concept of a value chain originated in the commercial environment, as a means of understanding (and expanding) the value that an organisation contributes to the overall channel from production to consumption of a product. A widely accepted definition is that of Kaplinsky and Morris (2001:4)

> *'The value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumer, and final disposal after use.'*

The concept has been widely applied in development work, specifically in agriculture. Roduner (2005) examines the application of value chain concepts in international development, and its use as a mechanism in poverty reduction – see Figure 6.5.

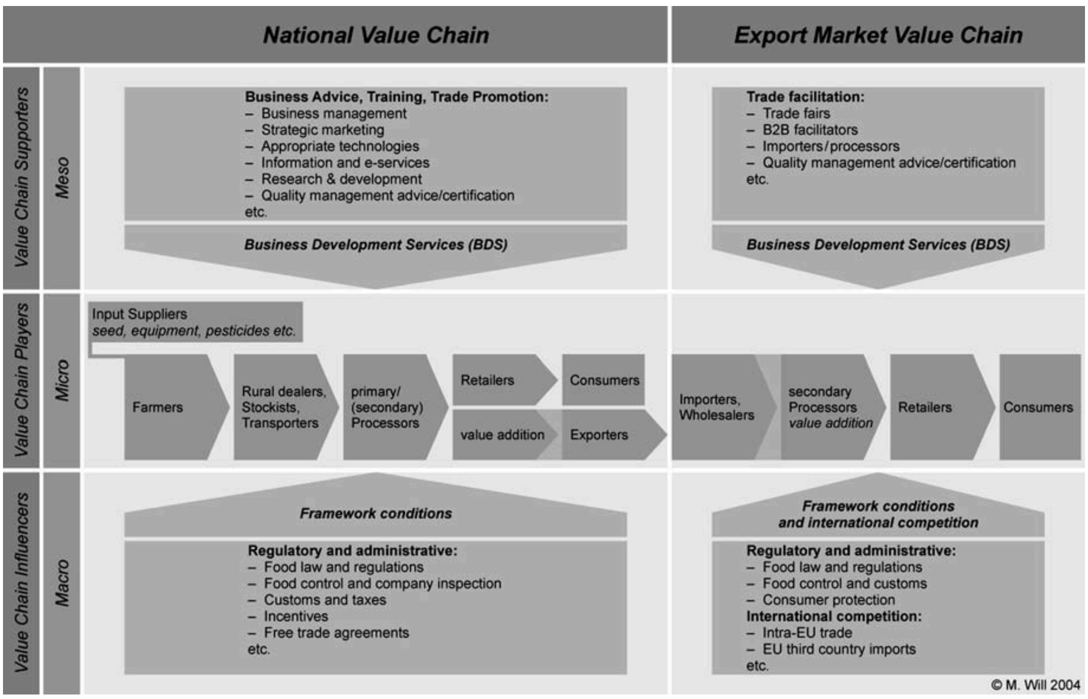


Figure 6.5 Roduner's value chain interpretation (Roduner, 2005:13)

Other value chain constructs include the ICT4D value chain of Heeks (2014), which provides a means of describing the process that leads to development impacts (see Section 5.7.2.4), and the ICT Impact Chain of Gigler (Gigler, 2011; Figure 6.6).

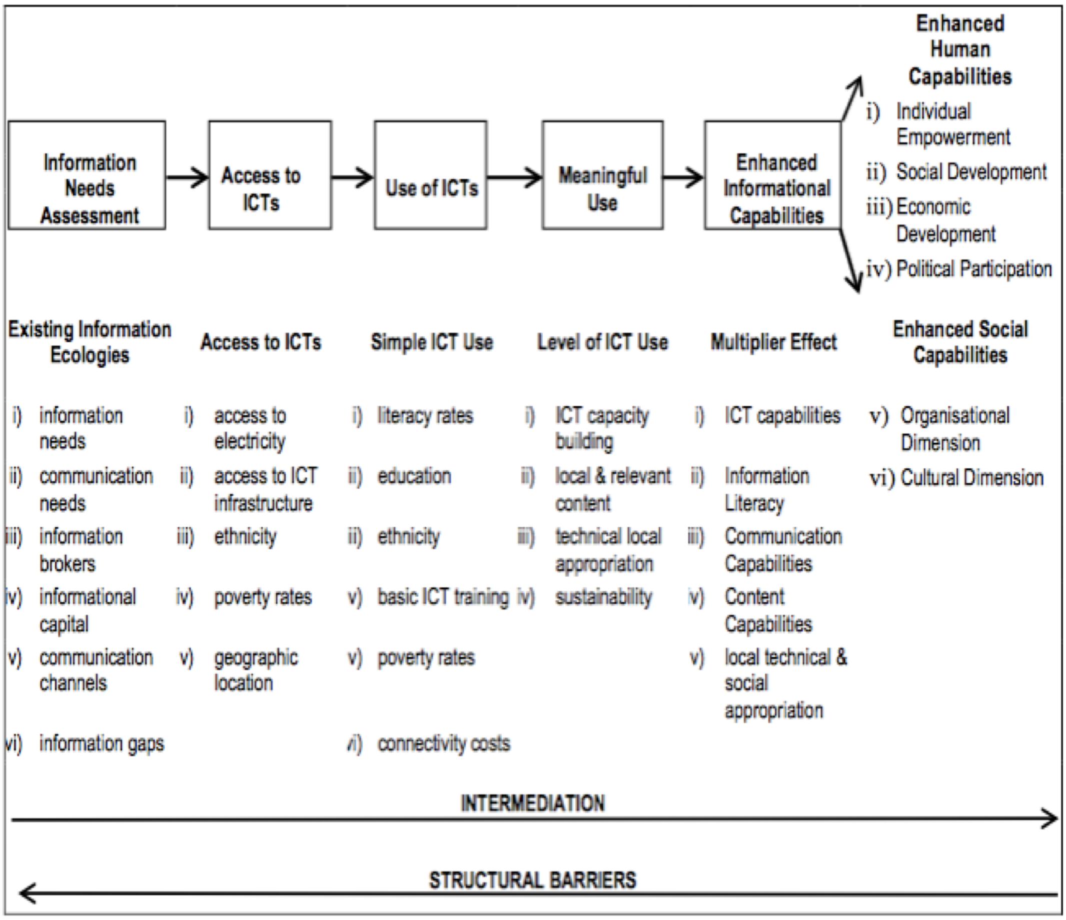


Figure 6.6 Gigler's ICT Impact Chain (Gigler, 2011:5)

Relevance: Regardless of the exact value chain conceptualization, its key principle is to focus attention on the value that is created along a process, from initiation to conclusion of a chain of activities. It represents a *construct of value* creation (Section 5.7.2.4).

6.4.4.2. Outcome chains

This concept is widely used in development, to describe the outcomes and impacts, and hence the value, that an intervention creates. In addition to being descriptive and facilitating a basis for evaluating progress (Earl et al., 2001), the construct has been used to describe the funder perspective on value creation. For example, see Figure 6.7 for Emmi et al.'s conceptualisation of *Value for Money* along an outcomes chain, referring to DFID's expression of value for money as the 'determination to get the most impact for the money we have' (Emmi et al., 2011: 14).

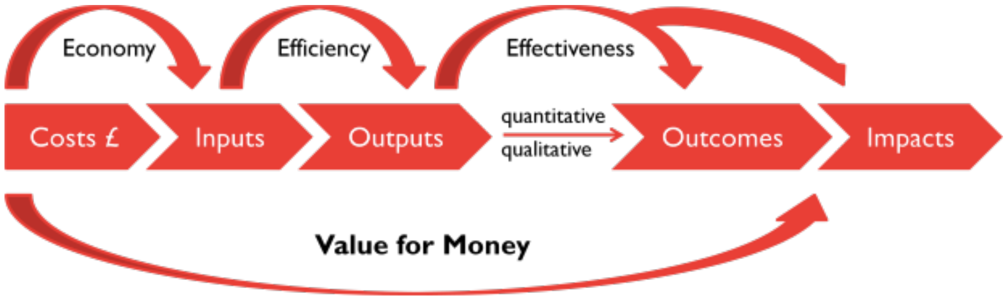


Figure 6.7 Interpretation of Value for Money along an outcomes chain (Emmi et al., 2011)

Relevance: The use of an outcomes chain (linked to value for money) or an impact chain illustrates another way of conceptualising a construct of value creation.

6.4.4.3. In summary: value-focused decision-making

This section outlines examples of the conceptualization of value creation. Value creation could be defined for each ICT4D intervention, and could take any form. A construct of value creation would ideally be based on a theory of value creation or change (i.e., how does the ICT4D intervention propose to create value in the community).

Relevance: A construct of value creation plays an important role in this research in that it enables choices that contribute to a process that creates value, as opposed to choosing between alternatives to come to a 'best' possible solution (which, in the context of messy problems, is not feasible – see Section 6.3.3 (D and E)).

This is in accordance with the work of Keeney (1992), who advocates decision-making as based on the values of the decision-makers, rather than driven by a predetermined (and limiting) set of alternatives. Keeney's value-focused decision-making emphasizes a process in which values are articulated and used to *identify decision opportunities*, as opposed to alternative-focused decision-making that *solve decision problems* by choosing between alternatives. He outlined conventional decision-making as a process in which problems are 'thrust upon us by the action of others' where these include government, competitors, stakeholders, and even national disasters (Keeney 1996:537). In value-focused decision-making, objectives are highlighted and prioritised, measures are assigned, and decision opportunities are identified that could 'enhance both the likelihood of achieving those objectives and the degree to which the objectives are achieved' (Keeney, 1996:543).

6.4.5. Project process

Externally funded ICT4D interventions almost without exception have a budget that needs to be spent within a pre-determined period of time. A *project* and *project process* governs activities and expenditure, and defines the sequence of activities. Linear processes are assumed, and the design includes phases from conceptualisation to exit.

Relevance: The four concepts in sections 6.4.5.1 to 6.4.5.4 reflect processes related to ICT4D interventions, and serve to provide considerations for project process design.

6.4.5.1. Socio-technical processes

A socio-technical process refers to the manner in which social and technical systems interact when a new ICT implementation is deployed. This often calls for technology to be deployed in an ever-changing context. Consideration of this interaction allows a focus, throughout the project lifecycle, on cultivating the sustainability of the final implementation (Da Silva & Fernandez, 2013).

Relevance: The process implication is an active and continued focus on sustainability throughout the life cycle, requiring an incremental, iterative, and flexible process.

6.4.5.2. Diffusion of innovation

This theory of Rogers (2003) refers to the mechanism by which ICT4D innovations are accepted within communities and organisations (adoption decision). It defines diffusion as 'a process in which an innovation is communicated through certain channels over time among members of a social system' (Rogers, 2003:5). Key elements are the innovation itself, the communication channels, the social system, and the length of time since introduction (Chigona & Licker, 2008).

Relevance: Its relevance to project process is the need for awareness of 'diffusion over time,' and hence possibly the need for an understanding of readiness of different sectors of the community at different points in time, and for iterations of some aspects of the project process (for example, training, communication, community awareness).

6.4.5.3. Grafting

This concept in Information Infrastructure Innovation entails '*careful alignment of available resources, capacities, and interests through the proposition of an information system (IS) innovation*' (Sanner, Manda, & Nielsen, 2014:220). The case highlighted by these authors considers a mobile phone-based health implementation in Malawi, and focuses on 'merging innovation with existing socio-technical arrangements… *in such a way that the parts continue to grow* (Sanner et al*.,* 2014: 220, own emphasis).

Relevance: As before, the relevance for project processes is the recognition of *readiness*, as well as the emphasis on *iterations* of activities that are probably required to 'grow' individual parts of the system over time.

6.4.5.4. Bricolage

This concept arose from the observed discrepancy between the intentions with an ICT implementation, and the reality that plays out in practice – the unintended consequences of the implementation. Ciborra (2002) described bricolage as follows:

'…tinkering through the combination of resources at hand. These resources become the tools and they define in situ the heuristic to solve the problem. Let the world help you: bricolage is about leveraging the world as defined by the situation. With bricolage, the practices and the situations disclose new uses and applications of the technology …' (Ciborra 2002, p. 49).

Bricolage allows people at the local level to apply known tools and routines at hand to solve new problems. Ciborra (1994) writes that 'no general scheme or model is available: only local cues from a situation are trusted and exploited in a somewhat blind and reflective way, aiming at obtaining ad hoc solutions by applying heuristics rather than high theory (p 16)' (Ali & Bailur, 2007).

Relevance: The following project process implications can be considered:

- Consider *readiness* of participants relative to the implementation;
- Consider *organic growth* of the uptake (which could imply, as before, that iterations of certain project components are required – e.g., through modularity); and
- Allow for flexibility of process, so as to accommodate new uses and applications.

Relevance: In summary, the above three concepts point to a project process that differentiates between the readiness of different project participants, that allows for iteration of (selected) project elements, and that is flexible *in terms of what is delivered,* all of which implicate flexibility in process-level decision-making.

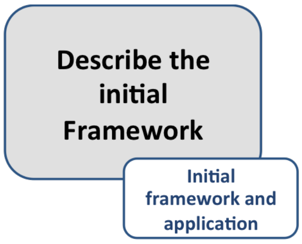
6.4.6. In summary

The approaches to complexity in decision-making, as outlined in this section, are summarised in Table 6.5. Each of the defined approaches is reflected in the initial framework, as discussed in the section that follows.

Table 6.5 Decision approaches to complexity

	Approach	Principle	Fundamental construct	Relevance to Decision-making in ICT4D
Systems	Systems thinking (Checkland, 1981; Turpin & Alexander, 2014)	Holistic and integrated view on the world	Objects and links between them, and properties that emerge as a result of interactions between objects	Holistic and multidisciplinary view on complexity (Turpin and Alexander, 2014).
Problem structure	Soft systems methodology (Checkland, 1981)	An iterative process of learning about problems and taking decisions to act towards improvement	Description of human activity systems to generate insights and identify actions	Iterative development of a path towards improvement, rather than a search for optimality
Organisational or decision structures	Networks (Tarafdar, 2012)	Describe interactions between nodes and links	Nodes, links, flows	Means to understand decision-making interactions and their impact on progress
	Actor-network theory (e.g., Heeks & Stanforth, 2007)	Describe the world in terms of actors that interact to create meaning and progress.	Networks of actors comprise social and technical elements, that interact through intermediaries	Describe the influence of actors (decision-makers) and their decisions on intervention success
	Social network theory and analysis	Connectedness and flow between people and organisations	Nodes (people and organisations), links (relationships, feedback mechanisms for information exchange), and their strengths	Structure of the network (within or across organisations) and its influence on decision-making (Tarafdar, 2012)
	Stakeholder theory (Bailur, 2006)	Understanding who is key in the intervention and how they can be managed	Stakeholders (people and organisations) related to the intervention	Highlights conflicts; Prevents naïve assumptions (Bailur, 2006)
Constructs of value creation	Value chains	Organisations create value within a chain, that transforms inputs to final products	The role in the value chain determines value addition	Value creation is expressed in terms of decisions that are made along a path of value creation, rather than through a choice between limited alternatives.
	Outcome chains	Value creation in development can be described in terms of a chain of events, from inputs through to impact	Transformation between steps leads to increased value addition	
	Value-focused decision-making Keeney, 1992	Fundamental values guide and integrate decision-making activities	Prioritised of fundamental and means objectives; alternative decision opportunities; guiding principles for decision-making	Process of value creation rather than choices between alternatives
Project or decision process	Socio-technical processes (Da Silva et al., 2013)	Flexible technology development in a changing context	System sustainability guides (decision-making in) the process (Da Silva et al., 2013; own insert)	Project processes that differentiate readiness for different groups of participants, that are iterative and incremental (e.g., through modularity), and that are flexible in terms of what is delivered.
	Diffusion of innovation	Adoption decisions depend on communication of the innovation over time within a community	Key elements are the innovation, the communicaton channels, social system, and duration since introduction	
	Grafting	Merge innovation with existing socio-technical arrangements, such that all parts continue to grow.	Careful alignment between the information infrastructure and interests, resources, and capacities	
	Bricolage	'tinkering through the combination of resources at hand'	The IS system will be used in conjunction with existing resources, for purposes that may not be as intended	

6.5. INITIAL FRAMEWORK



This section describes the initial decision framework, that is, the first deliverable of the Design Science Research process. It first summarises the approach that generated the building blocks (characteristics and elements) of the framework (Section 6.5.1). Thereafter, it integrates these building blocks into the initial decision framework that follows (Section 6.5.2). The intended use of the framework is discussed in Section 6.5.3

6.5.1. Approach

Work done in this and earlier chapters was aimed at unpacking concepts that could inform the decision framework. It comprised and exploration of three bodies of literature in ICT4D (i.e., sustainability, failure, and decision-making), which culminated in a number of characteristics of the decision framework (Section 6.2). It also comprised an exploration of selected decision approaches that could be appropriate to the decision framework (Section 6.4). The process, and the resulting characteristics, is outlined in Figure 6.8.

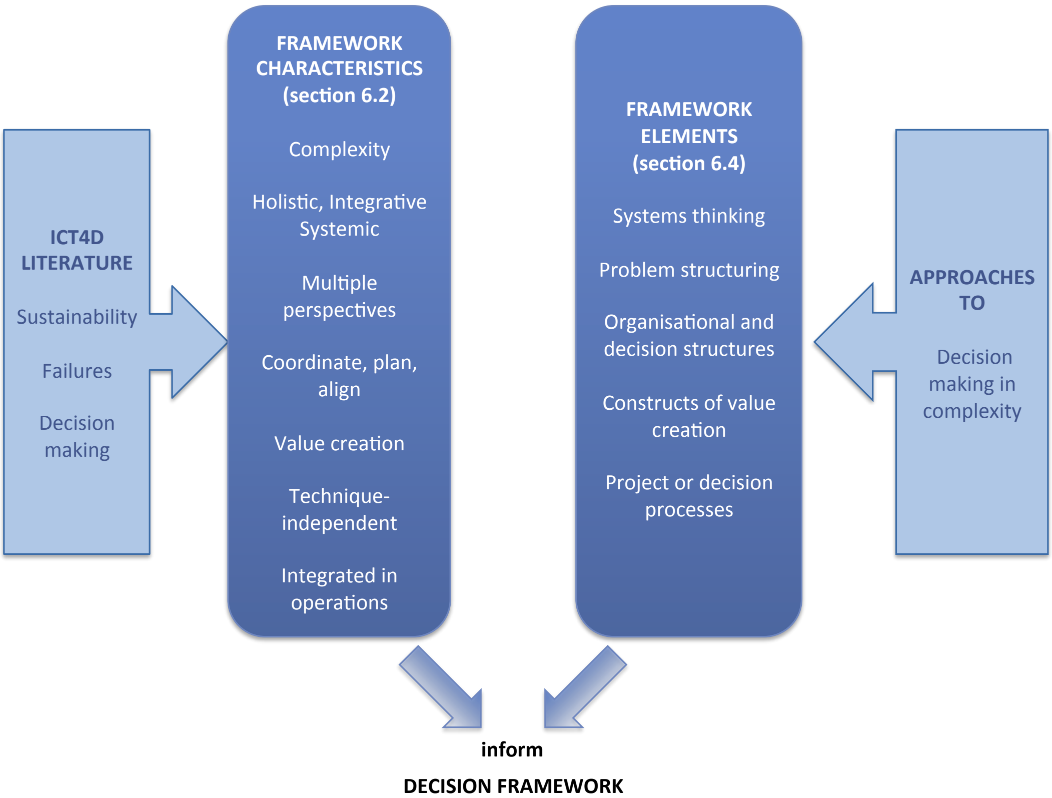


Figure 6.8 Concepts informing the decision framework

As outlined in Section 6.2.1, the purpose of the decision framework is to serve as a bridge between the actual and desired state of an ICT4D intervention. It would be

> *'a set of ideas or facts in support of decision-making in ICT4D. It is therefore seen as a bridge between complex and often conflicting decisions, and the value that the ICT4D intervention seeks to deliver'* (Section 6.2.1).

Heeks and Stanforth (2007) refer to the utility of an actor-network perspective when they say:

> *'helping them ('lower level' project actors) to see that their lack of traditional authoritative power may not necessarily be a barrier to influence so long as they can understand their place and role in one of the project actor networks.'*

In this research, the focus is more pro-active, by enabling decision-makers to *initiate project and decision processes* that will ensure appropriate decision-making relative to the value that the implementation intends to create (instead of '*helping them to understand…. their place and role*').

Different contexts call for different decision-making styles and strategies (Snowden & Boone, 2007). Contingency theory is used to motivate that '*organizations wanting to optimize performance need to adopt the structure that fits best with the situation they are in*' (Pries-Heje & Baskerville, 2008). In ICT4D, Heeks (2002:103) explains that factors influencing the success of ICT implementation tend to be 'situation-specific' (p. 103) or contingent, and that a lack of fit ('design-actuality gap' arises between the 'tool' and the 'task'. In this work, the purpose of the framework is to bridge this gap between intent and reality.

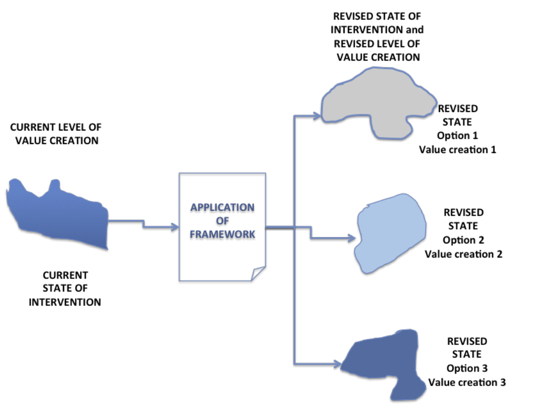


Figure 6.9 The decision framework guides decision-making towards a path of overall value creation

Application of the framework is intended to assist decision-makers to make a number of (consecutive) decisions that will facilitate value creation. At any point in time, the intervention is creating a specific level of value (see Figure 6.9). When a new decision is made within the context of the framework, the intention is that the state of the intervention and the level of value creation changes. Many options are possible, and the framework merely facilitates the decision context in a manner that will steer decisions towards, rather than away from, overall value creation. Rather than choosing among alternative paths, it is about making visible the decision context such that value is created over time, relative to the path towards value creation that the intervention has adopted.

This is in accordance with Keeney's (1992) concept of value-focused decision-making, in which the decision-maker is in control, rather than a variety of other role players. Value-focused decision-making helps to 'recognize and identify decision opportunities, create better alternatives for decision problems, and develop an enduring set of guiding principles for your organization' (Keeney, 1996:549; see Section 6.4.4.3)

The framework is designed to be sufficiently generic to be adaptable to a set of collective decisions in any context, and supports Snowden and Boone's (2007) notion that simple, complicated, complex, chaotic 'decisions require leaders to diagnose situations and to act in contextually appropriate ways.'

6.5.2. Framework

It is proposed that the characteristics and elements that were identified in the literature reviews inform the framework as follows:

Table 6.6 Proposed interpretation of characteristics and elements in the decision framework

<table>
<tr><th>Framework characteristic
(Section 6.2.2)</th><th>Framework element
(Section 6.4)</th><th>Application in framework
(Section 6.5.3)</th></tr>
<tr><td>Complexity</td><td rowspan="3">Systems thinking</td><td rowspan="5">A network of decision-makers and decision models at different organisational levels
An appropriate project process that allows for iterations of design and implementation</td></tr>
<tr><td>Holistic, integrative, systemic</td></tr>
<tr><td>Multiple perspectives</td></tr>
<tr><td>Coordinate, plan, align</td><td>Organisational and decision structures</td></tr>
<tr><td>Technique independent</td><td>Problem structuring</td></tr>
<tr><td>Value creation</td><td>Constructs of value creation</td><td>Framework elements:
• Theory of value creation
• Construct of value creation
• Value and sustained benefit</td></tr>
<tr><td>Integrated in operations</td><td>Project process</td><td>Framework element:
• Project process</td></tr>
</table>

Based on this interpretation, the first version of the framework is represented in the following diagram:

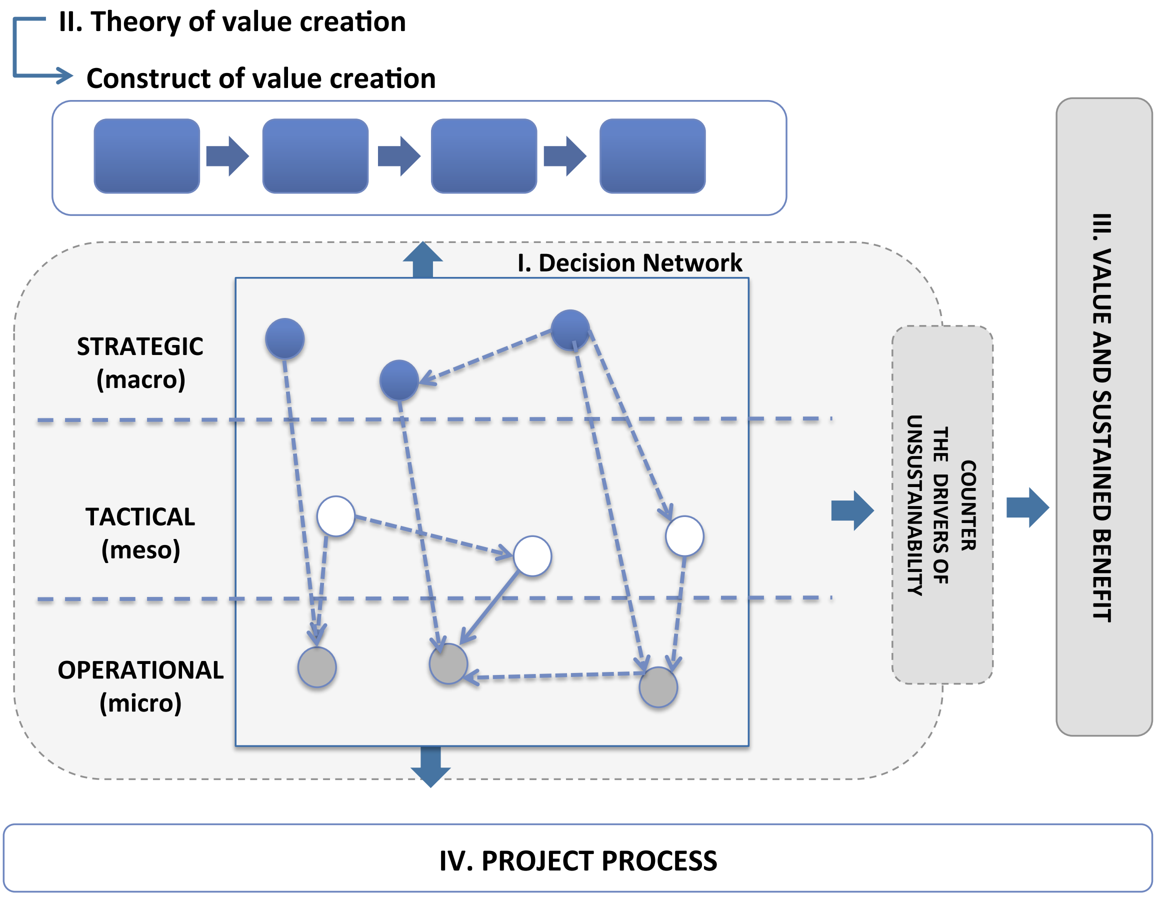


Figure 6.10 Initial decision framework

The framework comprises the following elements and assumptions:

I. Decision network

As per the definition of decision-making in ICT4D (Section 6.3), the premise of this work is that it considers a decision relative to *all decisions* related to the ICT4D intervention, instead of considering a decision in isolation. A ***network*** of decisions and decision-makers is considered, functioning at different levels of a (combined) organisational or social system (Figure 6.11).

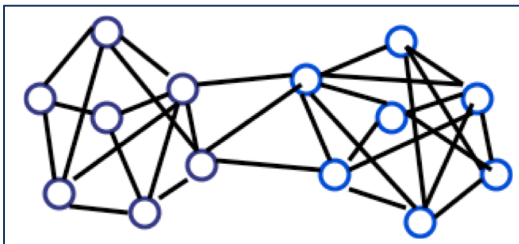


Figure 6.11 Network of decisions and decision-makers (Graphic: Adamic, 2012)

Each decision-maker is interacting with its own social or organisational system, which may have a focus that is not aligned with the ICT4D intervention (see Figure 6.12). The intervention therefore takes place within a (virtual) organisation.

Change results from the collective decisions made by role players in the system. Related decisions become constraints and/or enablers relative to an overall process of value creation (see II. Value and Sustained Benefit). While a specific decision may be simple and solvable by simplistic methods (e.g., budget allocation, technology selection), it forms part of a larger messy problem (Section 1.3.3), and as such forms part of a complex decision in the context of the entire population of decisions that are made relative to the ICT4D intervention. Some decisions (or drivers) support, while others inhibit, change and benefit of the ICT4D implementation

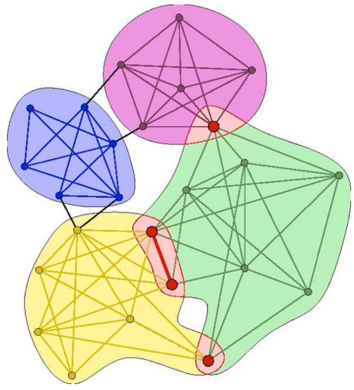


Figure 6.12 Decisions are made within organisational and social systems that may not be aligned with the overall construct of value creation (Graphic: Adamic, 2012)

Decisions may or may not be enhanced by decision support mechanisms. These constructs can range from hard (quantitative, well defined) models to soft (problem structuring) approaches, or a combination thereof (Section 5.7.2.3). For example, hard approaches could include a numerical optimisation model to calculate specific aspects (such as an optimal budget allocation), while problem structuring approaches could be used to facilitate participation, elicit multiple perspectives, and identify the appropriate problems to be solved ('soft' models).

The framework aims to make decisions visible rather than to dictate method, and is as such independent of decision methods, thereby fulfilling the requirement to be 'technique independent' (Section 6.2). An iterative and flexible project process facilitates iterative methods such as that of Checkland (1981) – see Section 6.4.2.1. Constructs could support decisions at the strategic, tactical, and operational levels.

Framework characteristics addressed: complexity; holistic, integrative, systemic; multiple perspectives; coordinate, plan, align; technique independent.

II. Value and sustained benefit

This refers to the value that is created in the community because of the ICT4D intervention, such as improved access to education, or improved sanitation. It can be defined at any level (output, outcome, impact), depending on the scope and time frame over which the intervention is considered. However, the nature of the value needs to be consistent with scope and time frame under consideration.

Instead of considering *sustainability* in all its various interpretations (see Chapter 3), the ***ability to sustain benefit*** is seen as inherent in the construct of value creation, the project process, decision-making, decision or organisational structure, and the definition of benefit. The benefit that is created is equal to the value discussed in this section. The slight change in emphasis accentuates that consideration needs to be given to *sustaining* the benefit. To this end, the following needs to be considered:

- what are the benefits that are expected to accrue from this ICT4D intervention;
- to what extent do we want the benefits to be sustained (i.e. for whom, and over what time period); and
- what do we need to do (what decisions do we need to make) to ensure that benefits are sustained?

The latter question requires the intervention owner(s) to deal with the intended benefits of the intervention, while also being cognisant of systems and processes that are generating unintended consequences (beneficial or not).

These aspects, in conjunction with the theory and construct of value creation, become the guiding principle for decision-making.

Framework characteristics addressed: value created; multiple perspectives; coordinate, plan, align.

III. Theory and construct of value creation

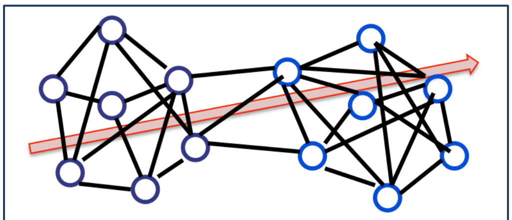


Figure 6.13 A network of decisions are aligned around a construct of value creation (Graphic: adapted from Adamic, 2012)

In contrast to conventional decision-making, value is not created by choosing between alternatives. Instead, value is created by ***aligning decisions to a construct of value creation*** (Figure 6.13). This construct is ideally rooted in a theory of value creation, and represents the assumption upon which the ICT4D intervention bases its value creation in the community. Better decisions are those that are aligned with the overall construct, and that do not adversely affect the ability of other decision-makers to support value creation. It can be represented by constructs such as an outcomes chain, a value chain, a process by which social capital is developed, or others (see Section 6.4.4). Agreement should be reached upfront between stakeholders in terms of the way in which the intervention intends to create value.

Framework characteristics addressed: value creation; multiple perspectives; coordinate, plan, align.

IV. Project process

This refers to the (externally) designed process within which the intervention is managed and delivered; it has significant influence in determining the freedom within which decisions can be made and implemented. Any relevant process design can be used. However, significant elements of the capacity to be sustainable are inherent in this process (e.g., freedom to meet community members where they are in terms of readiness, modular design, bricolage, flexibility, capacity for iterative process, etc.; see Chapter 9). The project process needs to be designed from this perspective, to ensure that benefit can be sustained.

Framework characteristics addressed: coordinate, plan, align; integrated into operations.

6.5.3. Application

This conceptual framework intends to assist the ICT4D intervention team in reaching agreement about key design constructs that will support the capacity for decision-making towards sustainability. It intends to facilitate agreement on the basis for value creation, and to align decisions and/or decision-makers along a chain of value creation.

The framework is applied at the outset of an intervention, to address the following:

Conceptual perspective

- How do we intend to create value through this intervention?
- What value is created?
- What benefit needs to be sustained, by whom, for whom, and for how long?
- What decision models are useful in supporting this process?
- What is the nature of the project process that will foster decision-making for sustained benefit?

Analytical perspective

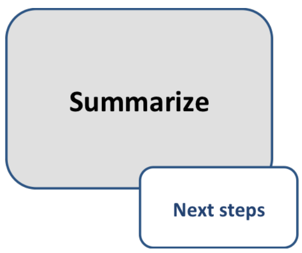
- What decisions are we making in this process?
- Where do they fit in terms of overall value creation?
- Which other decisions are they linked to (do they affect)?
- How do they enable value creation?
- How do they disable value creation?
- What should change to ensure alignment with other decisions and value creation?
- How should priority be given to different decisions, given the overall process?
- What decisions are we not making?

The framework is intended for use at both the *planning* and the *implementation* phases. In the planning stage, it should address the questions outlined above. In the implementation phase, the concepts defined during the planning phase should be used to guide decision-making, as decisions are made on an on-going basis.

The following principles can be highlighted to emphasize the role of the framework:

- At the macro level, identify the decisions that are and should be made, so that outcomes are not left to chance.
- At the macro level, articulate and organise the set of values and objectives, that is, identify the fundamental construct of value creation – this forms the 'guiding principle' for the (virtual) organisation that manages the ICT4D intervention.
- At the individual decision level, make decisions in a manner that is consistent with the construct of value creation, and with other decisions.

6.6. SUMMARY



This chapter set out to provide a first answer to the main research question of the thesis, namely:

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

A systematic process was followed to answer this question. This comprised the integration of results from the three literature reviews described in earlier chapters to define decision framework characteristics, as well as the definition of framework elements through examination of concepts that are used to address complex decision problems from fields such as Decision Science, Operations Research, and Management Science.

As background to the development of a framework, the decision problem in ICT4D, for the purpose of this study, was defined, and elements of the ICT4D decision problem was outlined. These definitions are rooted in an analysis of the literature, and could be useful in similar work.

The framework is intended for application at the planning as well as the implementation stages of an intervention. By highlighting decision-making as a focal point in ICT4D interventions (and as such countering conflicting decision-making), it is anticipated that the framework will contribute to sustaining the benefit of an intervention.

Chigona (2008:58) differentiates the following four benefits of a theoretical framework:

- Ability to make predictions;
- Ability to proceed systematically, to observe or measure selected things (not all);
- Explain what is happening, in terms of the theory; and
- Put the theory under stress in order to improve it.

In practice, the application of this framework is intended to provide the first three benefits. In this design science research project, the next two iterations of this study will contribute to the fourth point.

This chapter concludes the *Framework Design* of the *Design and Demonstration* phase of the Design Science research process (see Fig. 6.1). The next two chapters initiate the evaluation phase by applying the framework in two case studies, so as to assess its applicability and fit to practical problems, and to revise and enhance its validity.

CHAPTER 7. CASE APPLICATION: ICT4RED

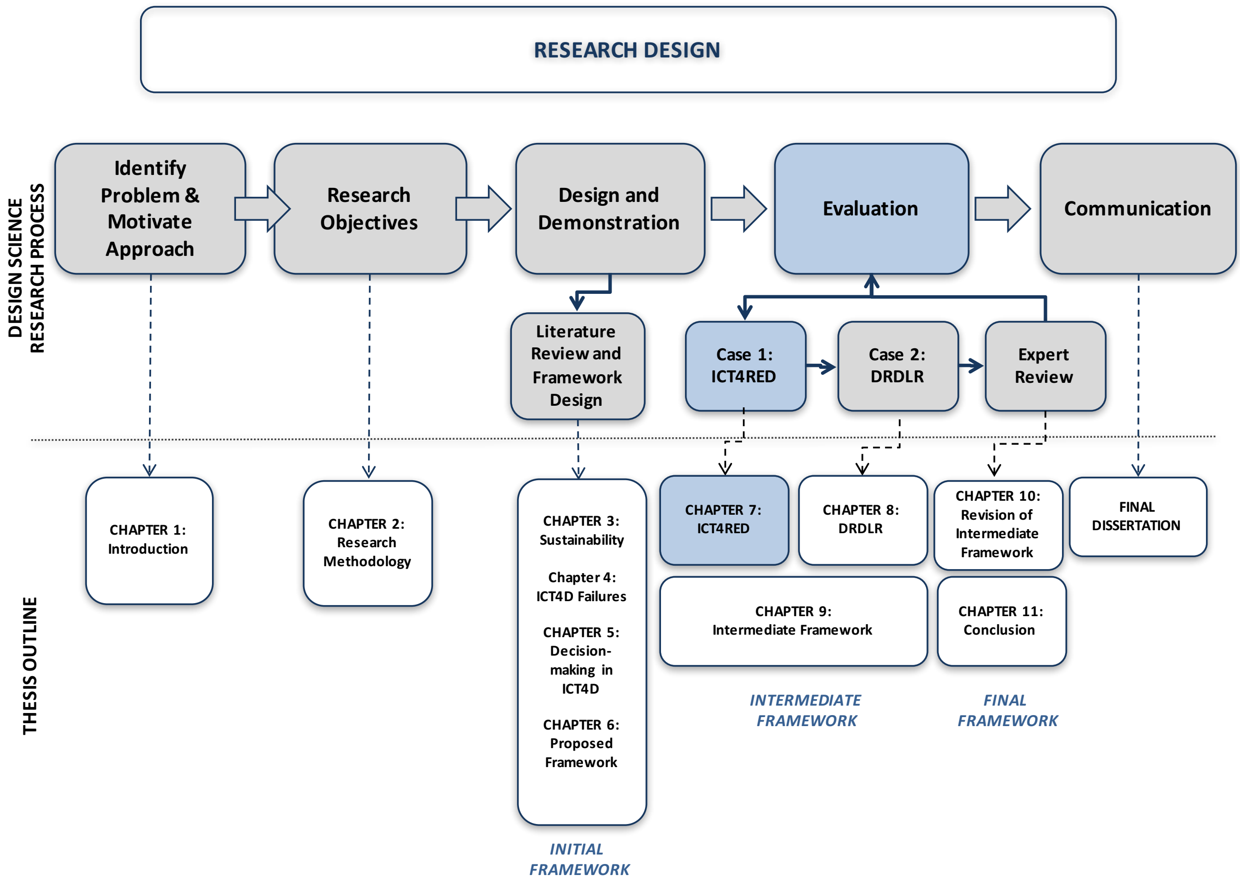


Figure 7.1 Research process and thesis outline: Chapter 7

7.1. INTRODUCTION

The initial decision framework, as presented in Chapter 6, needs to be evaluated for its applicability and validity in different decision contexts, and enhanced according to results. The purpose of the evaluation, as stated in Chapter 2, is to:

'observe and measure how well an artefact supports a solution to the problem…involves comparing the solution to actual observed results from use of the artefact in the demonstration' (Peffers et al., 2007:13; see Section 2.6.4).

This chapter comprises the first of two case studies that are used to evaluate the initial framework. As outlined in Chapter 2, case studies:

can be used in exploratory, explanatory or descriptive fashion' (Yin, 2014), and *can be employed for theory testing or theory building* (Irani et al., 1999; Myers, 2013; see Section 2.6.2)

In this research, theory building took place through a review of literature, and the integration of findings into an initial decision framework. Theory testing is undertaken by means of case analysis. In the Design Science Research Process of Peffers et al. (2006), the cases therefore firstly plays a role in the *evaluation,* but also in the *demonstration* phase by illustrating how the framework can elicit new perspectives on the case (see Figures 2.4 and 7.1). The cases contribute towards answering the overall research question, namely:

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

The initial framework, which was developed from literature, constitutes a first answer to this question (see Chapter 6). In this chapter, the initial framework is evaluated in a *post hoc* fashion against the first of the two case studies in a *within-case* analysis. The second within-case analysis is described in Chapter 8, after which generalizable elements from both cases will be integrated in a *cross-case* analysis. Finally, *interpretation* will follow, in which generalizable elements will be used to inform the *intermediate* decision framework (see Table 2.5 for this overall evaluation process).

This chapter firstly provides an overview of the approach to the analysis of both cases (Section 7.2), followed by a description of the ICT4RED project and a motivation for its inclusion as a case study (Section 7.3). Section 7.4 describes the case analysis, while implications for the decision framework are outlined in Section 7.5. Section 7.6 summarises the chapter.

7.2. APPROACH TO EVALUATION AND CASE ANALYSIS

The approach to the evaluation of this artefact was discussed in Chapter 2. The goal of the evaluation was defined in Section 2.6.4 as:

Assess the usefulness of the framework
in guiding decision-making for sustained benefit

The principles that were used in developing the evaluation approach, as well as the evaluation process (i.e., two case studies and an expert review), are summarised in Chapter 2. The properties of the artefact that will be evaluated are outlined in Table 2.9. These properties deal with elements such as the generality, consistency, completeness, and robustness of the artefact, and will be applied when determining the contribution of each case evaluation to the framework (see Chapter 9).

Further, Chapter 2 motivates why case studies are used as formative evaluation mechanism (Sections 2.6.2 and 2.6.3), and describes the method for in-case analysis (Table 2.5). Since the nature of the initial decision framework is now known (after completion of Chapter 6), it is proposed that the within-case analysis method (Table 2.5) be adapted and extended to form the following framework for case analysis:

Table 7.1 Method of within-case analysis (adapted and extended from Table 2.5)

Within-case analysis	*Objective & activities*	*Method*
Description and Relevance From project documents, participant observation, participation in decision modelling	Identify the **purpose** of this case relative to this research Identify and describe the **context** of the case Highlight the **decision-making** and **sustainability** context and challenges Define the **current status**	How is this case expected to contribute to the research? What is its relevance? Brief description, based on project documentation and participation. What challenges were encountered (retrospectively) What is currently happening in the project?
Case analysis Descriptions and decision maps	Describe each element of the framework relative to the case under consideration: • Network of decision-makers • Theory and construct of value creation • Value and sustained benefit • Project process	How was this element conceptualised in the project, if at all? Could this conceptualisation be enhanced? How does an enhanced description link to improved decision-making? How does an enhanced description link to sustainability?

This method forms the basis for the case description and analysis in Sections 7.3 and 7.4, as well as for the case that is described in Chapter 8.

7.3. ICT4RED: DESCRIPTION and RELEVANCE

The ICT4RED project comprised technology rollout across multiple schools over a multi-year time frame, as part of the larger Technology for Rural Education (Tech4RED) programme. The latter was a collaboration between the Department of Science and Technology (DST), Department of Basic Education (DBE), Department of Rural Development and Land Reform (DRDLR), and the Eastern Cape Department of Education (ECDoE). Tech4RED was aimed at the improvement of rural education via technology-led innovation (Herselman and Botha, 2014), and comprised interventions in ICT, Nutrition, Science, Health, Sanitation, and Energy (Mogege at al., 2016).

The ICT4RED project can be described from various perspectives. For the purpose of this research, the focus is on a description of aspects pertaining to decision-making and sustained benefit (in addition to general background information).

7.3.1. Purpose

The ICT4RED project delivered technology for improved teaching and learning to a rural area in the Eastern Cape (see 7.3.2 for an overview). The project involved activities that could be described along an ICT4D value chain, ranging from design to implementation. One reason for the inclusion of this project as a case study is its holistic involvement in various aspects of an end-to-end value chain. In addition, the complexity of the project provides a rich context for the exploration of decision-making and sustainability elements (see Sections 7.3.3 and 7.3.4).

The motivation for the selection of this case study was summarised in Table 2.3 against Myers' (2013) case selection criteria (repeated here for convenience):

Table 7.2 Criteria for case study selection (adapted from Myers, 2013)

Criteria for evaluating the case	ICT4RED
The case must be 'interesting', i.e., it must reveal something that was not known before	The case is an experimental (from first principles) deployment of a holistic ICT implementation in education.
The case must display sufficient evidence	The scope and extent of the case, as well as the duration and practical nature of the rollout, provides sufficient activities and interactions from which to collect evidence. It includes implementation, as well as extension of learning to general strategy.
The case should be 'complete', i.e., all relevant evidence to prove or disprove the case must be collected	The project life cycle allows for development of decision models within the scope of the ICT4RED implementation, and the testing of models and decision processes in other contexts, based on learning.
The case must consider alternative perspectives, i.e., must reflect real life situations (including contradictions)	The experimental nature of the project, and the adaptation of project design to fit local conditions, create sufficient information to reflect contradictions.
The case study should contribute to knowledge, i.e., must be generalized to one or more theoretical concepts	The uncoordinated decision environment within which the project is implemented, as well as innovative project design elements, provides sufficient scope for the development of new theoretical concepts.

Due to its holistic coverage of the value chain, and the multiple role players involved, the case is expected to contribute towards the systemic and process-oriented nature of the decision framework.

7.3.2. Overview

South Africa's education system is characterised by poor performance, especially in rural areas with its poor population and minimal resources (Herselman & Botha, 2014). The ICT4RED project was initiated in response to a government concept that tablets should be used as a means of accessing e-textbooks, thus eliminating the need for delivery of textbooks to schools, which has been inefficient due to logistical problems (Herselman & Botha, 2014). The project took a holistic approach by focusing on teacher development, in addition to focusing on the delivery and maintenance of technology.

In the South African education system, provinces are divided into districts, each of which comprises a number of circuits, which are in turn comprised of schools. The ICT4RED project was a pilot that was rolled out over a period of three years in the Nciba circuit of the Cofimvaba district in the Eastern Cape province (Fig. 7.2 and 7.3). The latter is a predominantly rural province, with the exception of the metropoles of Port Elizabeth (Nelson Mandela Bay Municipality) and East London (Buffalo City Municipality).

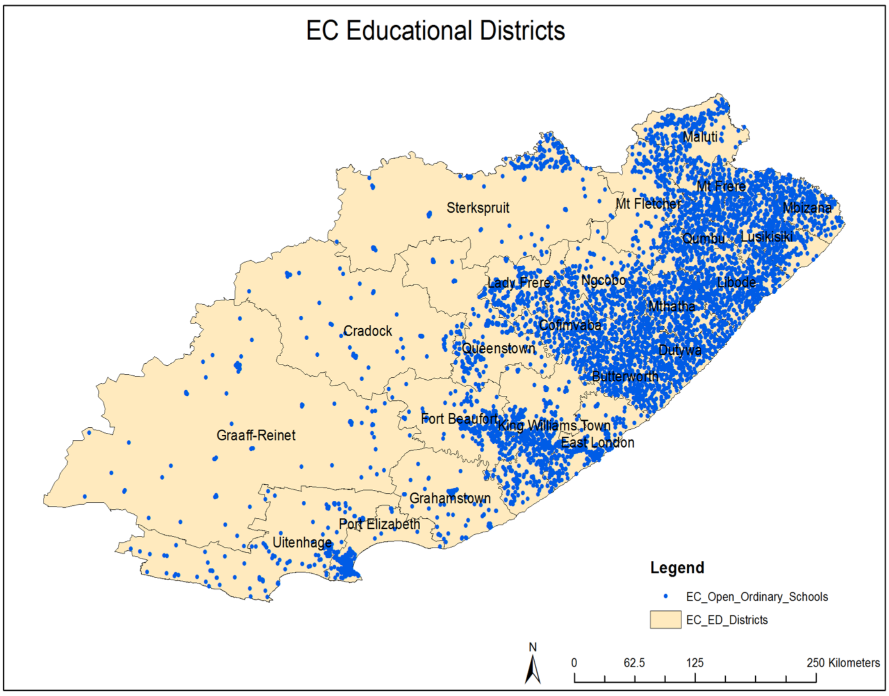


Figure 7.2 Distribution of schools in the Eastern Cape province (Herselman and Botha, 2014)

The project involved 26 schools, and was rolled out over three phases. The national population of schools is approximately 26 000, of which 5 500 are located in the Eastern Cape province[1].

The project was undertaken by CSIR, a national science council, and had a strong focus on research and learning. It adopted a unique modular approach, which originally comprised twelve components that were later reduced to six (see Section 7.4.3.1)

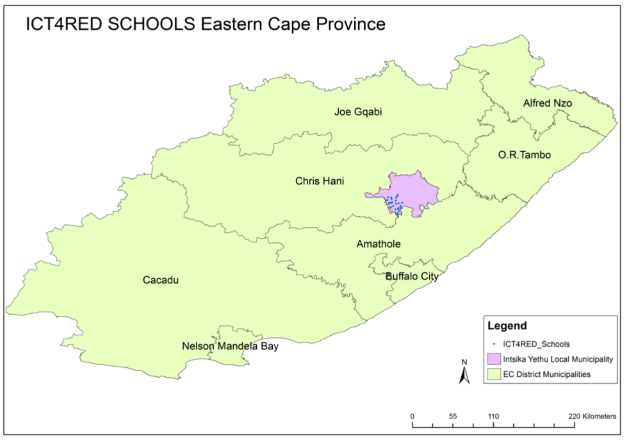


Figure 7.3 Location of the Cofimvaba district and participating schools (Herselman and Botha, 2014)

From an operational perspective, the following pre-negotiated implementation principles were adopted (Herselman & Botha, 2014):

[1] Source: Department of Basic Education.

- Minimum school disruption
- Flexibility with school structure
- Development of local capacity
- Reflection, learning, and improvement
- Working within the system
- Positive reinforcement
- Establishment of safe spaces
- Education focus

These principles confirm a holistic, non-invasive project approach, which is cognisant of the larger organisational system. Further, it intends to avoid 'technology dumping' – an unfortunate and unsustainable characteristic of numerous ICT4D projects, in which technology is delivered without the necessary supporting infrastructure and processes that are required for sustainability (e.g., Musiyandaka et al., 2013). In theory, these principles of the ICT4RED project should contribute towards sustainability. This is reflected by a number of authors who support principles such as embeddedness (e.g., Kendall, 2015; Kumar, 2011; Pade et al*.,* 2006), participation (Hage et al*.,* 2013; Osah et al*.,* 2014), and holism (Grunfeld, 2011; Walton & Heeks, 2011) as enablers of sustainability.

In addition to an M&E component, the project included a 'sustainability modelling' component. The latter was somewhat vaguely defined at the outset, and was primarily intended to develop a cost model for cost reporting and (potentially) decision-making. This research emanated from the sustainability modelling component, reflecting a broader than the original view on sustainability.

7.3.3. Sustainability challenges

In this study, the focus is on sustained benefit (rather than on sustainability in its many interpretations; Section 1.3.1). This merely implies that the focus is on the project's ability to sustain the benefits that it intends to deliver, as opposed to dealing with the wider concept of the sustainability of development *per se*. This requires that role players are able to articulate the intended benefits of a project, and then design a project that will ensure that such benefits are sustained. In ICT4RED, a clear, explicit, upfront definition of sustainability could not be elicited from project records; however, it was evident from discussions, and from the definition of the sustainability modelling component, that the project team interpreted sustainability from a financial perspective (Meyer, 2015).

Aspects inherent in the problem environment led to a number of sustainability challenges. If a broader perspective is taken on sustainability, and the concept of operationalising sustainability against a number of dimensions is adopted (Kumar & Best, 2006; Pade et al., 2006; Phade-Khene et al., 2011), some challenges can be identified – summarised here in terms of the dimensions of sustainability:

Table 7.3 Challenges to sustained benefit, according to the dimensions of sustainability

Dimension	Challenges to sustained benefit
Political	The project was funded by two government departments (DST, DRDLR), but implemented in the domain of another (DBE)
Organisational	Implementation took place at school level, but the initiative required support from multiple hierarchical levels of the Provincial Department of Education. Integration and alignment between multiple contractors were required for delivery.
Social	Prior exposure to technology was limited for some participants (e.g., older teachers). Security considerations at household and school level had an impact.
Financial	The budget of the Provincial Department of Education did not provide for on-going support of the initiative. Technology was deployed in a resource-poor environment, where the financial ability of teachers and households to contribute to the process is limited (e.g., travel to training sessions, airtime, at-home security, etc.).
Technical	Technical support to schools in deep rural areas is expensive (schools are inaccessible and connectivity is limited or non-existent).
Environmental	Technology recycling does not form a standard element of school-level operating procedures.

Table 7.3 is not comprehensive, but reflects some of the key challenges according to dimensions of sustainability.

If a process or systemic view was taken (see Section 3.4.3), other challenges could be identified, such as the requirement to implement within a short-term funding cycle while the time to institutionalise change is unknown, and the lack of alignment between stakeholders within and across organisational and political boundaries towards a common objective. The nature of the challenges to sustainability, as identified in this section, is consistent with the complexity of 'messy' problems (Section 1.3.3).

A post-project analysis highlighted challenges that became apparent as the project unfolded (Meyer, Marais, & Dlamini, 2016). Some of these challenges were anticipated and provided for by the project design. For example, a 'stakeholder management' role was defined to address some of the political complexities, and security measures were designed to limit non-availability due to theft. However, the ability to sustain benefits remains a concern (see Section 7.3.5).

7.3.4. Decision-making challenges

Similar to the sustainability challenges, some challenges with respect to decision-making were also inherent in the project. These included: the need for the project to engage with uncoordinated decision-making processes across multiple levels of the organisational hierarchy to ensure adoption; multiple potential interpretations of the goal of the project; and alignment across a number of subcontractors with respect to the project objective (Marais & Meyer, 2015).

In Chapter 6, a number of dimensions were defined against which a decision problem could be defined (Table 6.3). The same dimensions are used here to provide insight into the decision-making challenges of the ICT4RED project.

Table 7.4 Decision-making challenges of ICT4D problems in general, and ICT4RED specifically (see Table 6.3)

	Dimension	Decision problem in ICT4D	Decision-making challenges in ICT4RED
A	Complexity	Messy	Characteristics of a messy problem are evident – see description below.
B	Goal	Value creation in complex environment	The environment is constrained, and value can be created in multiple ways.
C	Decision-makers	Multiple, not all known	Project success is influenced by decision-makers in multiple entities and at multiple levels within an entity.
D	Solution space	Optimality (and a good solution) is difficult to define	Multiple (and unknown) potential benefits complicate the definition of the 'best' choice.
E	Value of alternatives	Difficult to assess; requires discussion against an agreed construct.	It is difficult to assess the impact of different choices on the overall outcome of the project.
F	Constraints	Resource-poor, relative to solution space	Resource-poor, relative to the solution space.
G	Extent of uncertainty	High	The effect of some decisions is unclear and difficult to predict.
H	Alignment of decision-making	Multiple formal and informal structures	Alignment is required across multiple formal and informal structures.
I	Decision power and control	Power, control, and influence play out in a network of formal and informal role players	The Department of Science and Technology, Department of Basic Education, Provincial, district, and school role players all influence performance, as does the project team[2] and community members.

Each of these dimensions are discussed in more detail for the ICT4RED project:

[2] The project team in this case referred to the CSIR implementation team and subcontractors, as well as collaborators from the Eastern Cape Department of Education.

A. Complexity

In Chapter 1, messy problems were defined (according to Churchman, 1967) as complex and with complex interdependencies, without clear-cut solutions, and difficult to solve due to conflicting and changing requirements (see Section 1.3.3). The interpretation for the ICT4RED project is as follows:

Complexity and complex interdependencies: the ICT4RED problem is *complex* in the sense that multiple interactions and multiple influences determine overall success. A single relationship between a decision and its outcome does not exist for all decisions.

No clear-cut solutions: multiple different solutions could have similar overall outcomes. For example, different technology choices could satisfy the requirements. Similarly, multiple teacher development programmes could improve teacher performance.

Conflicting and changing requirements: the project was initiated to provide access to electronic learning material. Over time, the key stakeholders placed significant emphasis on improved learner performance in national exams, as a result of the intervention. This changing requirement was confusing, and difficult (and impossible) to accommodate given the project focus and design and the short project time frames.

B. Goal

Multiple perspectives can be taken on value creation in this environment. The environment is resource-poor, and learner performance is poor (Herselman & Botha, 2014). The original goal was one of providing access to electronic learning material (which was seen as a way of eliminating inefficiency, thus creating value). The project was framed as one in which value is created through technology-enabled development of 21^{st} century teaching. These are two examples of the multiple interpretations of value creation. Multiple potential paths to success as well as multiple definitions of success complicate goal identification, project design, and project execution, and require significant effort in terms of alignment across role players.

C. Decision-makers

Multiple decision-makers influence the success of the ICT4RED project. These include government decision-makers, the project team and its contractors, communities, parents, school management, teachers, and learners (see Section 7.4.1 for decision maps). Multiple decision-makers have multiple or unclear goals, making alignment of decision-making critical but complex.

D. Solution space

In a low-performing resource constrained environment such as education in rural South Africa, multiple intervention designs could potentially constitute an improvement (see A). The solution space is therefore large and difficult to define. Multiple objectives (see B) are a further complicating factor for decision-making.

E. Value of alternatives

Since the goal as well as interdependencies within the system is unclear (A and B), it is difficult to assess the value that will be created by a specific intervention design choice.

F. Constraints

The conflict between the resource demands of resource-rich solutions (e.g., technology support and maintenance costs) and resources available in resource-poor environments emphasizes the importance of design decisions that focus on sustaining benefits.

G. Extent of uncertainty

The effect of decisions is difficult to predict (due to the systemic and complex nature of the problem), which creates uncertainty; so does the multiple role players, changing or unclear objectives, and the unpredictable response of the system to the intervention.

H. Alignment of decision-making

Decisions are made by multiple role players in multiple organisations, each of which may have a different interpretation of the objective (see B). This compromises the quality of decision-making, and requires alignment.

I. Decision power and control

Multiple role players residing in multiple structures contribute to decision-making (see H). However, their relative power and influence is not always clear and is sometimes impossible to define. This is a source of conflict, which could delay and complicate decision-making, and disable the ability to make timeous and ‘good’ decisions relative to an agreed-upon goal (if any).

7.3.5. Current status

The ICT4RED project was conducted between 2012 and 2015, with post-project analysis work during 2016 and 2017. An evaluation of benefit is difficult, especially since the benefits to be sustained were not explicitly defined upfront (see Section 7.4.2.2 for a description of benefits).

An on-going in-house process was conducted by the project team, and independent evaluation was done by the Human Sciences Research Council (HSRC).

The final in-house evaluation report states the following in terms of project objectives and success (summarised from: CSIR and Benita Williams Consultants, 2015):

Table 7.5 Summary of internal evaluation results

Objective	Objectives in detail	Assessment
Implementation success	Design systemic and sustainable approaches to providing access to digital content by learners at resource-constrained rural schools in South Africa; Design, develop, test, and improve new and evolving educational technologies, devices, platforms, and processes that support the access to digital content for rural school environments.	Positive teacher participation Technology deployment had some insignificant issues, but did not hamper teacher participation ICT committees are generally functioning Volunteers that assist with technical support are diligent and organised but require technical training Call centre is not extensively used
Improved quality of teaching and learning	Design models for teacher professional development that focus on 'how to teach with a tablet', rather than 'how to use a tablet'; Measure the effect of this initiative on the 21st-century skills of learners. For the purposes of the evaluation, the focus was shifted to evaluation of the influence of this initiative on the teaching skills of the teachers.	There is evidence of use of technology by teachers in private and professional life
Knowledge generation and influence on policy	Use the evidence from the research within this context to inform policy in an integrated and coherent manner.	Teacher professional development course was developed; policy of the Eastern Cape Department of Education as well as national policy dialogue was informed.

The report concludes that the project showed implementation success, and that teacher training and changes in teacher practices were successful. It also indicates that the evidence pertaining to use of technology and access to suitable content at the time of the final evaluation report is unclear. It highlights the production of knowledge (research products and teacher training) as successful, and notes that strategies of various provincial education departments were influenced (CSIR Meraka Institute & Benita Williams Evaluation Consultants, 2015).

A second, independent evaluation process was undertaken by the Human Sciences Research Council. The evaluation reviewed the Technology for Rural Education (Tech4RED) portfolio of projects in the Cofimvaba area, of which ICT4RED formed part. Evaluation reports were issued in December 2015 and March 2016, summarising the evaluation periods of May 2013, and March 2014 to October 2015. The evaluation included an assessment of outcomes indicators such as learner's mathematical competence (marks) at different evaluation dates (against a control group), and concluded that differences in marks could not be attributed to any of the Tech4RED interventions. The evaluation further reports positive experiences by teachers due to their training and access to technology, and concludes the following (Mogege, 2016: 78):

Due to the connectivity offered by the tablets and access to the Internet, the ICT4RED intervention is perceived as having reduced the geographical, ideological, emotional, linguistic, and epistemological distance between schools, teachers, and learners in rural areas and those in urban areas.

It also highlights that many of the Tech4RED interventions have not been around long enough to gain traction in the area.

Subsequent (post-project) reviews brought to light that technology is not widely used in classrooms, and that technology support could improve. However, teacher development is considered to have had a positive, motivational impact, with teachers implementing new techniques in their classrooms (Marais, 2017), and some being recognised nationally for their teaching ability.

None of the evaluation exercises arrived at a conclusion on sustainability. The internal evaluation team report comments on sustainability as follows (CSIR Meraka Institute & Benita Williams Evaluation Consultants, 2015:3):

'The long-term sustainability will only become apparent over time. A key issue is what are the components of an enabling environment? Ongoing evaluation is therefore required to develop recommendations for supporting teachers and schools. To sustain technology in future the identified barriers in the whole system (a project at District/Circuit level and the supporting systems of the department) need to be addressed.'

The HSRC evaluation commented as follows on sustainability (Mogege, 2016: 70):

Also, the issue of sustainability of the various interventions became an urgent matter that needed to be resolved as the whole Tech4RED initiative reached conclusion. This called into question the effectiveness of the process that was put in place to aid monitoring, reflection and learning during the implementation of the Tech4RED.

Based on the understanding of decision-making and sustainability challenges as outlined in Sections 7.3.3 and 7.3.4, and with consideration of these evaluation reports, the following is deduced in terms of sustained benefit in the ICT4RED project:

- Unavailability of resources and failure to institutionalise hampered the ability to sustain input factors such as technology maintenance or teacher development.
- Teachers developed skills, which had the potential to be sustained through repeated application. However, the institutionalisation of training was not provided for.
- Social media reports from the group of ICT4RED teachers confirm that motivated teachers apply their skills in their various teaching environments. Some teachers received awards based on their contributions. However, the percentage of motivated, 'transformed' teachers, and hence the scope of impact, is not clear.
- The sustainability of learner development due exposure to 21st century teaching methods is difficult to assess. Some learning is assumed, but processes were not in place to reinforce and sustain learning over time (institutionalisation).
- The sustainability of the research products is equally difficult to assess. However, numerous products were developed at different levels of impact, ranging from policy implications to teaching material and project approaches. Provided that the local ICT in education environment is unlikely to change in the near future, these research products are a benefit that could be sustained over a longer period of time.

This 'sustainability assessment' can be summarised as follows:

Table 7.6 Sustainability assessment

Benefit	Sustainability	Action required to improve sustainability
Access to technology	Low	Institutionalisation of technology support Incorporation in annual provincial budget
Teacher 21st century skills	Medium	Institutionalisation of teacher development On-going access to technology
Learner development through 21st century teaching and learning skills	Low	Institutionalisation of teacher development Exposure to 21st century teaching methods over multiple years of schooling On-going access to technology throughout schooling

An upfront definition of sustained benefit, as well as sustainability targets and prioritisation of the various benefits, could have focused project resources towards processes that would maintain benefits. Along a value chain, a focus on institutionalisation of development processes as well as on-going access to technology (institutionalisation of funding) would have contributed towards sustaining benefits. In addition, a monitoring and evaluation (M&E) process with a clear definition of sustained benefit and a focus on sustainability targets may have guided the project to focus on activities that aim to sustain benefits.

7.4. CASE ANALYSIS

In the previous section, the ICT4RED implementation was described, and challenges with respect to sustained benefit and decision-making were highlighted. In this section, the case is analysed according to the four elements of the initial decision framework, as defined in Chapter 6. While this framework is applied retrospectively, the intention is to assess whether the framework could be used to identify and manage some of the issues that affect the ability to sustain benefits. The framework is repeated in Figure 7.4 for ease of reference:

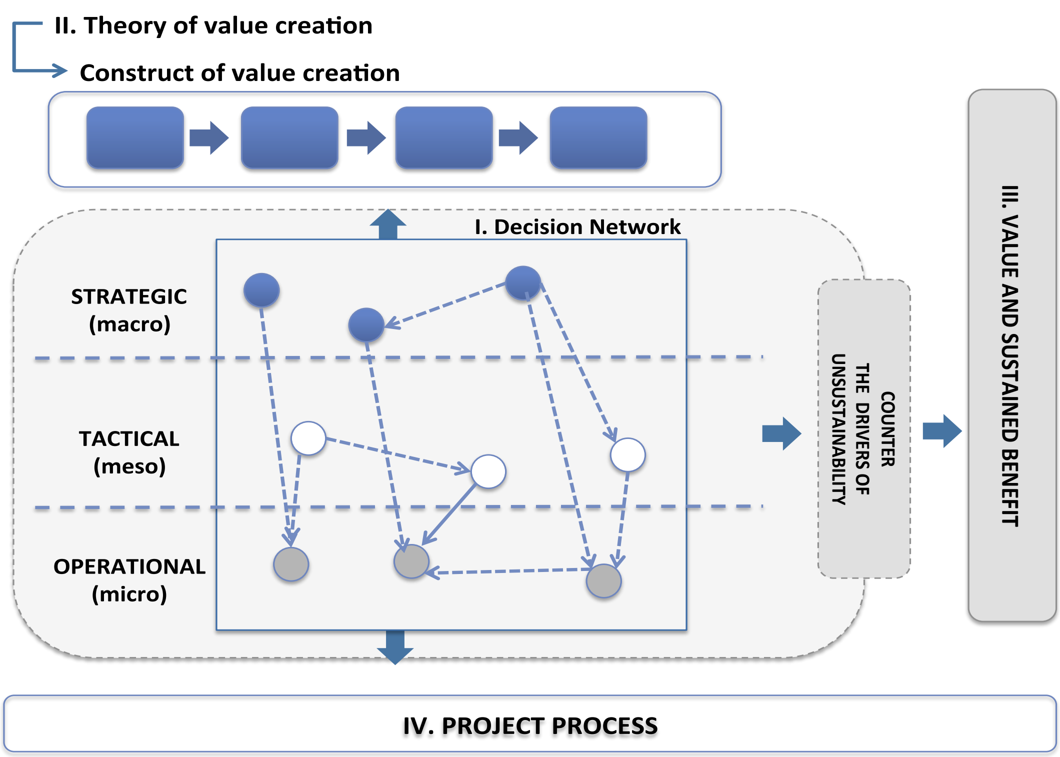


Figure 7.4 Initial decision framework

In the sections that follow, each of the dimensions is described for the ICT4RED project.

7.4.1. *Element I: Network of decision-makers*

The first element comprises a network of decision-makers. A formal decision map was not done at the outset of the project. The maps represented in this section were done during and after project execution. It is therefore retrospective, and benefits from knowledge that was gained during the course of the project. In practice, the intent would be to identify decision-makers at the outset of the project as far as possible (at least at a high level), and use this picture of decision influences to negotiate key enablers of sustained benefit.

7.4.1.1. Decision maps

The purpose of the first element in the decision framework, the network of decision-makers, is to highlight the influence of different *decision-makers* and *decisions* on the success of the intervention. As such, it can assist in identifying areas on which effort should be expended towards influencing success. A number of different approaches have been followed to understand networks (Barabasi, 2002), and to map interactions between people in networks or organisations (Davies, 2003). These include social network analysis (Monge & Contractor, 2003), and maps that trace power and influence – also called stakeholder maps (Bailur, 2006; IFPRI, 2010; Schiffer & Waale, 2008). The latter typically identify stakeholders and map their relative influence and importance with respect to an issue. Some representations also examine conflict between stakeholders (IFPRI, 2010), their extent of involvement (Bailur, 2006), or their position for or against a certain cause.

While any of these network-based techniques could be used to develop a representation of interactions that are associated with decision-making, it should be noted that the emphasis in this research is on the *decision-makers* (rather than role players in general) and their influence on *sustaining benefits* (rather than on their interactions in general). The latter is a multi-dimensional aspect, and the relative importance of a stakeholder (decision-maker) may differ with respect to different contributing factors of sustainability. Given the definition of the initial decision framework (see Chapter 6), the following are selected to be represented:

- Who are the decision-makers that are influencing the ability to sustain benefits?
- What is the sphere of influence of their decision-making (specifically, does it affect strategic, tactical, or operational issues)?
- Which aspects of value creation are they influencing?

Different representations of decision-makers and their influence on sustainability of the ICT4RED project are explored in this section, to address these questions. The relevance of the various representations is interpreted in Section 7.4.1.2.

A. Decision-makers and sphere of influence

A stakeholder map typically indicates who the stakeholders (role players) are, what their relative influence is on a specific aspect and on each other, as well as the direction of influence. In this case, the influence of stakeholders' *decision power* on ultimate *success* and *sustainability of the intervention* are of interest. A *decision network,* comprising a representation of decision-makers only and their decision role for the ICT4RED project, is therefore created:

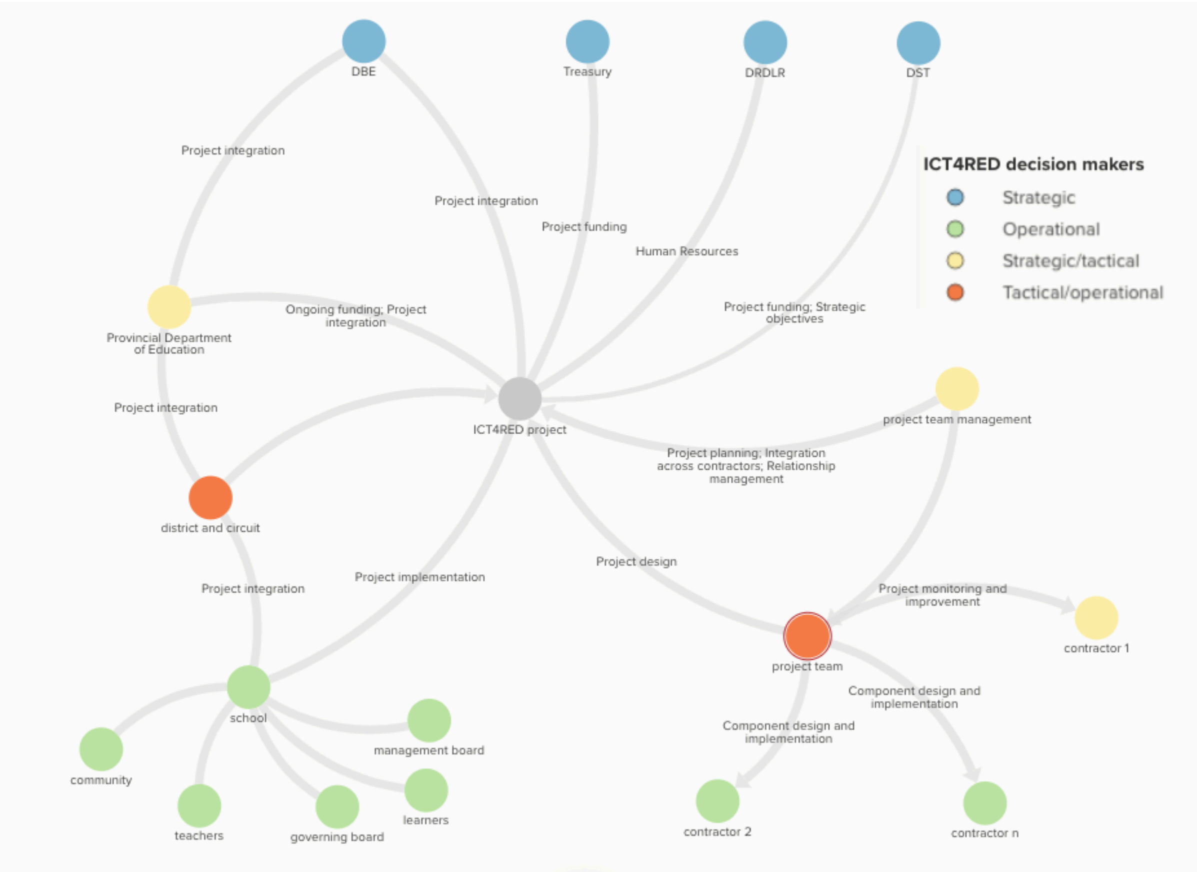


Figure 7.5 Decision network, indicating role players and their levels of influence

For each of the areas of influence (strategic, tactical, operational, and combinations thereof) in Figure 7.5, a number of decisions of the various role players are identified that could affect the ability to sustain benefits (Table 7.7). This mapping highlights and emphasizes critical decision-making issues that should be focused on during project planning and execution. While the mapping was done in hindsight, this decision-focused representation of role players could serve as a baseline for discussion at the outset of the project, as well as at regular intervals during project execution.

Table 7.7 Decision-makers and their influence on sustained benefit

Area of influence	Decision-maker	Decision affecting sustained benefit
Strategic objectives *Political and institutional sustainability*	DST	The definition of strategic objectives determines the scope, duration, and impact of the project (is the interest in sustaining benefits or in testing concepts?)
	DBE	The department's objectives with, and approach to, external projects determine whether the organisational environment will facilitate the sustainment of benefits
	Project team	A decision to clarify and align project strategic objectives with DBE and DST will define sustainability focus
Project funding *Financial and institutional sustainability*	Treasury	The size of funding that is allocated affects the scope and ability to implement mechanisms for sustainability
	DST	The decision pertaining to the duration and size of the pilot project affects ability to transfer
Ongoing funding *Financial and institutional sustainability*	DBE and Provincial Department of Education	A budget allocation is required to ensure integration of external projects. The decision pertaining to its existence, size, and duration affects the ability to sustain benefits.
Project resources (manpower) *Institutional sustainability*	DRDLR	The department's decision to provide resources should be aligned with project to ensure timeous and on-going availability of resources to support project activities
Project integration *Institutional sustainability*	DBE and Provincial Department of Education	A strategic decision to integrate external projects would facilitate sustained benefit
	District and circuit	Operational decisions enable or disable the integration of external projects and hence the ability to sustain benefits
Project planning and integration *Financial and institutional sustainability*	Project team management	A decision to plan for sustained benefit will lead to mechanisms for project transfer and integration Integration across contractors will influence operational decisions towards sustained benefit (e.g., alignment of technology design for limited budget)
Project and component design and implementation *Financial and institutional sustainability*	Contractors	A decision to design project elements for sustained benefit will lead to design decisions that support sustained benefit (e.g., technology design for limited budget; content update mechanisms for resource constraints, etc.)
Project monitoring and improvement	Contractors	A decision to monitor and evaluate with a view on sustained benefit will lead to identification of design activities that counter sustained benefit (e.g., lack of uptake of critical activities within provincial department of education).
Implementation	School and associated bodies	A decision to participate, create an enabling environment (safety, access to time and resources), and integrate the project into the school environment is critical to identifying and sustaining benefits.

B. Decisions and value creation

The representation of the previous paragraph was extended to link the role of different decision-makers and their areas of decision-making more explicitly to a construct of value creation. For this purpose, the information value chain of Heeks is chosen as *construct of value creation* against which decisions are mapped (see Section 5.7.2.4; Heeks, 2014b).

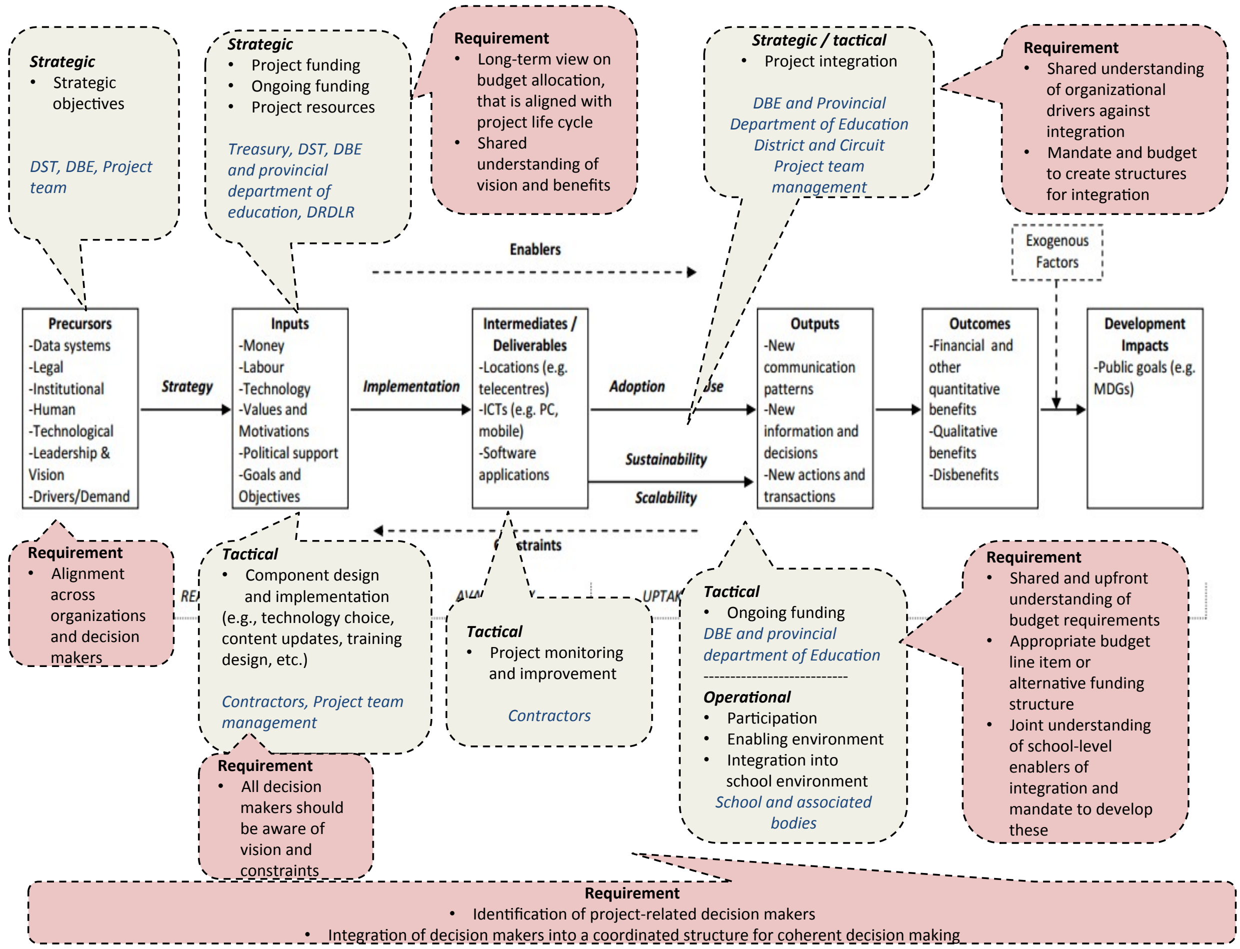


Figure 7.6 Decisions and their influence on value creation

This representation provides a sense of the influence of decision-making in the progression from inputs to impact. It indicates the key decisions (as mapped in 7.7) along the various steps of the value chain. Decisions are mapped to the points in the chain where they are appropriate, and decision-makers are indicated for each decision. In addition, 'requirements' for good decisions have been identified for each type of decision.

The following can be deduced from this representation:

- Outcomes and development impacts are dependent on a number of strategic, tactical, and operational decisions, which are taken by a number of different individuals and organisations.
- Project precursors and inputs are critically dependent on strategic decisions by multiple decision-makers. This requires integration between decision-makers and agreement on, and alignment towards, a common goal.
- The entire process of value creation is at risk if these strategic decisions are not facilitated.
- Tactical decisions affect the input to output part of the chain.
- These decisions are mostly in the hands of the project team and contractors, but require support from the national and provincial departments of education for integration into the system.
- Isolated project-specific decision-making (e.g., by contractors, or by the project team in isolation) has the potential to exceed budget constraints and violate strategic objectives.
- Adoption, use, sustainability, and the generation of outputs are critically dependent on the inclusion of the relevant departments in tactical decision-making; it should be a key focus of project activities and should be monitored closely.
- Generation of outputs, and the remainder of the process of value creation, is critically dependent on tactical decisions around ongoing funding. This should be addressed at the outset of the project. Expenditure would be wasted if this critical part of the chain were not enabled.
- Generation of outputs is critically dependent on participation at school level. This requires the mandate and focus by the project team and provincial structures to develop the environment in which this could take place.
- The map indicates that a large number of decision-makers influence project performance, at different levels of influence. Without an understanding of a common objective and the constraints (budgets and resources) within which the project functions, decision-makers will not be able to align their decision-making towards sustained benefit. To this end, structures and processes are required for the alignment of decision-making.

During project execution, a number of formalised decision support tools were developed. These were mapped during project execution along a value chain, so as to illustrate their relevance. An updated representation is given Figure 7.7:

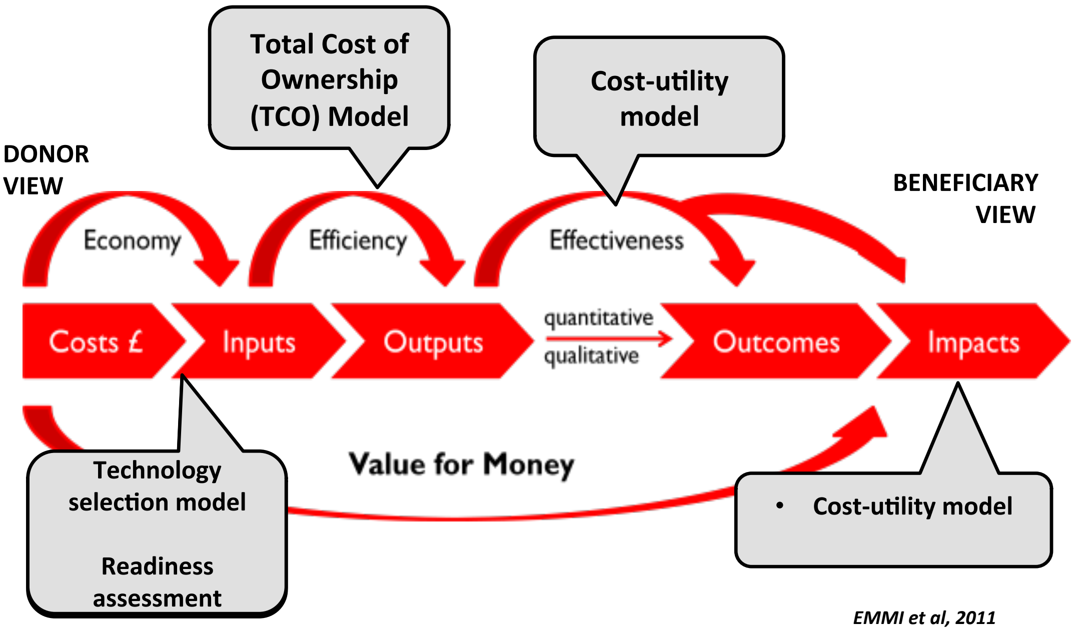


Figure 7.7 Decision models of the ICT4RED project (Meyer et al., 2015)

The outcomes chain as described by Emmi et al. (2011) was used as a construct against which to contextualise the value that each decision model aimed to enhance, as follows:

Economy	The technology selection aims to optimise purchase decisions (buy the best we can within our budget)
Efficiency	The Total Cost of Ownership (TCO) model is aimed at improving efficiency by ensuring that money is spent on the right things so that overall impact is more (achieve more if we work smarter)
Effectiveness & impact	The cost-utility model focuses on effectiveness and impact, by ensuring that the right things are done (what do we focus or spend on to make sure we reach our goals

This approach highlights that decisions can be linked to a construct of value creation. It positions the relative importance of the decision models in the chain. Note that this approach could have been enhanced if all decisions or decision-makers as well as intended benefit were identified upfront. This would enable the decisions to be placed in perspective and prioritised relative to benefit. As such, the relative effort in terms of decision support could be prioritised.

C. Decision-makers and influence on project elements

The representation in Figure 7.8 is yet another way of highlighting the impact of decision-making on project performance and sustainability. The matrix was developed during project execution, somewhat retrospectively, and indicates the role of different decision-makers relative to the different project elements. In this representation, the sequence of project elements or project steps is a representation of the way in which value is created by the project (i.e., a *construct of value creation*). The analysis highlights the sphere of influence of role players with respect to different project elements, as well as the constraints or opportunities resulting from decision-making associated with this configuration of role players.

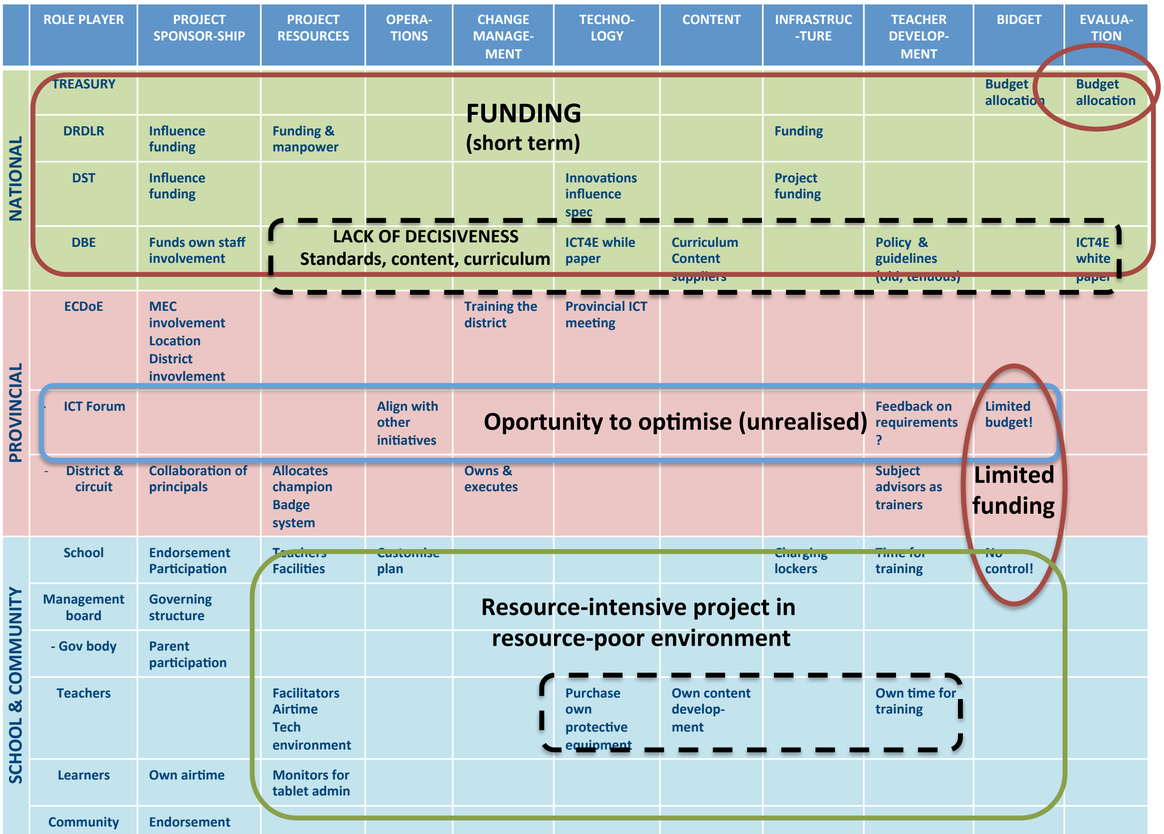


Figure 7.8 Decision matrix, indicating the contribution of decision-makers to project elements (Herselman and Botha, 2014)

This representation identifies the following constraints with respect to decision-making of the various role players, and hence areas for improvement:

- The national and provincial role players have a short-term focus on project finances (less than the project life cycle). This decision dynamic puts the continuation of the project at risk. Bridging mechanisms and / or alternative funding structures are required to transcend this if the initiative is to continue.
- Multiple role players influence the setting of standards, the curriculum, and guidelines pertaining to content (amongst others). This is a drawn out process, which does not provide an enabling environment for external projects.

Mechanisms are required to either transcend this decision dynamic in the short term. In the long-term, this is an opportunity for alignment across, and integration of, external projects.

- The provincial ICT forum is a decision structure that could potentially serve as a means of integration across different levels of the provincial hierarchy. However, this structure was not functioning adequately, resulting in lost opportunities for optimisation.
- The decision dynamics at school and community level highlights that the implementation of resource-rich solutions in resource-poor environments leads to complexity. Project design decisions should be cognisant of this discrepancy, and innovation should be aimed at bridging this divide.

The construction of the decision matrix in Figure 7.8 required an understanding of role player dynamics, and it may be difficult to construct at or prior to project initiation. However, it could be constructed during project execution and used for continuous improvement.

7.4.1.2. Interpretation: contribution of decision framework

The three decision maps that were outlined in the previous section provided perspectives that could be useful to the project, that were not evident from the normal project management process. These perspectives and their potential application or usefulness within the project are summarised in Table 7.8.

Table 7.8 Contribution of decision maps to the management of decision-making for sustained benefit

Decision map	Perspective	Potential application
A. Decision-makers and sphere of influences	Who are the decision-makers? What is their sphere of influence?	Develop a shared understanding of the various decision-makers and their influences on the project Identify the key decisions that affect the ability to sustain benefits
B. Decisions and value creation	Which decision-makers influence which part of value creation?	Develop a shared understanding of the critical decisions on the path towards value creation Define the mechanisms that need to be in place to facilitate these decisions
C. Decisions and project elements	Which decision-makers influence each of the project elements?	Identify the conflicts and discrepancies that are created by different decision-makers and decision environments

This analysis highlights that different representations of the decision environment and decision-makers contribute different perspectives – a single prescriptive format may not be sufficient. In addition, different constructs of value creation contributed different information – these included a construct based on the information value chain or an outcomes chain (Figures 7.6 and 7.7), as well as a construct that is linked to the project process (Figure 7.8).

The information that was generated highlights areas of integration and collaboration that is required in project-related decision-making. It develops a shared understanding, and provides a mechanism to pre-empt conflict and guide integration.

A potential constraint of this approach is that the richness of information is dependent on the analyst's or researcher's experience and understanding of the problem environment. This will determine the mechanisms that are created to support decision-making. A participatory process that includes multiple role players could be used to compensate for a lack of in-depth understanding of the environment, where appropriate. In addition, the analysis of the decision environment can be repeated and updated as the intervention develops, to enhance its accuracy as experience with the intervention environment develops.

7.4.2. Elements II and III: Value creation

7.4.2.1. Description

The purpose of these elements of the decision framework is to develop a joint understanding across all role players involved with the project (that is, the project team as well as the other decision-makers identified during the mapping of the decision network). Value and sustained benefit, and the theory and constructs of value creation (elements II and III of the framework, respectively) are closely related and are dealt with simultaneously in this section.

The ICT4RED project is both a research and an implementation project, and three perspectives on value creation can be identified from project documentation (CSIR Meraka Institute & Benita Williams Consultants, 2015; Herselman & Botha, 2014). These include the following:

Table 7.9 Perspectives on value creation

Perspective	Value created	Construct of value creation
A. Research	Artefacts, in the form of contextual frameworks, models, guidelines, and tools	Research framework
B. Implementation	Improvement in the 21st century skills of teachers Positive response of, and impact on, learners	Theory of change: teacher and learner outcomes
	Teachers that participate, react positively and stay motivated	Theory of change: implementation

These perspectives are outlined in the remainder of this section, providing more detail on the value created and the construct of value creation, as defined by the project:

A. Research perspective

Based on the research nature of the project, a premise existed that the research process in itself will create value. This is reflected in the following (Herselman & Botha, 2014:2)

'An envisaged intention of the ICT4RED initiative was to use the insights gained through the implementation to develop appropriate contextual frameworks, models, guidelines, and tools (as artefacts and outputs) to inform other similar initiatives before inception and can possibly guide these initiatives.

The following objectives were envisaged for the ICT4RED initiative:

- *Explore and design systemic and sustainable approaches to providing access to digital content at resource-constrained rural schools in South Africa. This incorporated an investigation into new and evolving educational technologies, devises, platforms, and processes that support the access to digital content for rural school environments;*
- *Explore and design approaches for Teacher Professional Development (TPD), towards the evolution of a more emerging teaching and learning engagement for the information age. This extends to the development of 21st Century teaching practices of teachers and 21st Century skills of learners; and*
- *Use the evidence from the research within this context to inform policy in an integrated and coherent manner.'*

This intention was translated into the following research framework:

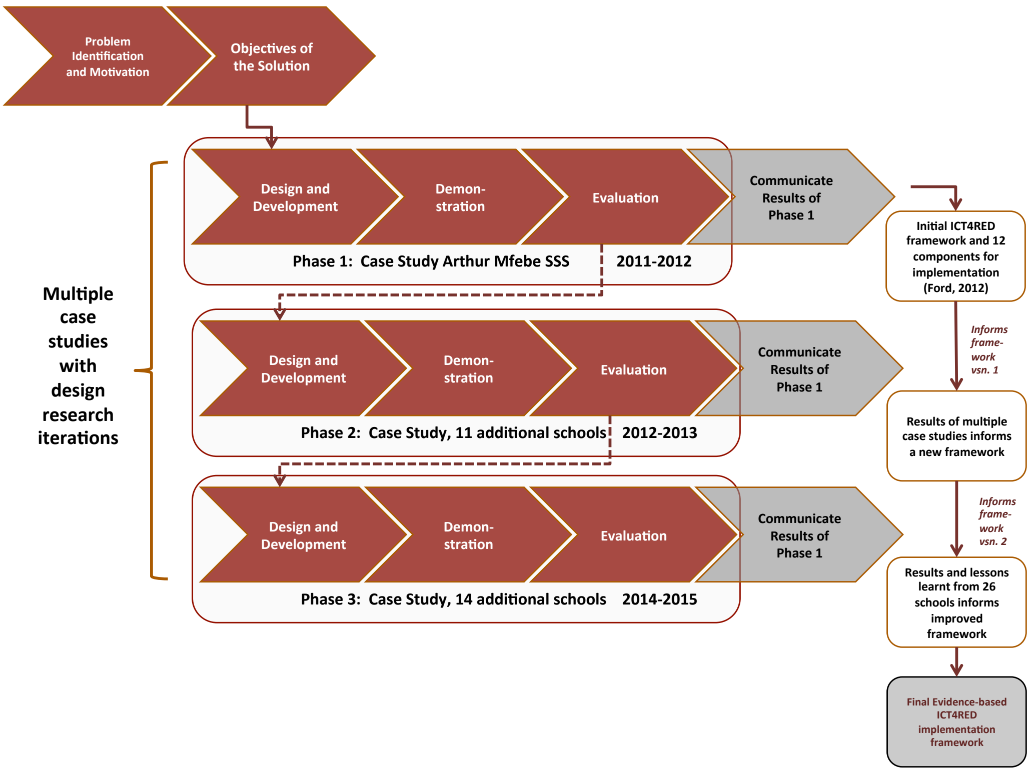


Figure 7.9 Research Framework for ICT4RED (Herselman and Botha, 2014)

The value that is created is seen as the development of artefacts in the form of frameworks, models, guidelines, and tools.

B. Implementation perspective

The formal 'theory of change' developed by the in-house M&E component comprised two different constructs of value creation (see Figures 7.10 and 7.11 below).

The theory of change related to *teacher and learner outcomes* (Figure 7.10) indicates that value is represented by the improvement in their 21st century skills (presumably learning skills). This is achieved by the following progression:

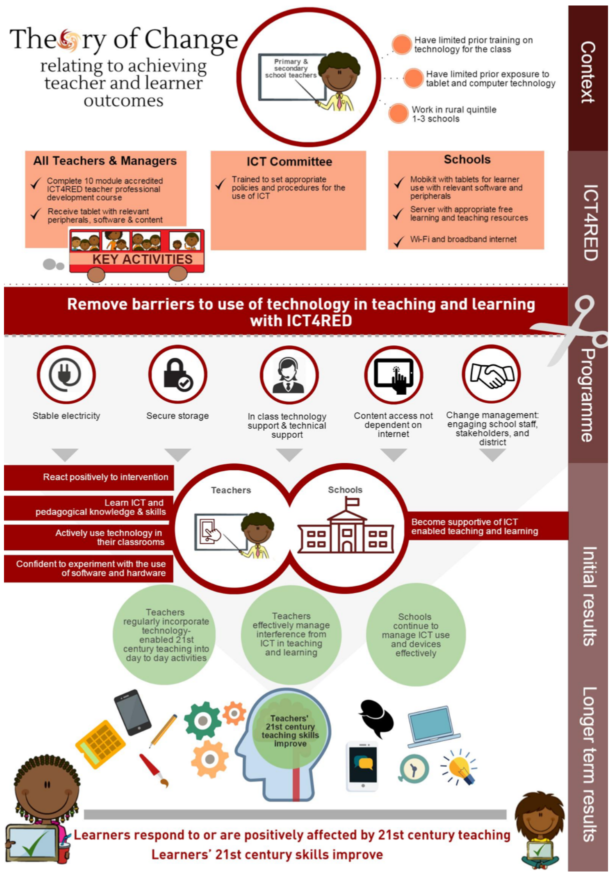


Figure 7.10 Theory of change: teacher and learner outcomes (CSIR Meraka Institute & Benita Williams Evaluation Consultants, 2015)

- Removal of the barriers to the use of technology in teaching and learning (through provision of devices, secure storage, electricity, technical support, content access, and change management); and
- Training (of teachers in 21st century skills, of ICT committees in procedure and policy development).

These activities are assumed to lead to the use of technology in teaching and learning, improved teaching skills, and ultimately improved learner results.

The theory of change related to *implementation success* (Figure 7.11) indicates that value equates to teachers that participate, react positively, and stay motivated. This is achieved by**:**

- Teacher professional development, technology, and content provision;
- Project management, communication, and earn-as-you-learn initiatives;
- In the absence of technical issues and conflicts with work requirements.

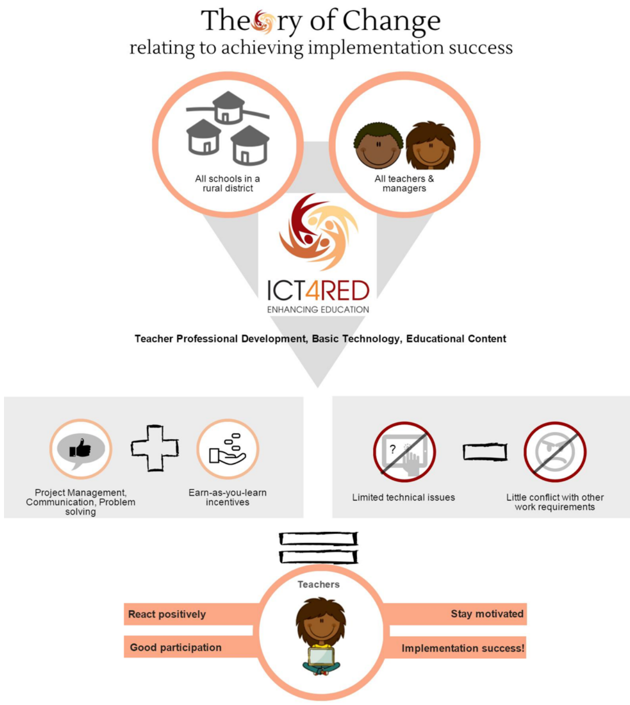


Figure 7.11 Theory of change: implementation success (CSIR Meraka Institute & Benita Williams Evaluation Consultants, 2015)

7.4.2.2. Interpretation: sustained benefit and decision-making

From the perspective of sustained benefit, the decision framework proposes that the following questions be asked (Section 6.5.2):

- What are the benefits that are expected to accrue from this ICT4D intervention;
- To what extent do we want the benefits to be sustained (i.e., for whom, and over what time period); and
- What do we need to do (what decisions do we need to make) to ensure that benefits are sustained?

These questions are explored here for the ICT4RED project, and the contribution generated through application of the framework is indicated for each question.

Question 1: What are the benefits?

Based on the ICT4RED project documentation, and participation in the project, evidence exists that the first question was addressed, as outlined in Table 7.9. However, the explicit differences in value creation was not necessarily articulated and shared at the outset of the project. Instead, at least parts thereof evolved over time. In addition, the measurement of benefits was a cause of debate. While the focus of the intervention was on teacher development, there was pressure from various role players to measure benefits in terms of learner performance.

Framework contribution: A clear, upfront definition of intended benefits, linked to the focus of the intervention, may have lead to alignment of stakeholders around value creation.

Question 2: To what extent do we want the benefits to be sustained?

The *sustainability* of this project was mostly defined in terms of financial sustainability, which implies that sufficient money needs to be available to support technology and training (i.e., sustain the inputs that are required to bring about change; see the theories of change in Figures 7.10 and 7.11, as well as the value chain of Heeks in Figure 7.6).

Framework contribution: An upfront mapping of value, and interrogation of this question, may have lead to the following insights:

Table 7.10 Value and sustained benefit

Perspective	Value created	For whom?	Over what period? (for example)
Research	Artefacts, in the form of contextual frameworks, models, guidelines, and tools	Policy makers, future researchers and practitioners	Medium term (i.e., around 5 years), or until the nature of the environment changes sufficiently to warrant new approaches
Implementation (1)	Improvement in the 21st century skills of teachers Learners respond to, or are positively affected by, 21st century teaching	Teachers Learners	Medium term (around 5 years) The time lag that is required before a positive effect is seen would need to be debated and agreed upon by project participants, and monitored
Implementation (2)	Teachers that participate, react positively and stay motivated	Teachers	Medium term (around 5 years)

The nature of the artefacts that result from the research process determine to some extent their duration and usefulness. In the case of the implementation perspective, the underlying dynamics of the way in which change is brought about in this system determines the appropriate time frames over which benefits can be expected to last.

Framework contribution: While the detail in Table 7.10 is presented as examples that may be disputed, a debate on these questions would lead to the following positive effects:

- A focus on the unit for which change is brought about (teachers) and the expected lag time before change;
- A definition of how long inputs need to be sustained to support the project's objectives; and
- A debate about institutionalisation of change, that is, what mechanisms are required to embed change in the provincial Department of Education, and what budget and structures are required to achieve this.

The latter is key to sustained change (i.e., beyond the medium term period), and would implicitly enhance the value of the project towards sustaining the benefits (indefinitely). Should this debate indicate that sustained change is a key focus of this project (which was not necessarily articulated in this case, while it may have been implied), project resources could be channelled to achieve this. If not, project resources could be channelled towards other objectives (for example, research on more aspects, and/or more research output).

Question 3: What do we need to do (what decisions do we need to make) to ensure that benefits are sustained?

The project emphasis on sustainability was on finances, and as such to have sufficient finances available to sustain inputs to the project (as outlined in the previous paragraph). A debate around this question would have shifted the focus towards the decisions that are mapped in Figure 7.6, that is, decisions at all levels that would facilitate sustained benefit.

Framework contribution: These decisions would move away from sustaining inputs only. It is clear from the map (Fig 7.6) that sustainability requires decisions at multiple levels, and along a larger part of the information value chain.

7.4.2.3. Interpretation: contribution of decision framework

Based on the discussion in Section 7.4.2.2, the application of these two decision framework elements would:

- Lead to new perspectives that would clarify and shift the understanding of sustained benefit in the context of this project; and
- Result in changes in which the project is approached (specifically, through sharing of perspectives and collaborative decision-making around key aspects of sustained benefit).

A key joint perspective would be: what would be sustained and for how long? This could in turn lead to the appropriate re-allocation of project resources. A potential shift in focus would be from sustaining the inputs (which is a resource intensive) to institutionalising the change (which would be inherently more sustainable). As such, the case indicates that addressing the questions outlined here has the potential of adding to the value delivered by the intervention.

Note that two constructs of value creation (namely the Information Value Chain of Heeks, and the Outcomes chain of Emmi) were useful in terms of answering the third question. The implication is that the manner in which value creation was expressed in this project (theory of change, research framework) does not implicitly allow decision-making aspects to be linked to value creation. The introduction of an external construct of value creation, such as the value chain of Heeks, seems to be useful. As before, the experience of the project team, or the extent to which diverse views are incorporated in this decision-focused analysis, are potential limiting factors in the implementation of these framework elements.

7.4.3. Element IV: Project process

7.4.3.1. Description

This element is included in the decision framework to highlight the fact that the ability to sustain benefit is also dependent on the manner in which the project is executed. The assumption is that the multiple decisions that are taken during project execution (and hence at some point in a project process) influences project outcome. In addition, it is assumed that iterative approaches that allow for continuous review and improvement has a higher potential to sustain benefit. Specifically, it is assumed that key aspects of a process that enables sustained benefit include the freedom to meet community members where they are in terms of aspects such as readiness, modular design, bricolage, flexibility, and capacity for iterative process (see Section 6.5.2). This section examines the project process design of ICT4RED, and identifies aspects that are in support of, and contradictory to, the delivery of sustained benefit.

A key aspect of the design of the ICT4RED project was its modularity. A twelve-component model was conceptualised, which changed over time to comprise six components (see Figs. 7.12 and 7.13):

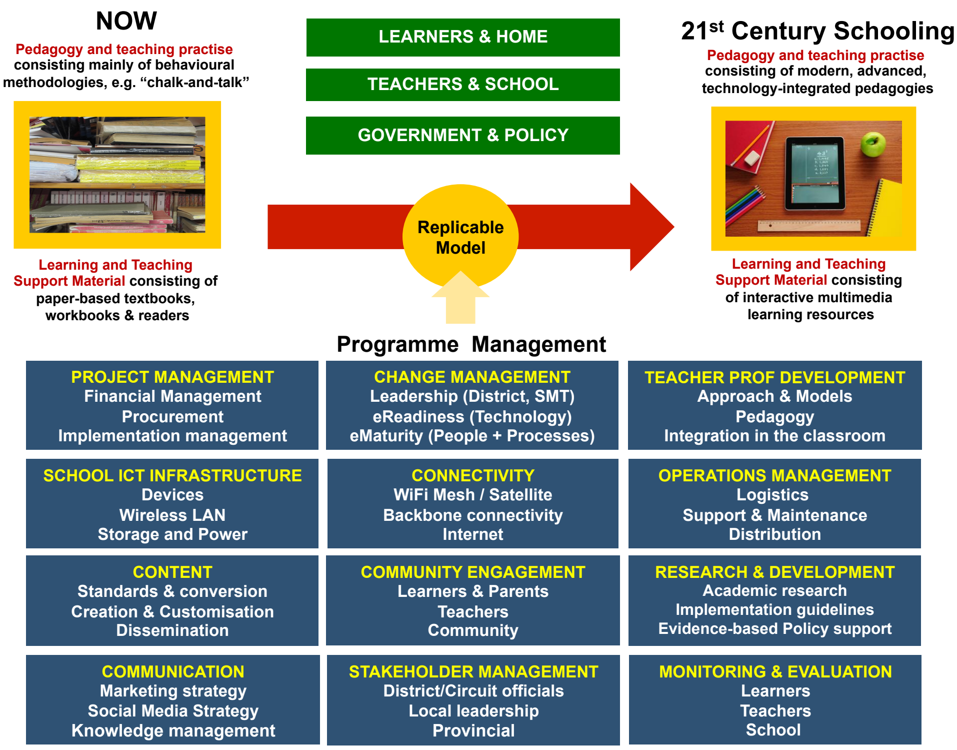


Figure 7.12 Twelve-component model (Herselman and Botha, 2014)

This modular design is aligned with the requirement that project approaches should allow for readiness, organic growth, and flexibility, as outlined in Section 6.4.5. While it may not have been the original intent, it became clear that modularity, and the associated flexibility, could be a key enabler of sustained benefit when designing an intervention that matches the readiness of schools with respect to the various project components.

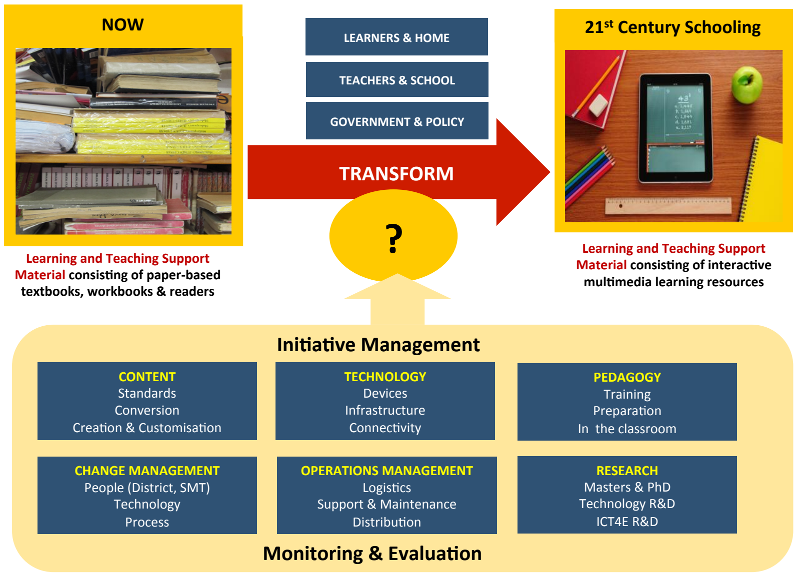


Figure 7.13 Six-component model (Herselman and Botha, 2014)

For schools that have the capacity to absorb the full implementation (including all technology, training, change management, etc.), all modules could be deployed. For schools with limited exposure to technology, immature processes, limited capacity for training and management of the initiative, etc., a reduced implementation could be deployed, matching their readiness status. This is outlined in the representation in Figure 7.14 below.

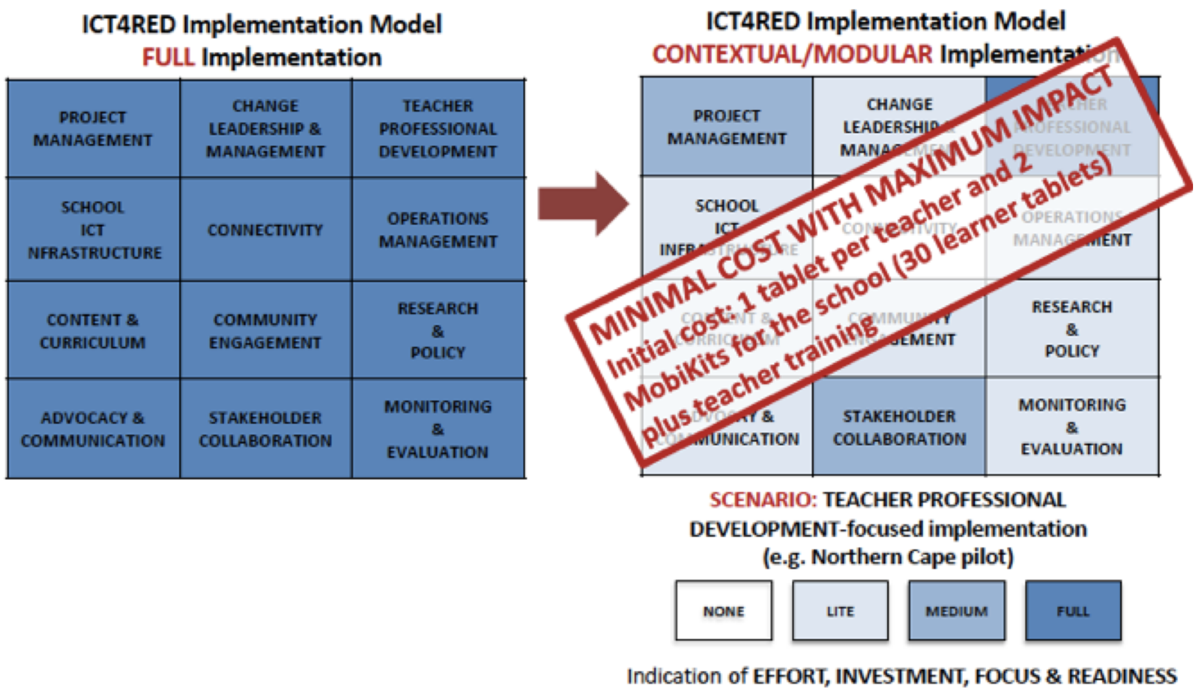


Figure 7.14 Modular implementation scenarios (Ford, 2016)

7.4.3.2. Interpretation: contribution of decision framework

Based on the description in Section 7.4.3.1, a modular project design contributes as follows to sustained benefit:

- Implementations can match readiness of schools, thus ensuring that gradual progress is made towards benefits;
- This approach enables controlled learning about what the system can absorb at a specific point in time, and the ability to develop the capacity to absorb more change over time. This is similar to the Bricolage concept (Ali & Bailur, 2007), and facilitates *institutional sustainability*; and
- This approach does not overwhelm available resources, and limits wastage (of school capacity, finances, etc.). Project resources can be channelled towards areas of most progress, as such reducing costs and ensuring appropriate impact.

Depending on the manner in which the modular design is implemented, it could counter sustained benefit. A key risk is the implementation of elements in isolation, without cognisance of the overall goal and constraints, and without coordinated decision-making. For example, technical design decisions in the ICT4RED project (such as the configuration of the help desk) proved to be expensive relative to the financial constraints of the Eastern Cape Department of Education. Similarly, an upfront understanding of the aspects that affect sustainability from the perspective of each of the different modules would have paved the way for monitoring and evaluation of key sustainability aspects, in addition to the implementation focus outlined in Section 7.4.2. These issues of coordination of decision-making have been highlighted by identifying and assessing decision-making in the context of value creation (see Section 7.4.2).

7.4.4. Summary

While the decision framework was here applied retrospectively for ICT4RED, it should ideally be applied prior to implementation, during the project planning and design phase. The framework is intended to provide insights into the decision environment and guide decision-making from a *conceptual* as well as *analytical* perspective (see Section 6.5.3). For the ICT4RED project, the questions posed from these two perspectives have been addressed in the previous sections. The potential contribution of the two perspectives and the questions to be addressed by each, for the ICT4RED implementation is summarised below.

Conceptual perspective

The conceptual perspective is intended to contribute alignment across decision-makers with respect to the intent of, and constraints to, value creation.

Table 7.11 Summary: conceptual perspective generated by the application of the decision framework

Question	Response	Reference (section)
How do we intend to create value through this intervention?	Two value creation mechanisms were identified, namely research and implementation (see Table 7.9 for detail). Early definition of these mechanisms, and a joint understanding thereof between all stakeholders, has the potential to focus efforts and performance measurement appropriately (teacher focus rather than learner outcomes) and open the debate as to what extent the various products (research or implementation products) should be sustained (and hence prompt planning for appropriate exit strategies from implementation).	7.4.2 (Table 7.9)
What value is created?	Value was defined in terms of research artefacts, 21st century skills of teachers with positive learner responses, and motivated teachers (see Table 7.9 and 7.10). As above: early definition, sharing, and clarification of objectives across all stakeholders would have implications for management of the project towards sustaining appropriate benefits.	7.4.2 (Tables 7.9; 7.10)
What benefit needs to be sustained, by whom, for whom, and for how long?	These answers have not been made explicit during the project process – see Table 7.10 for a retrospective assessment An upfront understanding could have shifted the focus towards institutionalising the change, rather than sustaining the inputs (technology support, etc.)	7.4.2 (Table 7.10)
What decision models are useful in supporting this process?	See Figures 7.6 and 7.7 Some decision models have been created during the project. However, the analysis highlighted a range of additional decisions that could be supported through models or processes.	7.4.1.1 (B)
What is the nature of the project process that will foster decision-making for sustained benefit?	The ICT4RED project adopted a modular approach. The analysis highlighted the benefits of modularity and its contribution towards sustainability	7.4.3

Analytical perspective

This perspective is intended to contribute to structuring decision-making in the intervention in a way that would facilitate rather than frustrate sustained benefit.

Table 7.12 Summary of the analytical perspective that was generated by the application of the decision framework

Question	Answer	Reference (section)
What decisions are we making in this process?	The analysis indicated a number of decisions that are or could be made along a value chain	7.4.1.1(B)
Where do they fit in terms of overall value creation?	A generic value chain (of Heeks) as well as an outcomes chain was used to represent decision-making. The constructs of value creation that were created by the project (theory of change, research framework) did not contain steps to which decision-making and decision-makers could easily be linked. The implication is that various constructs of value creation should be explored when applying the decision framework.	7.4.1.1(B) 7.4.2.1
Which other decisions are they linked to (do they affect?)	The generic value chain links decisions to value creation, and therefore also prioritises decisions relative to each other. The classification into strategic, tactical, and operational decisions introduces the scope of influence and therefore an additional way of linking decisions to each other.	7.4.1.1(B)
How do they enable value creation?	The generic value chain links decisions to steps towards value creation. It is evident from the representation that the sequence of decisions each has its own impact on value creation, and that the decisions in combination have an impact on overall value creation.	7.4.1.1(B)
How do they disable value creation?	Some potential conflicts in value creation were highlighted through the analysis	7.4.1.1(B)
What should change to ensure alignment with other decisions and value creation?	The analysis highlighted that decision-makers should collaborate with respect to a joint understanding of value and benefits, mechanisms of value creation, and constraints. The project design and project process should provide mechanisms and processes to ensure alignment.	7.4.1.1(B)
How should priority be given to different decisions, given the overall process	The analysis identified strategic, tactical, and operational decisions. This implies a natural priority and progression from strategic to operational, and also emphasizes alignment across these levels with strategic intent. Further, the constructs of value creation imply an order of events, in which subsequent events cannot take place unless earlier decisions are not made well.	7.4.1.1
What decisions are we not making?	Some decisions were actively supported by decision models (e.g., costing and technology selection). The value chain analysis pointed to a number of additional decisions that could be supported (e.g., resource allocation). In addition, some decisions (specifically pertaining to institutionalisation) have not been identified upfront as critical to sustained benefit, and have not been addressed.	7.4.1.1(B)

In summary, the analysis of decision-making in accordance with the decision framework provided a conceptual as well as analytical view on decision-making. These views could be used to align decision-makers with respect to value creation and to structure decision-making to support sustained benefit. The value chain approach to decision analysis proved enable a number of useful perspectives.

7.5. IMPLICATIONS FOR DECISION FRAMEWORK

The decision framework was applied retrospectively to the ICT4RED project, as outlined in the previous two sections. The purpose was to:

Assess the usefulness of the framework
in guiding decision-making for sustained benefit

The intent was to determine whether the framework is applicable in practice, and whether it succeeds in generating insights that could be used to enhance the ability to sustain the benefits of an ICT4D implementation. In addition, the aim was to identify any enhancements that would enable the framework to better fulfil its original goal. The retrospective application relies on historical data and memory, and may not elicit all the complexities inherent in the application of the framework.

Each of the four elements of the decision framework was applied to the case, and the potential usefulness and contribution of each element was interpreted. Learning was summarised into conceptual and analytical perspectives (see Section 7.4). The following benefits and omissions were evident from the application of the framework:

Table 7.13 Summary: new perspectives generated by the application of the decision framework

Framework element	New perspectives generated	Omissions or learning	Ref (section)
Network of decision-makers	Decision-makers at different spheres of influence were identified A sequence in decisions as well as potential conflicts could be identified	The completeness of information would depend on the experience and insight of the project team. This may require repeated application of the framework. The prioritisation of decisions relative to sustained benefit may be required.	7.4.1.2
Value and sustained benefit	Multiple values and benefits were identified, emphasizing the need for communication and prioritisation.	Multiple values and benefits require that value and benefit be prioritised, and require clarity about specific disablers and enablers of value creation.	7.4.2.3
Theory and construct of value creation	As above	A generic construct of value creation proved to be useful in reflecting the role of decision-makers (rather than the stated theories of change and research frameworks as defined by the project).	7.4.2.3
Project process	The modularity of the ICT4RED implementation could be linked to its contribution to sustain benefits	While modularity can enable sustained benefit, it can also frustrate it if modularity creates silo thinking within the project team, and if the team is not aligned in terms of benefits and constraints. This implies that a tight coupling between project process and other framework elements is required.	7.4.3.2
Conceptual perspective	This perspective created new insights that made value creation and its mechanisms visible	The experience and skill of the analyst, and knowledge of the project environment, could influence the quality of the analysis. The analysis should be repeated more than once.	7.4.4
Analytical perspective	This perspective generated new insights with respect to the structuring of decision-making	The practical implications of this perspective are not immediately clear. Some additional mechanisms may be required in the framework.	7.4.4

Based on this analysis, the following changes to the framework are proposed:

- Add a mechanism or questions that prioritises different benefits, as well as decisions relative to different benefits;
- Include questions that prompt thinking about enablers and disablers to value creation;
- Emphasize that generic value creation constructs (specifically, in the form of value chains) be defined for the purpose of the decision analysis;
- Emphasize the interrelatedness of the four components of the framework; and
- Prompt the translation of concepts into practical implications for project design.

Further, it is proposed that the framework be extended from the current diagrammatic concept to include a checklist of questions (or similar mechanism) that will prompt easy application thereof. This is addressed in the intermediate framework (see Chapter 9).

7.6. SUMMARY

This chapter set out to assess whether the initial decision framework is applicable in practice, and to identify how the framework should be adapted to enhance its effectiveness. As such, the work was still in pursuit of answering the main research question of the thesis, namely:

What are the elements of a framework that support strategic decision-making for the design and implementation of ICT4D interventions in resource-constrained environments, in support of sustained benefit?

The question was answered by finalising the method for case analysis that was initially discussed in Chapter 2. Thereafter, each of the elements of the decision framework was defined for the ICT4RED implementation. The analysis showed that new insights were developed through the application of the framework. However, it also indicated that some elements required further explanation, and that a checklist or similar mechanism should accompany the framework to render it easy to implement in practice.

This chapter concludes the first of two case studies that are applied to test the framework. Chapter 8 will comprise a similar application of the framework to the second case study, after which learning from both cases will be integrated to develop the intermediate decision framework (see Chapter 9).

CHAPTER 8. CASE APPLICATION: DRDLR

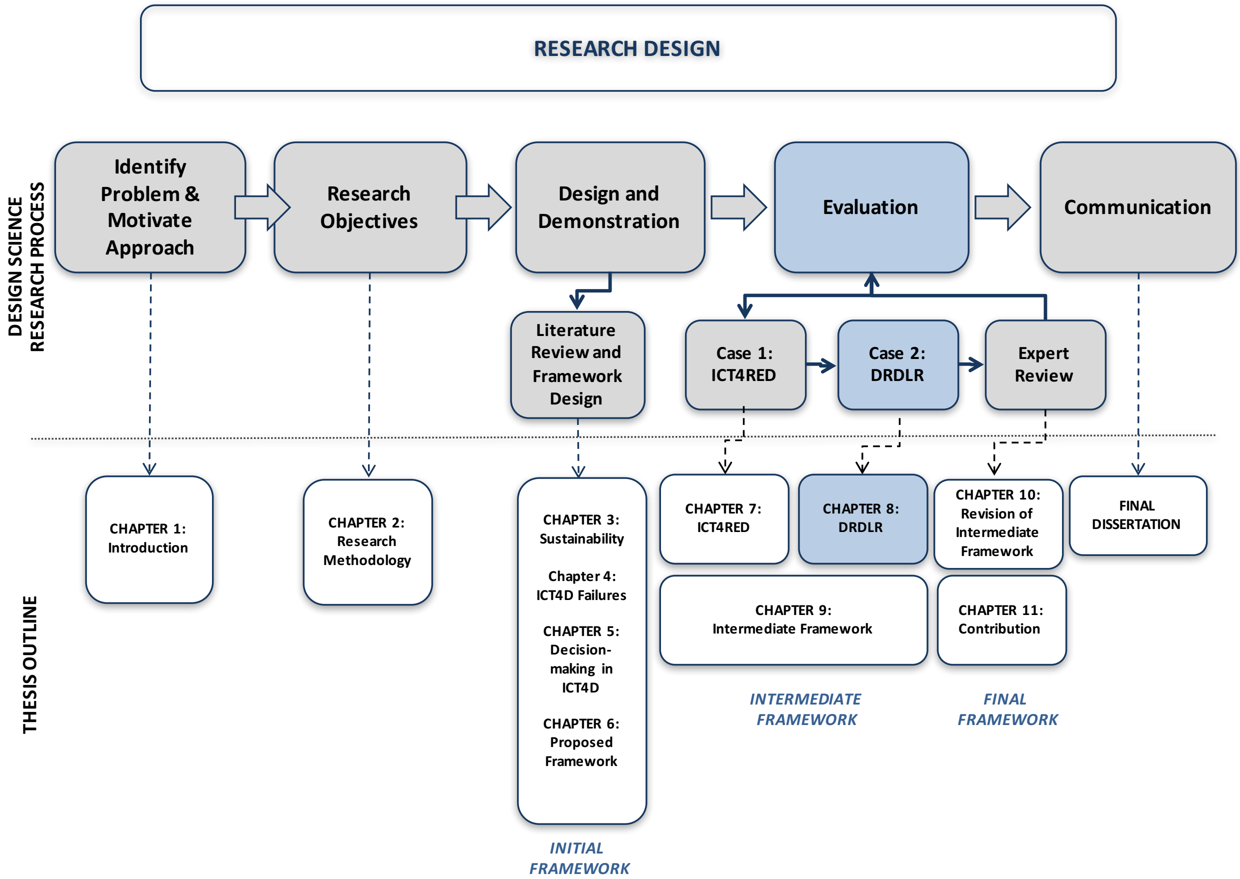


Figure 8.1 Research process and thesis outline: Chapter 8

8.1. INTRODUCTION

This chapter describes the second of two case studies that are used to evaluate and enhance the initial decision framework. Similar to the ICT4RED case, the Department of Rural Development and Land Reform (DRDLR) project is concerned with the rollout of technology in rural South Africa. It comprises the establishment of public access hubs, or ICT Hubs, rather than technology-enabled teaching and learning.

This case analysis plays a role in evaluating *'how well the artefact supports a solution to the problem'* (Peffers et al. 2007:8) by applying the decision framework to the case under consideration. As before, the analysis is aimed at theory testing, and contributes towards answering the overall research question:

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

This *within-case* analysis is intended to contribute learning with respect to the completeness and usefulness of the decision framework, so as to inform the intermediate decision framework in a *cross-case* analysis in Chapter 9.

This chapter is structured as follows: first, the approach to the analysis of the case is briefly reiterated (Section 8.2), after which an overview of the DRDLR project is given and its relevance as a case study is motivated (Section 8.3). Section 8.4 comprises the analysis of the case, in which the various elements of the decision framework are applied to elicit new perspectives on decision-making towards sustained benefit. The implications of this analysis for the decision framework are outlined in Section 8.5, and Section 8.6 summarises the chapter.

8.2. APPROACH TO EVALUATION AND CASE ANALYSIS

The approach that was used in the previous chapter to evaluate the artefact (Section 7.2) is repeated for the DRDLR case. As before, the goal of the evaluation is to (see Section 2.6.4):

Assess the usefulness of the framework
in guiding decision-making for sustained benefit

The case analysis method that was derived in Chapters 2 and 7 is again used for this case, and is repeated here for convenience.

Table 8.1 Method of within-case analysis

Within-case analysis	Objective & activities	Method
Description and Relevance From project documents, participant observation, participation in decision modelling	Identify the **purpose** of this case relative to this research Identify and describe the **context** of the case. Highlight the **decision-making** and **sustainability** context and challenges Define the **current status**	How is this case expected to contribute to the research? What is its relevance? Brief description, based on project documentation and participation. What challenges were encountered (retrospectively) What is currently happening in the project?
Case analysis Descriptions and decision maps	Describe each element of the framework relative to the case under consideration: • Network of decision-makers • Theory and construct of value creation • Value and sustained benefit • Project process	How was this element conceptualised in the project, if at all? Could this conceptualisation be enhanced? How does an enhanced description link to improved decision-making? How does an enhanced description link to sustainability?

This method is applied to describe and analyse the DRDLR case, as outlined in Sections 8.3 and 8.4.

8.3. DRDLR: DESCRIPTION and RELEVANCE

The ICT Hub project[1] was initiated as a means of providing access to ICT in rural areas. Similar to the ICT4RED project, it comprised the rollout of technology across multiple sites over a multi-year time frame. However, the project was less comprehensive than ICT4RED in the sense that the primary focus of technology deployment and access was not enhanced by multiple project modules such as teacher development or stakeholder engagement (see Section 7.4.3). This case analysis describes and analyses the aspects pertaining to decision-making and sustained benefit, in addition to providing general background information.

[1] This project name is adopted for the purpose of this research, so as to differentiate it from other Digital Doorway initiatives, and to reflect the inclusion of ICT centres in the project scope (see Section 8.3.1).

8.3.1. Purpose

The Digital Doorway (DD), developed by CSIR, aims to provide access to computers in underprivileged communities in South Africa (Abdesin et al., 2010). The technology was developed over time, with the consequence that currently deployed Digital Doorways include multi-user terminals, freestanding solar-powered containers, and ICT laboratories (Digital Doorway, 2017a). In 2013, the DRDLR defined a project around this technology, aimed at providing communities with access to ICT through the deployment and/or upgrading of different types of Digital Doorways at various sites across South Africa. The overall purpose includes bridging the digital divide and enabling community development (CSIR Meraka Institute & Benita Williams Evaluation Consultants, 2016).

The project's primary focus on technology rollout and access, rather than on supporting sustainable use (see, e.g., CSIR Meraka Institute 2017a & 2017b), implies that it does not address an end-to-end ICT4D value chain (see Section 8.3.3). In spite of its less comprehensive project definition, the project comprises sufficient complexity to contribute to this research. For example, DRDLR's ownership of the CSIR-supported ICT Hubs contributes to organisational complexity. In addition, the requirement for financial sustainability increases complexity, since it requires a long-term value creation view, while the project focus is one of short-term technology rollout. As before, the project's complexity provides a rich context for the exploration of decision-making and the elements of sustainability (see Sections 8.3.3, 8.3.4). Table 2.3 summarised the motivation for the selection of this case study (repeated here for convenience).

Table 8.2 Criteria for case study selection

Criteria for evaluating the case	*ICT Hubs*
The case must be 'interesting', i.e., it must reveal something that was not known before	The case is an experimental deployment of an implementation to enable rural access to ICTs. It has a less holistic approach than the ICT4RED case, which in itself introduces specific challenges.
The case must display sufficient evidence	The duration of rollout, and obstacles to realisation of implementation schedules, provides sufficient material from which to collect evidence.
The case should be 'complete', i.e., all relevant evidence to prove or disprove the case must be collected	The project life cycle and implementation challenges allow for understanding of issues of sustainability in the project design phase, as well as assessment of implication thereof in the implementation phase.
The case must consider alternative perspectives, i.e., must reflect real life situations (including contradictions)	The experimental nature of the project and diverse implementation sites create sufficient information to reflect contradictions.
The case study should contribute to knowledge, i.e., must be generalized to one or more theoretical concepts	The uncoordinated decision environment and the resource-constrained nature of the environment within which the project is implemented provide sufficient scope for the development of new theoretical concepts.

Due to the contradictions between scope and purpose, and the significant role of the government department in ensuring success, the case is expected to contribute towards the systemic nature of the decision framework.

8.3.2. Overview

The Digital Doorway is a joint initiative between CSIR's Meraka Institute, the Department of Science and Technology and the Department of Rural Development and Land Reform. It has been used in numerous contexts in South Africa and Africa, with the purpose of making *'a fundamental difference to computer literacy and associated skills in Africa'* (Digital Doorway, 2017b:1). Its purpose is formalised as follows (Digital Doorway, 2017a: concept page):

> *'to provide people in rural and disadvantaged areas with freely accessible computer equipment and open source software, enabling them to experiment and learn without formal training and with minimal external input.'*

The initiative is seen as an enabler of socio-technical innovation, as summarised by Stillmann et al. (2010:2):

> *'a purposed social-technical system in which the Digital Doorway is a key technical agent supported through direct engagement with a community for communication, knowledge, and innovation in the context of providing opportunity to a disadvantaged community.'*

The premise is that robust computer systems are installed within communities, who then have the opportunity to develop their own computing skills, with minimal guidance or intervention (Digital Doorway, 2017b). Over time, the configuration of the DD has evolved from a single terminal to three- and four-seater terminals, as well as solar-powered container DD's (see Figures 8.2 and 8.3). In addition, some digital doorways form the building blocks of ICT Centres.

These various configurations have been installed at more than 240 different sites in South Africa and Africa (see Figure 8.4), serving users that are predominantly under the age of 21 (Digital Doorway, 2017b). In addition to some urban and peri-urban sites, installations are predominantly in rural areas. Sites are mostly resource-constrained, especially in rural areas where physical access complicates access to technology support.

Figure 8.2 Multi-seater Digital Doorways (Digital Doorway, 2017a)

Figure 8.3 Solar-powered container Digital Doorways (Digital Doorway, 2017a)

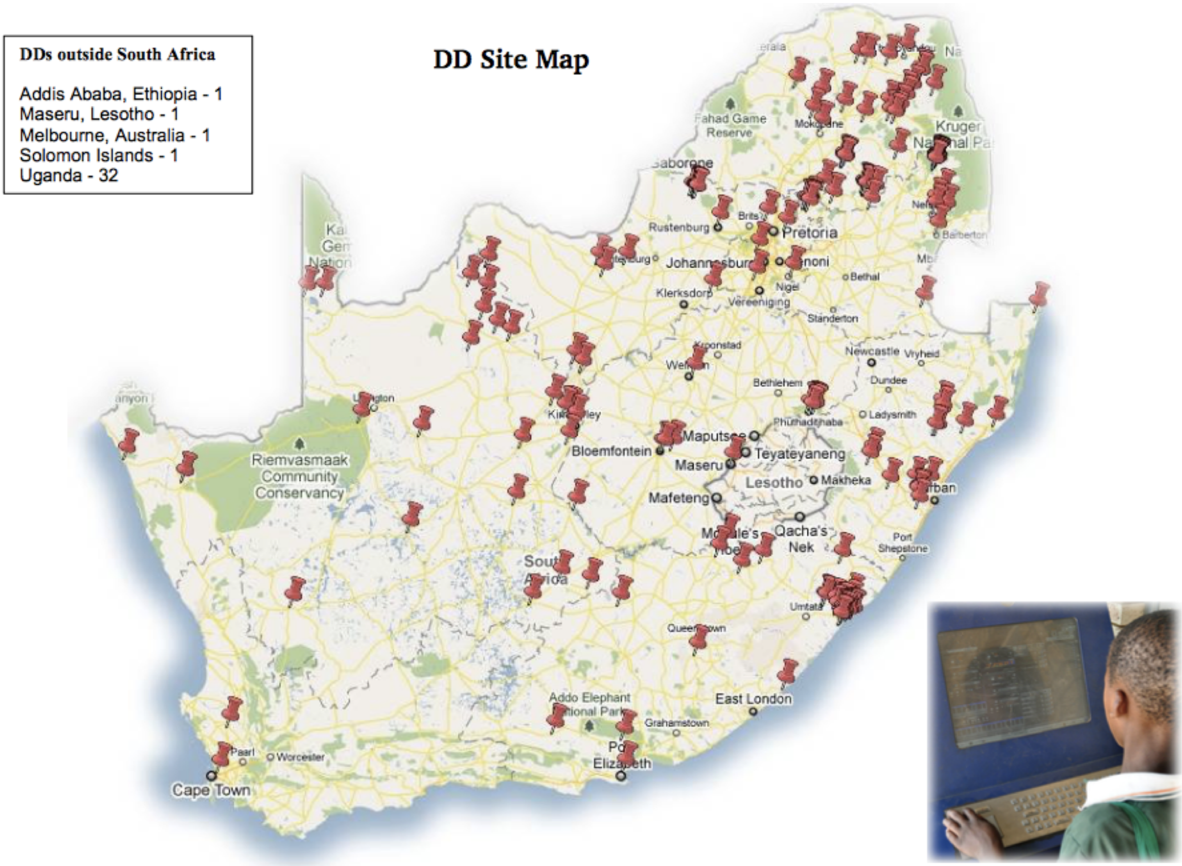


Figure 8.4 South African sites of Digital Doorways (Digital Doorway, 2017b)

The DRDLR ICT Hub project intended to use the Digital Doorway as the technology by means of which to provide access to information and communications technology to resource-poor communities. As such, it comprised the rollout and/or refurbishment of a number of Digital Doorways. In addition to providing access, the intention was to develop centres that would generate their own income through a portfolio of services, to be financially sustainable while also contributing to the social and economic development of communities. The project was structured as follows (summarised from CSIR Meraka Institute & Benita Williams Evaluation Consultants, 2016):

Table 8.3 Project components

Project component	*Detail*
Technology upgrades	Upgrading of the existing 15 container Digital Doorways and the 11 still to be deployed as part of the DST project. Upgrading of 18 iSchoolAfrica sites (installation of a content server, Uninterrupted Power Supply (UPS), as well as Wi-Fi and Satellite to ensure connectivity).
Technology deployment	The deployment of an additional 22 new specification container Digital Doorways.
Connectivity provision	Provision of satellite internet connectivity at 66 sites (existing 15 container Digital Doorways and the 11 still to be deployed as part of the DST project, the 18 iSchoolAfrica sites where the Department is involved and the 22 new specification container Digital Doorways).
Monitoring, evaluation, operations, and sustainability plan	Conducting of an M&E process and development of a sustainability plan for the 48 (existing 15 container DDs + 11 still to be deployed as part of DST project + 22 to be deployed as part of this project) container Digital Doorways.
Training of champions	Training of two champions from each site who were identified by DRDLR. They will undergo a 10-day intensive training course on the Digital Doorway. This will enable them to provide technical support to users, maintain the Digital Doorway and 'market' the Digital Doorway and the functionality.

The project structure reflects the predominant focus on technology rollout. ICT Hub 'champions' would be trained to support the community in using the hub, and in attaining financial sustainability. Similar to ICT4RED, the project included a monitoring and evaluation component as well as a 'sustainability modelling' component. The latter was primarily defined to develop a cost model that would represent the total cost of the implementation (total cost of ownership; see also Section 7.4.1.1), with a view of using costs to understand financial sustainability. The sustainability modelling work formed the basis of this case analysis. As in the ICT4RED case, a somewhat broader perspective was taken by the researcher on sustainability, and the effect of aspects such as organisational design, project decision-making, and project process on sustainability were also considered.

8.3.3. Sustainability challenges

The focus of this research on sustained benefit, rather than on sustainability in general, implies that role players should be clear about 'the intended benefits of a project and then design a project that will ensure that such benefits are sustained' (see Section 7.3.3.).

Some aspects inherent in the ICT Hub problem environment present sustainability challenges. Based on related research, such as those examining telecentres (Attwood & Braathen, 2010; Kumar & Best, 2006), it is clear that multiple factors affect the success and sustainability of community information centres. Following the approach of considering multiple dimensions of sustainability (Kumar & Best, 2006; Pade et al., 2006; Pade-Khene et al., 2011; Section 7.3.3), the following challenges could be identified for this project (based on an analysis done during project execution – Meyer & Marais, 2014):

Table 8.4 Challenges to sustained benefit, according to the dimensions of sustainability (Meyer & Marais, 2014)

Dimension	Challenges to sustained benefit
Political	Political pressure to show progress in rural areas led to the deployment of technology (rather than sustained use thereof) as indicator of 'success' – that is, technology delivery rather than technology use was the indicator of success. Sites for DD deployment were pre-selected, as such compromising the capacity to optimise sustainability by developing site-specific solutions.
Organisational	Sustainability of the ICT Hubs was complicated by the DRDLR acting as (on-going) organisational home of the initiative. This was exacerbated by the (conflicting) demand for the ICT Hubs to be self-sustaining within a bureaucratic environment. DRDLR required that technology support be provided by the National Rural Youth Service Corpse (NARYSEC) youth, which were not organised in a mature organisational construct. This complicated the sustained technical support to the hubs. The organisational skills and capacity of different communities for uptake of the ICT Hubs (i.e., readiness per community) were not known.
Social	Communities' differing needs, interest, and ability to engage with technology was not known.
Financial	The ICT Hubs were required to be financially self-sustaining. However, technology deployment preceded clarity about the manner in which financial viability would be reached. This complicated the ability to design a solution that could potentially be financially independent.
Technical	Technology support had to be delivered in low-resource, remote communities.
Environmental	Technology recycling does not form a standard element of rural ICT practice. In addition, reverse logistics (where this is an applicable solution) would be expensive in rural environments.

As was outlined in Chapter 7, this multi-dimensional view of sustainability is not the only one that would elicit challenges. For example, considering the scope of work of the project (see Table 8.3), it is clear that the focus of the DRDLR ICT Hub project was predominantly on technology rollout, that is, towards the initial parts of an ICT4D value chain (see Figure 8.5):

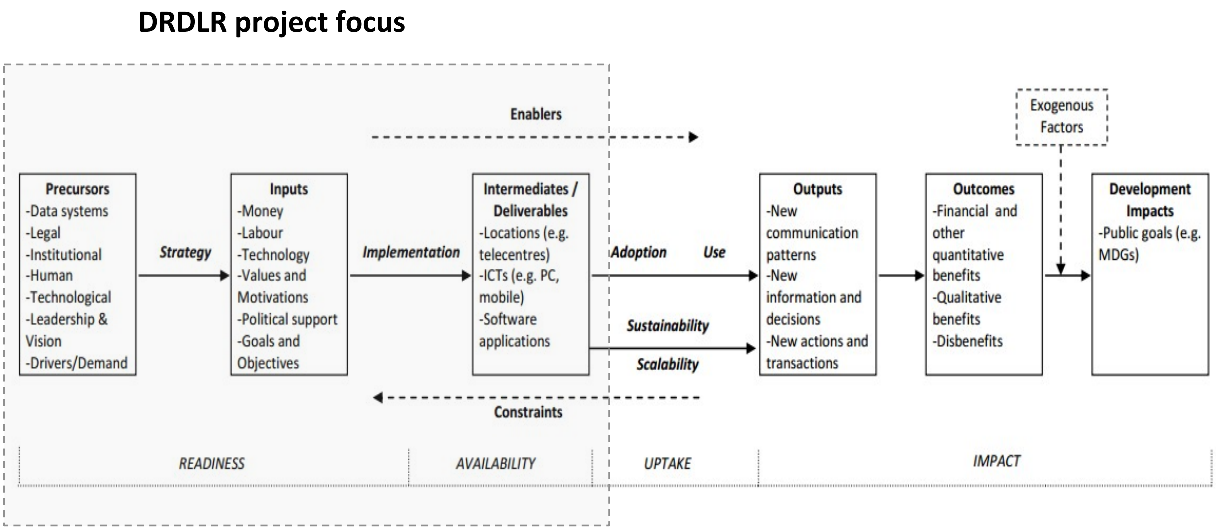


Figure 8.5 Scope of DRDLR project, relative to the ICT4D value chain of Heeks (2014b)

The DRDLR required that this technology-focused implementation should be financially sustainable. Considering the ICT4D value chain, it is clear that the value that is created from a technology implementation (and hence the potential value for which customers or other clients would pay) results from adoption of technology, and hence the use thereof to create value. One would therefore expect that a significant portion of project resources should be expended towards supporting and realising value creation, to facilitate the creation of worth for which users or other stakeholders would be willing to pay. A focus on technology deployment rather than value creation generates an inherent tension between a short-term focus on implementation and access, and a long-term focus on the ability of the community to turn access to this asset into a mechanism that can provide sustained value, which would in turn be able to elicit funding in various forms. This discrepancy in focus presented one of the key sustainability challenges in this project.

At the outset of the project, the technology concept (Digital Doorway) was relatively mature, and had already been implemented, tested, used, and researched in numerous contexts. However, financial sustainability was defined in concept only, and the complexities thereof were poorly understood. In addition, organisational sustainability was not part of the consideration of the initial project definition.

The DRDLR project was therefore on the one hand characterised by a clear intent (provision of access to computing facilities that are financially sustainable), but on the other hand by uncertainty pertaining to the manner of reaching financial sustainability, the manner of supporting the rollout (organisational sustainability), as well as the developmental benefits that were to be derived. The technology was mature, while the remainder of the project concept was relatively immature. Given the imbalance between technology maturity and the maturity of other dimensions of sustainability, as well as the political pressure to show visible progress, the risk for technology dumping in this project was high.

As before, the nature of the challenges to sustainability, as identified in this section, is consistent with the complexity of ‘messy’ problems (Section 1.3.3).

8.3.4. Decision-making challenges

Some decision-related challenges were inherent in the nature of the project, and can be deduced from the descriptions in the earlier sections.

For example:

- A focus on technology rollout, without clarity with respect to other enablers that are required to ensure impact within the community;
- A pressure for financial independence of the hubs, without clarity about the audience for services and the manner in which independence would be achieved prior to technology rollout;
- Decisions to use immature and/or bureaucratic organisational structures to facilitate the provision of technical support;
- Pressure to deliver to political requirements; and
- Site selection decisions that were not aimed at optimising sustained benefit.

As before, the dimensions of a decision problem are used, as derived in Chapter 6, to describe the decision-making challenges of the DRDLR project.

Table 8.5 Decision-making challenges of ICT4D problems in general, and DRDLR ICT Hubs specifically (see Table 6.3)

	Dimension	Decision problem in ICT4D	Decision-making challenges in DRDLR ICT Hubs
A	Complexity	Messy	Characteristics of a messy problem are evident – see description in paragraph A.
B	Goal	Value creation in complex environment	The environment is constrained, and value creation is determined by the extent to which the varying needs of different communities are addressed by the technology rollout. Political pressure influences the extent to which success is defined.
C	Decision-makers	Multiple, not all known	Project success is influenced by decision-makers in multiple entities and at multiple levels within an entity.
D	Solution space	Optimality (and a good solution) is difficult to define	Multiple (and unknown) potential benefits complicate the definition of the 'best' choice. The view of choices is limited, in the sense that the development of enablers of sustained benefit is not considered as a key component of the project (e.g., community readiness development, responsiveness to needs of specific communities).
E	Value of alternatives	Difficult to assess; requires discussion against an agreed construct.	It is difficult to assess the impact of different choices on the overall outcome of the project.
F	Constraints	Resource-poor, relative to solution space	Resource poor, relative to the solution space.
G	Extent of uncertainty	High	The effect of some decisions is unclear and difficult to predict.
H	Alignment of decision-making	Multiple formal and informal structures	Alignment is required across multiple formal and informal structures, of which the organisational maturity differs.
I	Decision power and control	Power, control, and influence play out in a network of formal and informal role players	The Department of Rural Development and Land Reform, the project team[2], and community members all influence performance. Political power has an uneven influence on the overall outcome.

The decision complexities are similar to that of ICT4RED. The essence of each dimension is listed in the paragraphs that follow, and is related to the ICT4RED case (as outlined in Section 7.3.4.)

A. Complexity

Complexity and complex interdependencies: multiple interactions and multiple influences determine overall success. A single relationship between a decision and its outcome does not exist for all decisions.

[2] Note that 'project team' here refers to the CSIR team and subcontractors responsible for the implementation (see also Fig. 8.8).

No clear-cut solutions: multiple different solutions could have similar overall outcomes. For example, different configurations of the DD could satisfy requirements.

Conflicting and changing requirements: the pressure to rollout ICT Hubs to ensure visibility in the community is not balanced by pressure to enable use and uptake. This incomplete requirement affects project design, focus, and sustainability.

B. Goal

Similar to the ICT4RED case, value creation has multiple perspectives, and multiple paths could lead to value creation. For example, mere access to (functioning) technology may create value by enhancing the technology literacy of communities (Mitra et al., 2005). However, ICT Hubs that deliver services according to community needs may affect economic and social development to a larger extent, but could require differentiated solutions for communities of differing needs and readiness.

C. Decision-makers

While a single government department is responsible for the project, political influence should still be balanced with community needs to arrive at appropriate impact. The pressure for visibility (that is, to be seen to do ‘something’) skews ‘performance’ towards the earlier stages of the ICT value chain. As such, value creation is forced toward technology drop (i.e., delivery of technology only) rather than toward engagement for long-term value creation. A strong counterweight in decision-making is required to ensure appropriate value creation.

D. Solution space

Similar to ICT4RED: multiple interventions could potentially constitute an improvement in this low-performing resource-constrained environment (see A). The solution space is therefore large and difficult to define. Multiple objectives, and in this case multiple end-points along an ICT4D value chain, (see B) further complicate decision-making.

E. Value of alternatives

As for ICT4RED: The goal as well as interdependencies within the system is unclear (A and B), making it difficult to assess the value of a specific intervention design choice.

F. Constraints

As for ICT4RED: The conflict between the demands of resource-rich solutions (e.g., technology support, maintenance costs) and resource availability in resource-poor environments emphasizes the importance for design decisions to focus on sustaining benefits.

G. Extent of uncertainty

Similar to ICT4RED: The system's response to decisions is difficult to predict, due to the systemic and complex nature of the problem; this creates uncertainty, which is further exacerbated by changing or unclear objectives.

H. Alignment of decision-making

Similar to ICT4RED: Decisions are made by multiple role players in multiple structures with varying organisational maturity. For example, operations support was to be done by the newly established NARYSEC youth – a corps of rural youth, in which individuals was employed on a short-term basis and trained to fulfil specific roles in rural areas; their functioning was administered by DRDLR on behalf of the South African Government (DRDLR, 2017). The operational decisions of the members of this group had a potentially significant effect on project outcomes. The involvement of this relatively immature organisational structure compromises the quality of decision-making, and requires alignment.

I. Decision power and control

Multiple role players residing in multiple structures contribute to decision-making (see H). Decisions are influenced by political pressure for visible results, affecting the interpretation of a 'good' and appropriate objective (see B). This leads to unevenness in power and influence on the outcome of the project. In addition, the relative power and influence is not always clear and sometimes impossible to define. Decision-making is influenced towards technology drop rather than to show impact, disabling the ability to make timeous and 'good' decisions relative to an agreed-upon goal.

In summary, the decision environment is complex, and attainment of good decisions, targeted towards progress of any nature, is difficult. It requires a good conceptualisation of the problem, as well as guidance and coordination of decision-making.

8.3.5. Current status

The DRDLR project was initiated in March 2013, and was on-going at the time of this research. In essence, the project involved the installation or refurbishment of ICT Hubs in various formats (including Digital Doorways, ICT centres), the development of an operations plan, monitoring and evaluation, and a sustainability plan (CSIR Meraka Institute, 2017a; Table 8.3). It also comprised an operations support process, including maintenance of infrastructure (CSIR Meraka Institute, 2017b). The project scope changed over time, affecting the number and technical configurations of installations.

The project's status at the time of this research can be deduced from the factors that are reported on by the evaluation process, as well as through progress reports. The Final Evaluation Report (CSIR Meraka Institute & Benita Williams Evaluation Consultants, 2016), reflecting on project status in March 2016, indicates progress with respect to the input factors on the ICT4D value chain, such as technology that has been deployed, champions that have been trained and that received value from training, service provider contracts that have been concluded, costing data and financial modelling that have been developed, and procedures, frameworks, and reports that have been developed. On the access side, partial progress is reported, as is partial availability of DD champions, partial monitoring of operations, and partial improved access to technology and data for decision-making (amongst others). The full list of achievements is contained in Appendix B.

The project status is reflected in eight recommendation themes proposed by the M&E process (CSIR Meraka Institute & Benita Williams Evaluation Consultants, 2016). When listing these recommendation themes relative to an ICT4D value chain (see Figure 8.6), it is clear that the project (at the time of the research) mostly dealt with obstacles related to provision of technology, and some related to access and use.

The project has not yet progressed to the point where it attempts to enable long-term benefits through use of technology. Obstacles are still related to technology rollout and monitoring of equipment. A key issue is coordination and management of the DD champions and management of operations. An Operations Management entity is proposed as resolution to the coordination and communication issues.

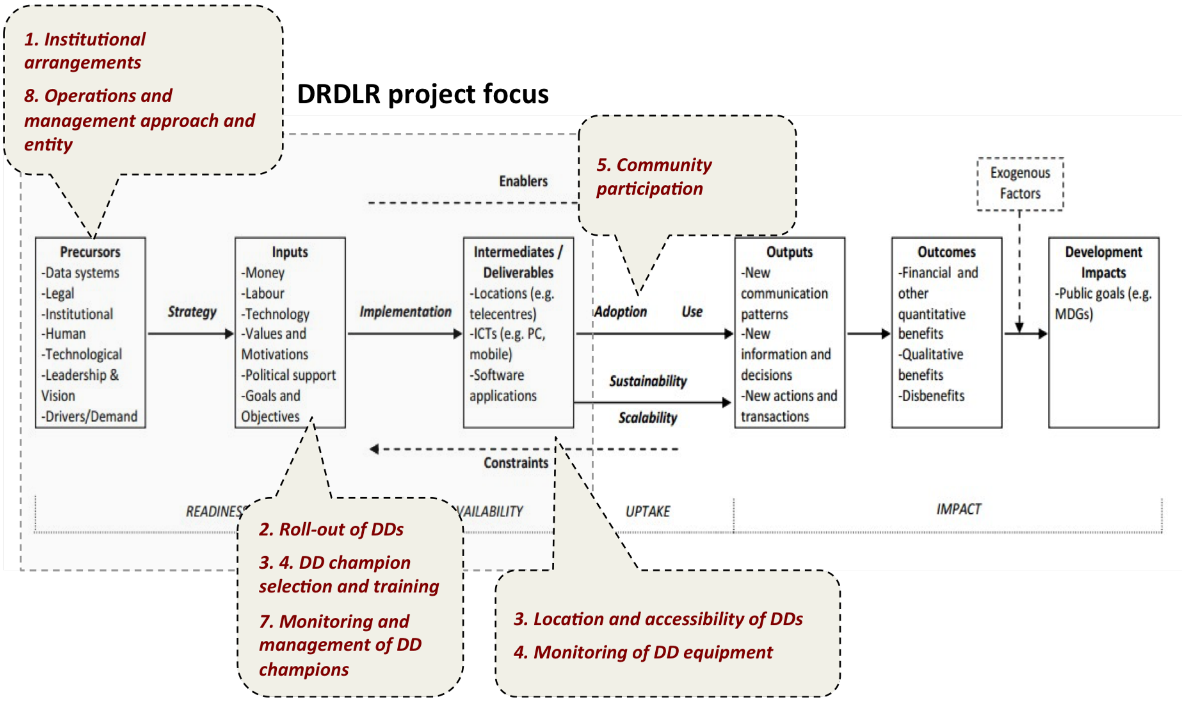


Figure 8.6 M&E recommendations in March 2016, indicative of project status (summarised from CSIR Meraka Institute and Benita Williams Evaluation Consultants, 2016; based on Heeks, 2014b).

The December 2016 progress reports provide further insight into the status of the project at the time of writing, and confirm the views presented in this section (CSIR Meraka Institute 2017a, 2017b). Reported obstacles relate mostly to the ability to sustain operations (that is, to provide access to technology). Specific issues relate to access to ICT Hub champions, the capacity of champions to access infrastructure, the ownership and involvement of ICT Hub champions and theft of equipment.

As outlined in this section, the 'benefits' and associated obstacles, as interpreted within the project, relates to the delivery and therefore access to technology. If a broader view were taken on the project, namely to achieve the longer term objectives to 'achieve improved rural services to support livelihoods' and being financially sustainable, broader benefits could be defined and different obstacles would be derived.

Based on this discussion, as well as an understanding of the decision-making and sustainability targets that were discussed earlier, the following can be deduced in terms of sustained benefit of the DRDLR project (see also the discussion in Section 8.4.2):

- While a longer term benefit of 'Improved rural services to support livelihoods' is envisaged, the benefits that need to be developed and sustained to this end are not clear.
- A clear and shared view on benefits and value addition has not been developed across all role players, and recommendations are not in place to do so.
- Some aspects that are recognised as critical to long-term success, are acknowledged as being omitted due to the limited scope of the project. While an implementing structure is proposed as remedy, the issue of sustained value addition through ICT Hubs is not addressed.
- While the DD technology is mature and have successfully been rolled out to a number of sites, a number of technology support aspects hamper the sustainability of access to technology.
- A lack of community awareness is hampering improved use of the technology.
- Technology has been rolled out ahead of operations and sustainability plans, and ahead of availability of trained champions. This has lead to unsupported sites and the risk of under-utilisation of the deployed technology (CSIR Meraka Institute, 2017a), and has complicated uptake, thus affecting sustained benefit.

When combining the obstacles to sustained benefit from the progress reports with the findings of the evaluation process, and the broader view taken on sustainability relative to ideal long term project goals, the following subjective 'sustainability assessment' can be made:

Table 8.6 Sustainability assessment

Benefit	Sustain-ability	Action required to improve sustainability
Access to technology	Medium	Local capacity building for technology support Development of focused organisational structures to manage and ensure continuity of operations support personnel (NARYSEC youth)
Value creation and financial sustainability	Low	Development of a clear and shared view on benefits and value addition Selection of future sites in support of sustainability (with consideration of issues beyond access, such as readiness and potential). Differentiated community needs and readiness assessment Development of focused organisational structures to facilitate the capacity for financial sustainability Retrospective: Improved scheduling of project phases and activities (aligned with value chain perspective) so as to pilot financial sustainability earlier in the project cycle.

A key sustainability risk in this project therefore seems to be the lack of an integrated holistic view at the outset of the project on factors that would lead to sustained benefit (an initial sustainability review or analysis), *and the mitigation of risks to sustainability during the project process*.

As in the case of ICT4RED, an upfront definition of sustained benefit, as well as sustainability targets and prioritisation of the various benefits, could have focused project resources towards processes that would sustain benefits. In addition, improved scheduling of activities to develop the capacity for sustained benefit could be beneficial. Along a value chain, a focus on the enablers of on-going access to technology would have contributed towards sustaining benefits. Importantly, a focus on unlocking value from access to technology is critical for long-term sustained benefit.

8.4. CASE ANALYSIS

In this section, the DRDLR case is analysed according to the four elements of the initial decision framework, as defined in Chapter 6. The intention of this retrospective application of the framework is to assess whether the framework could be used to identify and manage some of the issues that affect the ability to sustain benefits. The framework is repeated in Figure 8.7 for ease of reference:

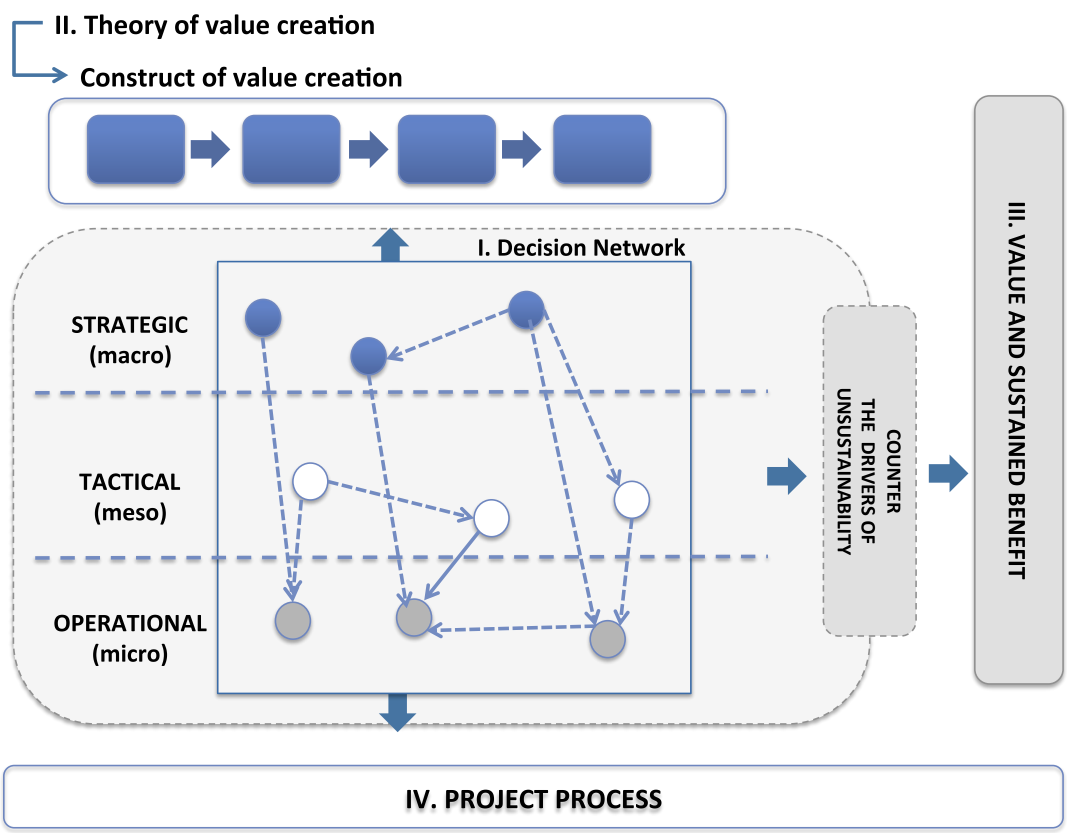


Figure 8.7 Initial decision framework

In the sections that follow, each of the dimensions is applied to the DRDLR project.

8.4.1. Element I: Network of decision-makers

The network of decision-makers is described in terms of decision maps. A formal analysis of decision-makers was not undertaken at the outset of the project. Similar to the ICT4RED case, the map represented here was done during and after project execution, and benefits from knowledge that was gained during the course of the project. In practice, the intention is that decision-makers should be identified as early as possible in the project. This understanding should be used to structure project responsibilities and negotiate key enablers of sustained benefit.

8.4.1.1. Decision maps

The various approaches to decision mapping has been outlined in Section 7.4.1.1. This case analysis adopts the same background, and develops an understanding of the decision-making dynamics of the project by exploring the following (from Chapter 7):

- Who are the decision-makers that are influencing intervention sustainability?
- What is the sphere of influence of their decision-making (specifically, does it affect strategic, tactical, or operational issues)?
- Which aspects of value creation are they influencing?

As in Chapter 7, different representations of decision-makers and their influence on sustainability are explored, to address these questions. The relevance of the various representations is interpreted in Section 8.4.1.2.

A. Decision-makers and sphere of influence

A *decision network* is created here to represent decision-makers and their decision roles in the ICT Hub project (see Figure 8.8). The aim is to represent the influence of stakeholders' *decision power* on ultimate *project success* and *sustainability*.

Figure 8.8 addresses the three questions listed above. It identifies the various role players (i.e., who are the decision-makers?) and differentiates the different spheres of influence (strategic, tactical, operational, and combinations thereof) of the various role players. (i.e., what is the sphere of influence of their decision-making?). The area of value creation that they are influencing is indicated by the connections between decision-makers.

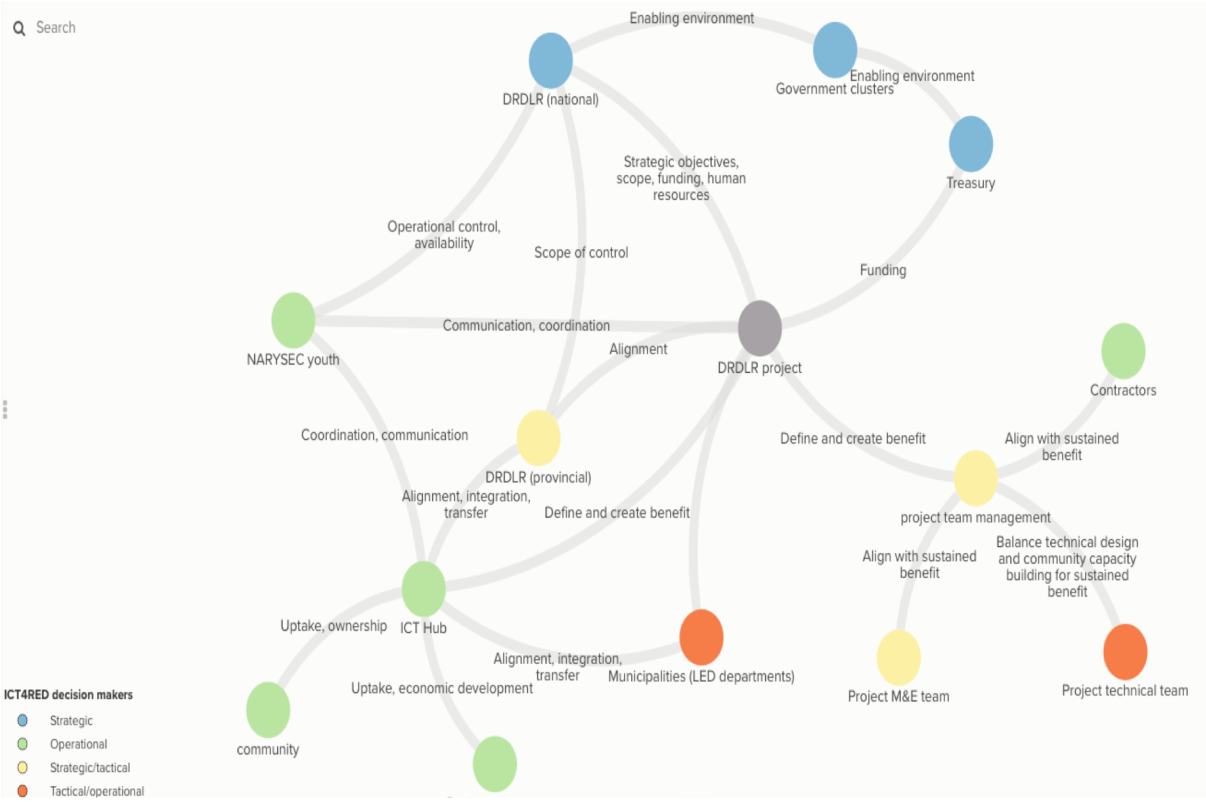


Figure 8.8 Decision network, indicating role players and their sphere of influence

The intended role of this map is to emphasize the critical decision-making issues that should be aligned among role players, to ensure long-term benefit. Conflicts between these spheres of influence would affect the ability to create and sustain benefit. Importantly, it serves to highlight that specific role players should be involved in relevant planning and decision-making activities. Such a decision-focused representation of role players could serve as a baseline for discussion at the outset of the project, as well as at regular intervals during project execution.

For each role player within each sphere of influence, examples of the decisions that could influence sustained benefit are summarised (Table 8.7).

Table 8.7 Decision makers and influence on sustained benefit

Area of influence	Decision-maker	Decision affecting sustained benefit
Enabling environment *Indirect influence*	Government clusters	Rollout and alignment of infrastructure, for example policy, planning and implementation of broadband telecommunications nationally (including rural areas) – current weak coverage in rural areas
	Municipalities (Local Economic Development (LED) departments)	Alignment across development programmes Readiness to adopt ICT Hub initiatives
Strategic objectives *Political, institutional sustainability*	DRDLR	The definition of strategic objectives determines the scope, duration, and impact of the project (is the interest in sustaining benefits or in and attaining visibility through technology showcasing?)
		The department's objectives with, and approach to, on-going management of ICT Hubs determine whether the organisational environment will facilitate the sustainment of benefits
	Project team	A decision and action to clarify and align project strategic objectives across role players will define a sustainability focus
Project funding *Financial, institutional sustainability*	Treasury	The size of funding that is allocated affects the scope and ability to implement mechanisms for sustainability
	DRDLR	The scope of the project for which funding is earmarked influences the activities that can be undertaken to generate sustained benefit
Project scope and focus *Financial, institutional, social sustainability*	Project team management, DRDLR	A decision for engagement between the project owner and the project team to consider the effect of project focus on long-term sustainability would lead to mechanisms to transcend a short-term focus
Project planning and integration *Financial, institutional sustainability; Uptake*	Project team management	A decision to consider readiness and sequencing in project planning will facilitate uptake in the community, rather than access to technology that cannot be used.
Project design and implementation *Technological and social sustainability*	Project team management, technical team	A decision to design project elements for sustained benefit will lead to design decisions that support sustained benefit (e.g., inclusion of project elements such as community readiness development, development of community technical capacity; attaining a balance between designing the technology for sustainability through remote mechanisms, vs. developing the community capacity to support the implementation).
Project resources (manpower) *Institutional sustainability*	DRDLR	The department's decision to use NARYSEC youth for technical support should be aligned with the project to ensure timeous and on-going availability of resources to support project activities
Project monitoring and improvement	Project M&E team, contractors	A decision to monitor and evaluate with a view on sustained benefit will lead to identification of design activities that counter sustained benefit (e.g., concurrent community development to ensure uptake; readiness assessment that focuses on capacity and potential).
Project integration and transfer *Institutional sustainability*	Project team management, Provincial DRDLR, Municipal LED	A decision to plan for sustained benefit will lead to mechanisms for project transfer and integration
Implementation *Social, financial, institutional sustainability* *Long-term value creation*	NARYSEC youth, ICT Hub champions	Operational decisions (coordination with project team for on-going access to facilities; notification of breakdown in processes that affect access) are critical to ensuring access, which is in turn critical to unlocking longer-term value
	Community	Community ownership could ensure improved security, and hence availability and access, which are critical to unlocking value
	Business owners	Engagement with the ICT Hub to unlock business opportunities

B. Decisions and value creation

In this section, the influences of the various decision-makers are mapped to a *construct of value creation*. For this purpose, the information value chain of Heeks is chosen (see Section 5.7.2.4; Heeks, 2014b).

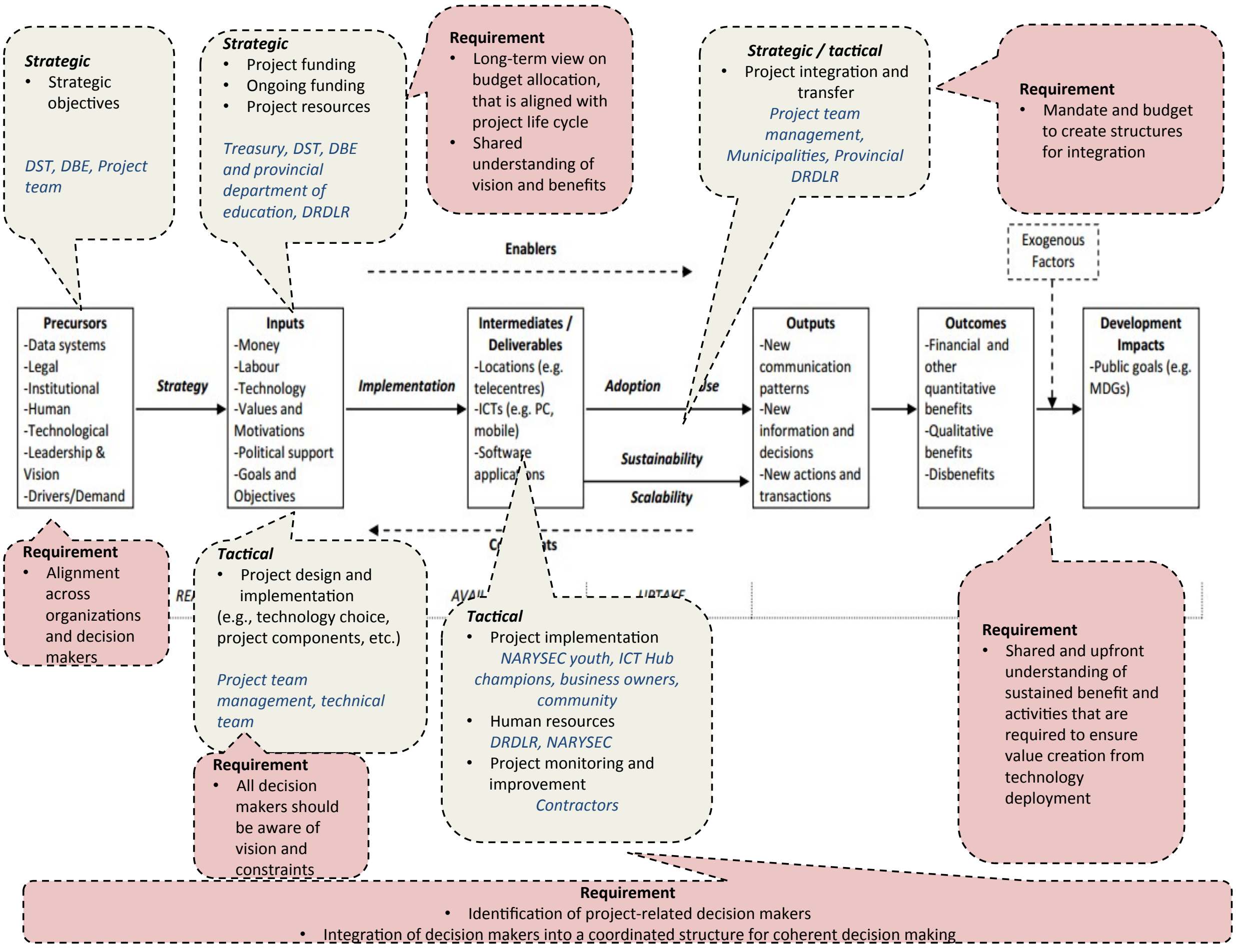


Figure 8.9 Decisions and their influence on value creation (based on Heeks, 2014b)

As before, this representation provides a sense of the influence of decision-making in the progression from inputs to impact. It indicates the key decisions (as mapped in Table 8.8) along the various steps of the value chain. The decision-makers and their points of influence on the chain are mapped. In addition, 'requirements' for good decisions have been identified for each type of decision.

The following deductions from the ICT4RED case remain relevant here:

- Outcomes and impacts are dependent on a number of strategic, tactical, and operational decisions, which are taken by a number of different individuals and organisations.

- Project precursors and inputs are critically dependent on strategic decisions by multiple decision-makers. This requires integration between decision-makers and agreement on, and alignment towards, a common goal.
- The entire process of value creation is at risk if these strategic decisions are not facilitated.
- Tactical decisions affect the input to output part of the chain.
- These decisions are mostly in the hands of the project team and contractors, but require support from the national and provincial departments of education for integration into the system.
- Adoption, use, sustainability, and the generation of outputs are critically dependent on the inclusion of the relevant departments in tactical decision-making; it should be a key focus of project activities and should be monitored closely.
- The map indicates that a large number of decision-makers influence project performance, at different levels of influence. Without an understanding of a common objective (benefits) and the constraints (budgets and resources) within which the project functions, decision-makers will not be able to align their decision-making towards sustained benefit. To this end, structures and processes are required for the alignment of decision-making.

In addition, the following observations specific to this case are of importance:

- The decisions related to this project focuses on technology delivery. Decisions that will translate delivery to outcomes and impact are not considered (i.e., decisions towards the end of the value chain).
- Similarly, decisions around long-term benefit and the way in which to sustain it are not evident.
- In this absence of clarity about benefits, isolated project-specific decision-making has the potential to affect sustained benefit.

During project execution, a number of formalised decision support tools were developed. The outcomes chain as described by Emmi et al. (2011) was used as a construct against which to contextualise the value that each decision model aimed to enhance. For each of the key dimensions of value, metrics and constraints were identified, and potential decision support was identified:

Table 8.8 Decision models to support value creation (Meyer et al., 2015)

	DIMENSION	METRICS (examples)	CONSTRAINTS (examples)	DECISION SUPPORT (examples)
"DONOR" PERSPECTIVE	**ECONOMY** (mostly procurement driven)	• Cost per Mbs bandwidth available at a site • Cost per user device • Cost per local GB of storage • Cost per HR hour utilised	• Availability of suppliers • etc	• Technology selection tool • TCO model
	EFFICIENCY (delivery/ implementation)	• Rand invested per ICT hub deployed (capex vs. operational cost) • Rand invested per service unit delivered • Rand invested per simultaneous internet users • Rand invested per hour of availability	• Bureaucracy of implementation agency • PFMA	• TCO model • Cost-utility calculations • Services portfolio definition
	EFFECTIVENESS (strategy)	• Rand invested per person reached with technology	• Community uptake • Remoteness of target population	• Site selection model (typology) • Services portfolio definition (relevance)
BENEFICIARY PERSPECCTIVE	**SROI**	• Ideal: Rand of social value created per rand invested • Time value of jobs created • etc	• Community uptake • Accessibility of solution	• Project checklist (critical success factors to ensure community engagement)

The decision models in support of value creation were mapped against an outcomes chain:

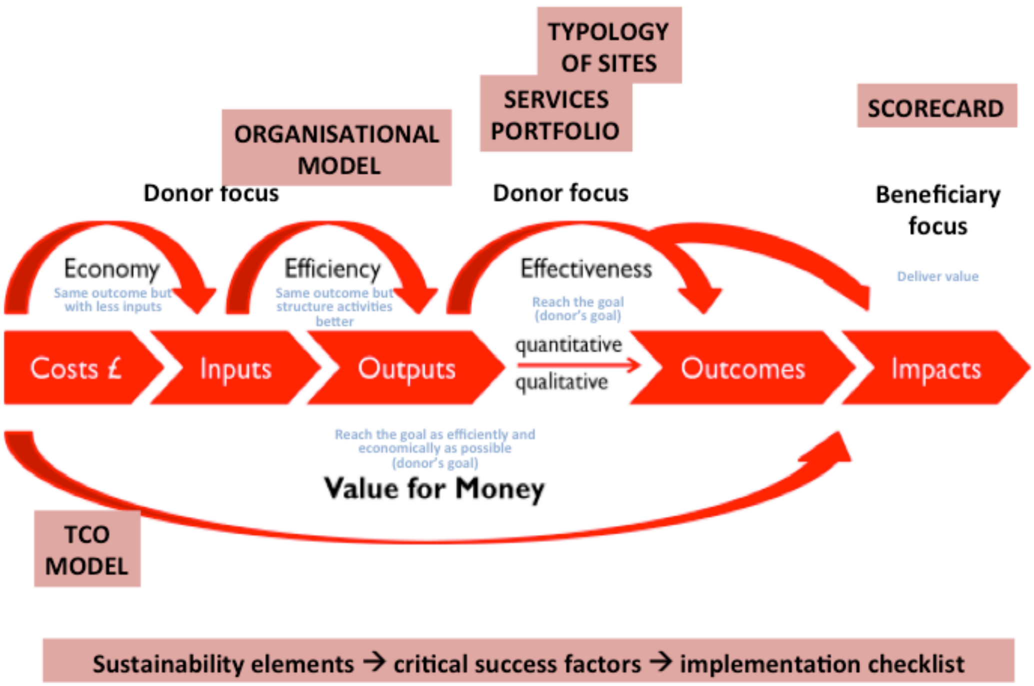


Figure 8.10 Decision models of the DRDLR ICT Hub project (Meyer et al., 2015)

As before, this approach emphasizes that decisions can be linked to a construct of value creation. It positions the relative importance of the decision models in the chain. It further highlights the need for all decisions or decision-makers, as well as intended benefit, to be identified upfront. Should such an understanding be developed, decision-makers could align and prioritise their decisions relative to benefit.

The decision mapping in Figure 8.10 illustrates the role of the specific decision aid along a chain that is focused at enhancing the sustainability of a project by taking a Value for Money focus. The link of these decision models in support of sustained benefit can be made explicit by summarising it against the elements of sustainability of ICT projects:

Table 8.9 Decision models to support value creation

	ECONOMIC	SOCIAL	TECHNO-LOGICAL	POLITICAL	ORGANI-SATIONAL
IMPLEMENTATION CHECKLIST	X	X	X	X	X
TCO MODEL	X				
SERVICES PORTFOLIO	X	X			X
TYPOLOGY OF SITES	X	X			X
ORGANISATIONAL MODEL					X
VFM SCORECARD	X	X	X	X	X

C. Decision-makers and influence on project elements

A decision map was developed as part of the sustainability modelling task during project execution as a means of assessing decisions in different project areas on sustainability. Note that the map was developed retrospectively. It is summarised in Table 8.10, and indicates the role of different decision-makers relative to the different project decision areas (see Appendix C for the full decision map).

As with the previous presentations, the map highlights the connection between individual or group decision-making and the capacity to sustain benefits. It emphasizes the implications of decision-making, and the links to sustained benefit. In addition, the analysis highlights that some gaps existed in decision-making at the time of its development (for example, approaches to community engagement that have not been developed, and site selection decisions that influenced deployment).

Table 8.10 Decisions and their influence on project elements

Project element	By whom?	Implication	Link to sustained benefit
Infrastructure	Component manager Contract manager Project manager	Cost (TCO) vs. effectiveness (see also Section 7.4.1.1) Maintenance & support model Quality of service	Financial Operations, supply chain Social (long-term buy-in)
Technology	Contract manager Technical team Operations consultant	Cost (TCO) Longevity User experience Fit for purpose Maintenance, warranty, support model	Financial Operations, supply chain Social (long-term buy-in) Technical
	Project team	A decision and action to clarify and align project strategic objectives across role players will define a sustainability focus	
Technology (upgrades)	DRDLR Contract manager Technical team	Cost (TCO) Durability Diversity of technology supported	Financial Operations Technical (supplier ecology)
Technology (Schools)	Client Contract manager Technical team Operations consultant	Effective use of tablets supported by Wi-Fi enabled internet access NARYSEC tech support Update of contents	Financial Operations Effective use
DD champion development	DRDLR DD manager Meraka contract manager NARYSEC liaison Provincial DRDLR	Appropriateness of DD champion, turnover User satisfaction Job satisfaction Turnover of DD champions Level of service delivery Scope and richness of services that can be delivered NARYSEC sustainability - human capital development	Financial Operations Social - use and uptake Social - skills development
Change management	DRDLR DD Manager	Community ownership	Uptake Use
Operational model	DRDRL DD Manager Meraka contract manager	Cost Continued operations performance Availability for use	Operations Uptake Cost / affordability Organisational (management)
Stakeholder management	National DRDLR	Engagement Support	Uptake & Use Financial Operations
Supplier management	National DRDRL Meraka contract manager	Service delivery	Uptake & Use Financial Operations
Resource allocation	National DRDRL Meraka contract manager	Service delivery (scope & service level agreement (SLA)) Financial Operations	Uptake & Use Financial Operations
Community engagement	Approach to be determined		Social (uptake and use)
Site selection	DRDLR national and provincial	Cost increases Project delays due to top down decisions, people on the ground not ready for uptake Uncoordinated deployment (divide DDs equally per province in each round of deployment)	Social sustainability Financial sustainability

This representation highlights the following constraints with respect to decision-making of the various role players, and hence areas for improvement:

- Critical decision areas were undecided at the time of the analysis (e.g., community engagement approaches), reinforcing the need for appropriate sequencing of decisions.
- Multiple role players influence the functioning of the technical support, for example that provided by the NARYSEC youth. However, decisions around this aspect are not located within the decision influence of the ICT Hub (no organisational structure) and the community itself.
- In this analysis, the community was not identified as a key decision-maker. However, a number of the decisions have implications for use, uptake, and hence social sustainability.
- The Meraka contract manager has a key role in numerous decisions. However, this engagement is temporary (scope of project), while the intervention has a longer (at least medium term) time frame. The appropriate structures have not been defined to participate and/or take over this decision-making.

The construction of the map in Table 8.10 required an understanding of role player dynamics, and it may be difficult to construct at or prior to project initiation. However, it could be constructed during project execution and used for continuous improvement.

8.4.1.2. Interpretation: contribution of decision framework

The three decision maps that were outlined in Section 8.4.1.1 provided perspectives that could be useful to the project, which were not evident from the normal project management process.

The potential application of the perspectives, as identified for the ICT4RED case, remains valid here. They are repeated in Table 8.11 for convenience:

Table 8.11 Contribution of decision maps to the management of decision-making for sustained benefit

Decision map	Perspective	Potential application
A. Decision-makers and sphere of influences	Who are the decision-makers? What is their sphere of influence?	Develop a shared understanding of the various decision-makers and their influences on the project Identify the key decisions that affect the ability to sustain benefits
B. Decisions and value creation	Which decision-makers influence which part of value creation?	Develop a shared understanding of the critical decisions on the path towards value creation Define the mechanisms that need to be in place to facilitate these decisions
C. Decisions and project elements	Which decision-makers influence each of the project elements?	Identify the conflicts and discrepancies that are created by different decision-makers and decision environments

This section confirms that the inclusion of an element in the decision framework to describe the decision-makers and the relationships between them contributes to the understanding of decision influences, and assisted in identifying gaps that could be addressed in project execution. These gaps have a direct influence on the ability to sustain benefits from the project, as illustrated in the various maps.

The selected maps were used as an example, and are not intended to be prescriptive. Numerous maps could serve this purpose. The key elements that were included are:

- Who are the decision-makers?
- What is their sphere of influence?
- Which aspects of value creation are they influencing?

8.4.2. Elements II and III: Value creation

8.4.2.1. Description

The description and analysis of this case has highlighted the lack of a shared (or adequately defined) concept of value creation (see Section 8.3.3). Elements II and III of the decision framework (namely, value and sustained benefit, and the theory or construct of value creation) focus on eliciting such a shared understanding across all role players involved with the project (that is, the project team as well as the other decision-makers identified during the mapping of the decision network). These two elements are dealt with simultaneously in this section.

The DRDLR project has primarily been defined as a technology deployment project. The intent of the project was to provide access to computing facilities to rural and peri-urban areas, to enable users to enjoy access to information, entertainment, and skills development through their own exploration of the resource (CSIR Meraka Institute, 2017a). However, the project was undertaken in support of a longer-term objective, namely, *improved rural services to support livelihoods* (CSIR Meraka Institute and Benita Williams Evaluation Consultants, 2014). In addition, financial sustainability was a requirement, which in this context in turn implied that benefits should be created (and sustained) that would attract user funding or investment by external funders.

For the purposes of this research, the benefits to be derived from the deployment of technology could therefore defined as (A) access to technology, and (B) value-adding services.

Table 8.12 Perspectives on value creation

Perspective	Value created	Construct of value creation
A. Technology	Access to and use of technology and connectivity	Theory of change
B. Value-adding services	Services in support of economic and social development (not clarified)	Unclear

These perspectives are outlined in the paragraphs that follow, providing more detail on the value created and the construct of value creation, as defined by the project:

A. Technology deployment

The Design Evaluation Report as well as the Final Evaluation Report defines the Theory of Change of the project, as follows:

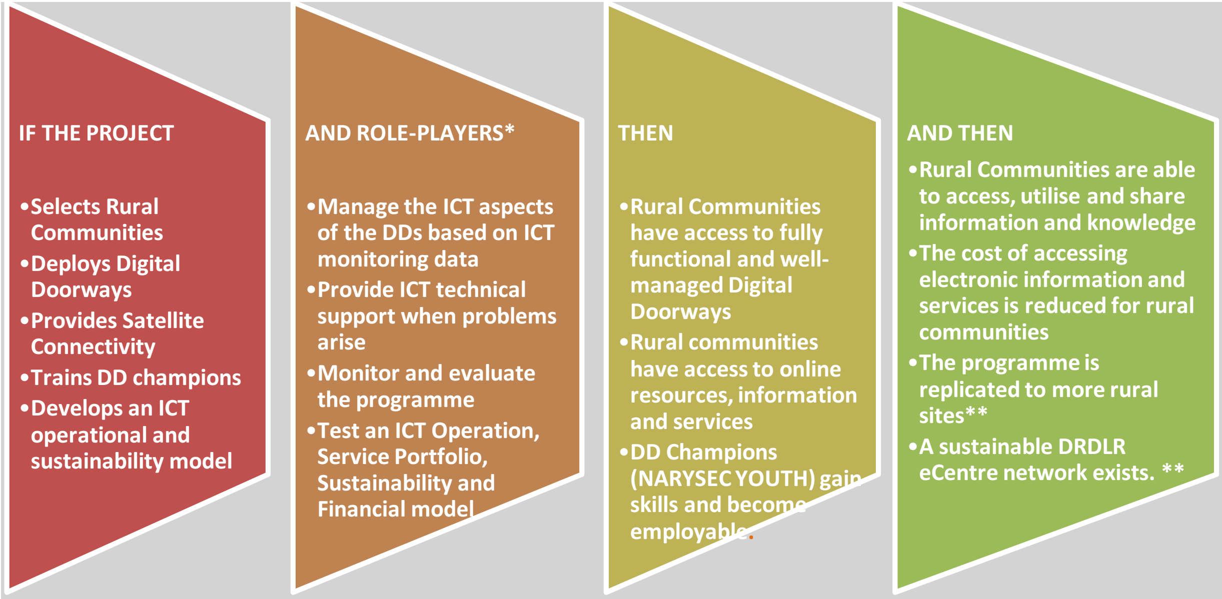


Figure 8.11 Theory of Change (CSIR Meraka Institute and Benita Williams Evaluation Consultants, 2014; 2016)

The evaluation reports differentiate between aspects that are within and outside the control of the project team, and then highlight that some activities that are required to achieve success are not covered by the project, namely operations management, and building of community ownership of assets (CSIR Meraka Institute and Benita Williams Evaluation Consultants, 2014; 2016). The project did not manage to respond to these observations between the design evaluation report and the final evaluation report – they remain recommendations in both reports. In addition, the final evaluation report is mute on how the technology-focused project outcomes would lead to value creation that would ensure 'improved rural services to support livelihoods' and/or financial sustainability of the centres. The delivery of services though ICT Hubs, and the Hubs' potential to facilitate service delivery by the community, are not addressed. This particular aspect would address the long-term objective, and is a critical mechanism towards financial sustainability.

B. Financial and organisational sustainability

The capacity to create value from the technology is dependent on sustained access. Therefore, resolution of the issues described in paragraph A, from a holistic perspective, is essential. For sites where access is stabilised, needs surveys and a customised services portfolio could enable the development of services to ensure financial sustainability. A sustainability plan highlighted the various factors to consider (Meyer et al., 2015), and a cost model has been developed to support decisions with respect to financial sustainability (Meyer, 2015). However, the scheduling of these activities relative to project rollout could have been improved, with earlier testing of concepts for a number of technologically mature test sites. In addition, site-specific community development plans could have ensured that appropriate skills and organisational capacity, as well as community involvement, have been reached in support of the use of a site. A modular approach to the delivery of a package of site-appropriate enhancements to the intervention could aid the effort to sustain benefits.

In summary, this discussion highlights that the project's conceptualisation of sustained benefit is partially complete. While technology deployment has been defined, and a construct exists that refers to long-term benefits, critical elements are lacking to enable agreement on, and achievement of, sustained benefit.

8.4.2.2. Interpretation: sustained benefit and decision-making

From the perspective of sustained benefit, the decision framework proposes that the following questions be asked (Section 6.5.2):

- What are the benefits that are expected to accrue from this ICT4D intervention?
- To what extent do we want the benefits to be sustained (i.e., for whom, and over what time period)?
- What do we need to do (what decisions do we need to make) to ensure that benefits are sustained?

These questions are explored in this section for the DRDLR ICT Hub project, and the contribution generated through application of the framework is indicated for each question.

Question 1: What are the benefits?

The long-term *benefit* that needs to be sustained for this project was implied, rather than explicitly defined by the client or the project team. The project takes place within the DRDLR's mandate to support outcome 7 of the National Development Plan, namely *vibrant, equitable and sustainable rural communities with food security for all*. Further, it 'aims to contribute to the achievement of Output 3 in the National Development plan: Improved rural services to support livelihoods' (CSIR Meraka Institute and Benita Williams Evaluation Consultants, 2014:4). While these longer-term goals are referred to in project documentation, an explicit link is not made between the deployment of ICT Hubs and the achievement of these broader goals.

The DRDLR project documentation and the discussion in the previous paragraph indicate that the first question was partially addressed (see Table 8.12). The short-term (within scope) outcome of delivery of, and continued access to, technology was defined. However, the longer-term benefits of explicit differences in value creation was not necessarily articulated and shared at the outset of the project. Considering the project in the context of a construct of value creation (in this case, the ICT4D value chain of Heeks, 2014b) immediately highlights that project focus and benefit definition does not extend to the creation of long-term benefits (see Figures 8.5; 8.9). Upfront clarity around longer-term benefits would force the definition of appropriate value creation mechanisms (such as an appropriately defined services portfolio and organisational support structure) that could be developed and aligned with technology rollout. In this case, these mechanisms were developed concurrently, and interaction with technology development was not possible. Specific issues could include the balance between local capacity for technology support, and the design of technology to be remotely supported and inherently (technologically) sustainable.

Framework contribution: A clear, upfront definition of intended benefits, from a shorter and longer term perspective, would have influenced the sequencing of project activities, and would have defined the balance of focus in terms of the capacity for sustained benefit.

Question 2: To what extent do we want the benefits to be sustained?

The focus of this project was on delivering technology, and the concept of *sustainability* was therefore related to sustained functioning of, and access to, the technology that was delivered. As highlighted in the previous paragraph, this short-term view leaves long-term value creation to its own devices – that is, unguided and unplanned, and therefore unpredictable. Critical project elements and focus areas are therefore not planned for upfront (services portfolio, organisational sustainability).

Framework contribution: An upfront mapping of value, and interrogation of this question, may have lead to the following insights:

Table 8.13 Value and sustained benefit

Perspective	Value created	For whom?	Over what period? (for example)
Technology deployment	Access to and use of technology and connectivity	Community members Business owners Investors	Medium term (i.e., around 5 years), but with mechanisms to continuously renew technology
Value-adding services	Services in support of economic and social development (not clarified)	Community members Business owners	Medium term (around 5 years)

An essential element of the discussion around value-adding services is then the mechanism through which such service delivery would be attained.

Framework contribution: While the detail in Table 8.13 are presented as examples that may be disputed, a debate on these questions would lead to the following positive effects:

- A focus on mechanisms by which to deliver value-adding services;
- The definition of investors as beneficiaries of the project, thus involving them in early discussions about design and especially deployment (appropriate sites) for the hubs;
- A definition of how long inputs need to be sustained to support the project's objectives – that is, for how long should services be provided; what is the duration and nature of support that is required to ensure that services are sustainable; what is required to ensure investor involvement; and
- A debate about precursors for community readiness and uptake would have been initiated, that is, how should services be differentiated for different communities, and what is required to facilitate community uptake and hence social sustainability. Concomitant project mechanisms to ensure the development of capacity within the community to sustain benefit would have resulted.

A discussion of these aspects could have resulted in the re-focusing of project resources, and the timely sequencing of activities, thus ensuring that technology is not deployed but not used (i.e., sustained uptake).

Question 3: What do we need to do (what decisions do we need to make) to ensure that benefits are sustained?

The project emphasis was on technology deployment, and as such to 'tick the boxes' in terms of technology that is visible in the field. A debate around this question would have shifted the focus towards the 'required' decisions and other aspects as mapped in Figure 8.9, that is, decisions towards the latter part of the ICT4D value chain that would facilitate sustained benefit.

Framework contribution: Decisions that are essential to the delivery of long-term value would be considered. Similar to the ICT4RED case, it is clear that sustainability requires decisions at multiple levels, and along a larger part of the information value chain.

8.4.2.3. Interpretation: contribution of decision framework

Based on the discussion in section 8.4.2.2, the application of these two decision framework elements would:

- Lead to new perspectives that would clarify and shift the understanding of sustained benefit in the context of this project;
- Result in changes in which the project is approached (specifically, through introducing project elements that would deal with longer-term benefit, through widening the view on beneficiaries in the process (investors) and on extending decision-making to include more participants (community, investors); and
- Enable the alignment of decision-making across multiple role players.

A key joint perspective would be: what would be sustained and for how long. This could in turn lead to the appropriate re-allocation of project resources. A potential shift in focus would be from focusing on technology deployment (which is critical, but not the eventual benefit) to focusing on value creation and service delivery, as well as on developing the capacity of the beneficiaries (community and investors) to sustain value. As before, the case indicates that addressing the questions outlined here could potentially enhance the value delivered by the project.

8.4.3. Element IV: Project process

8.4.3.1. Description

The premise of this research is that the multiple decisions that are taken with respect to a project affect the ability to sustain benefit. A large number of these decisions are taken during project execution, and hence within a project process. It is therefore assumed that the nature of the project process has an influence on the ability to sustain benefit, and that project processes with specific characteristics can better sustain benefit than others (see Section 7.4.3). In this section, the project process of the DRDLR ICT Hub project is described and examined. During project execution, a retrospective analysis of the project process was undertaken, and process aspects that would enable sustained benefit were identified.

The DRDLR project was aimed at technology deployment, and followed a linear project process. From a process perspective, the project was complicated by the following factors:

- A project definition of limited scope, focusing on the rollout infrastructure;
- Late addition of NARYSEC youth resources as champions or service agents for the ICT Hubs;
- Transfer of project ownership between departments;
- Compressed delivery time scale, driven by pressure to meet DRDLR KPIs within individual financial years; and
- Unexpected extension of scope, within short time frames.

The sustainability modelling task of this project undertook a retrospective review of the role of the project process in enabling or frustrating the capacity to sustain benefits. The project team highlighted the following as key aspects that influence the ability to deliver sustained benefit (summarised from Meyer et al., 2015):

Table 8.14 Project-level disablers of sustained benefit

Focus area	Constraints	Project phase (potential)
Joint vision, objectives, benefits	No clear project-level definition of anticipated benefits Broadly defined project objectives do not allow interrogation of the ability to deliver sustained benefit The design evaluation did not interrogate the design in terms of the enablers that are required to deliver on the strategy to sustain benefit The multi-purpose use of ICT Hubs by communities and government departments were essential to its longer-term sustainability, but were not planned for The original project scope did not include an upfront definition of a portfolio of basic services that would have allowed scoping of DD champion functions, training programme development, and definition of support requirements The project scope did include an operational plan for maintenance of services	Project definition
Organisational design	Accountability and responsibility of the long term operations of the ICT Hubs are not clearly assigned within DRDLR The initiative is managed by a national government department; its provincial structures were only involved to a limited extent in intervention design	Concep-tualisation
Management of operations	No direct management structures are in place, and no regional or provincial management structures are dedicated to the management of the Hubs and champions. Success is therefore dependent on local individuals (Hub champions). Technology deployment was not supported by operational processes, leaving communities to their own devices to sustain operations The focus was on providing rather than maintaining Internet access, or on establishing computer literacy and adoption	Execution
Holistic definition of success	The nature of benefit that should result from technology and services, as well as the duration thereof and the context that was required to sustain benefits, was not defined upfront Holistic measures of success were not defined, and no mechanism existed for such a definition from the beneficiary perspective	Project definition
Scope and reach of monitoring and evaluation	The M&E process did not interrogate project assumptions to the extent that it would identify the key disablers to the delivery of sustained benefit before onset of the implementation (e.g., the capacity and extent of organisational processes to deliver trained champions on time)	Learn, reflect, improve
Readiness and transfer	Readiness of the community for uptake and use of the Hub was not assessed before implementation Readiness of the project team and internal processes to engage with various aspects was not assessed before implementation (e.g., capacity of procurement processes to deliver on time) The design of a transfer strategy was not included in project design The incomplete transfer or lack of transfer between the community-owned entity and government departments reflects inadequate coordination of organisational processes between agencies.	Close-out and transfer

Based on the analysis of disablers of change, a project process was developed that would enable change by focusing on circumventing disablers of change. The process was based on the implementation of a strategy to sustain change, as follows:

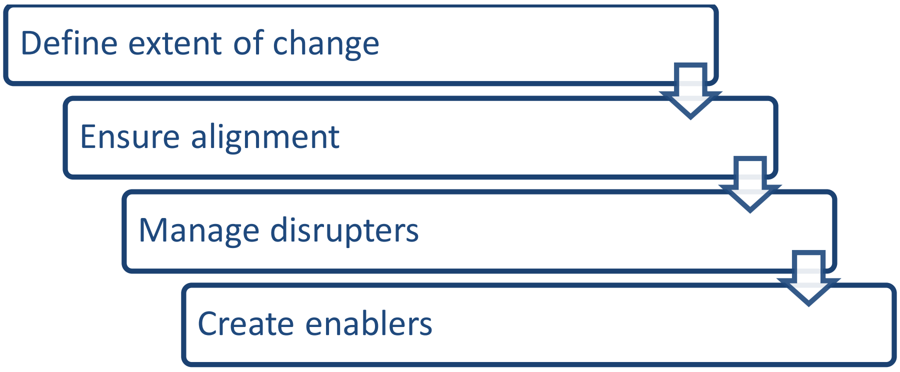


Figure 8.12 Strategies to effect sustained change (Meyer et al., 2015)

In this context, *the project process is seen as a facilitator of sustained benefit,* as follows:

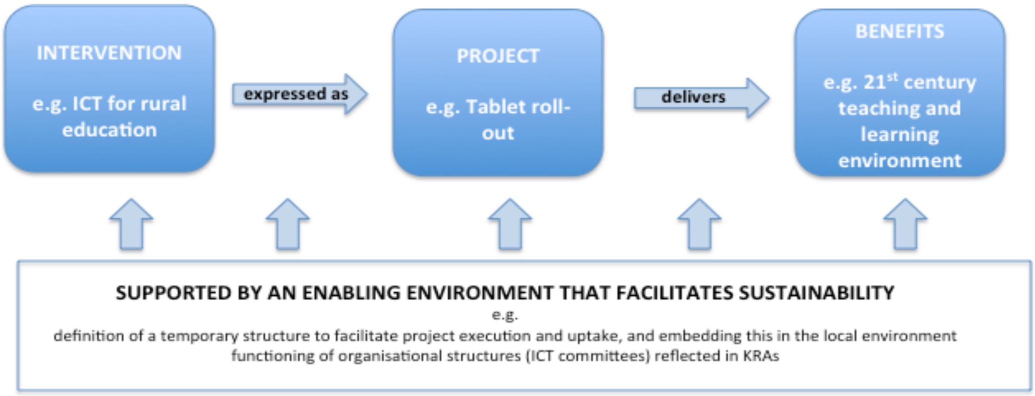


Figure 8.13 The project process as an enabler of sustained benefit (Meyer et al., 2015)

This approach was translated into the following proposed project process:

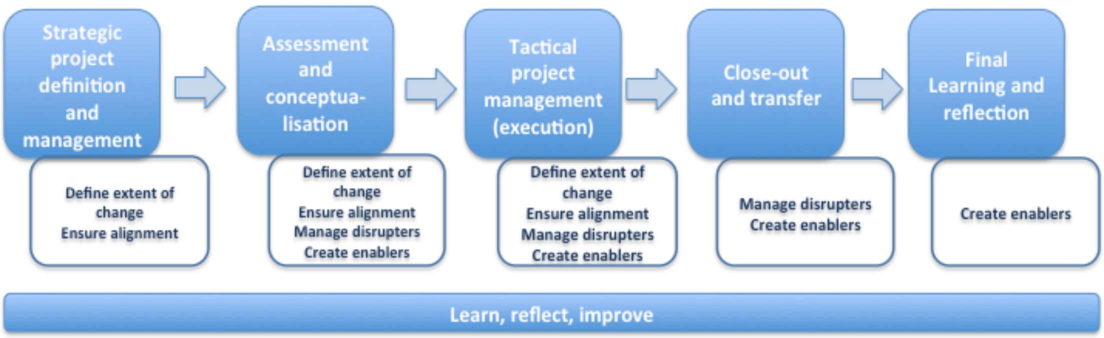


Figure 8.14 Proposed project process to facilitate sustained benefit (Meyer et al., 2015)

A next interpretation of the project process in Figure 8.14 included the addition of detail, and the definition of decision tools that would support the project process, as follows:

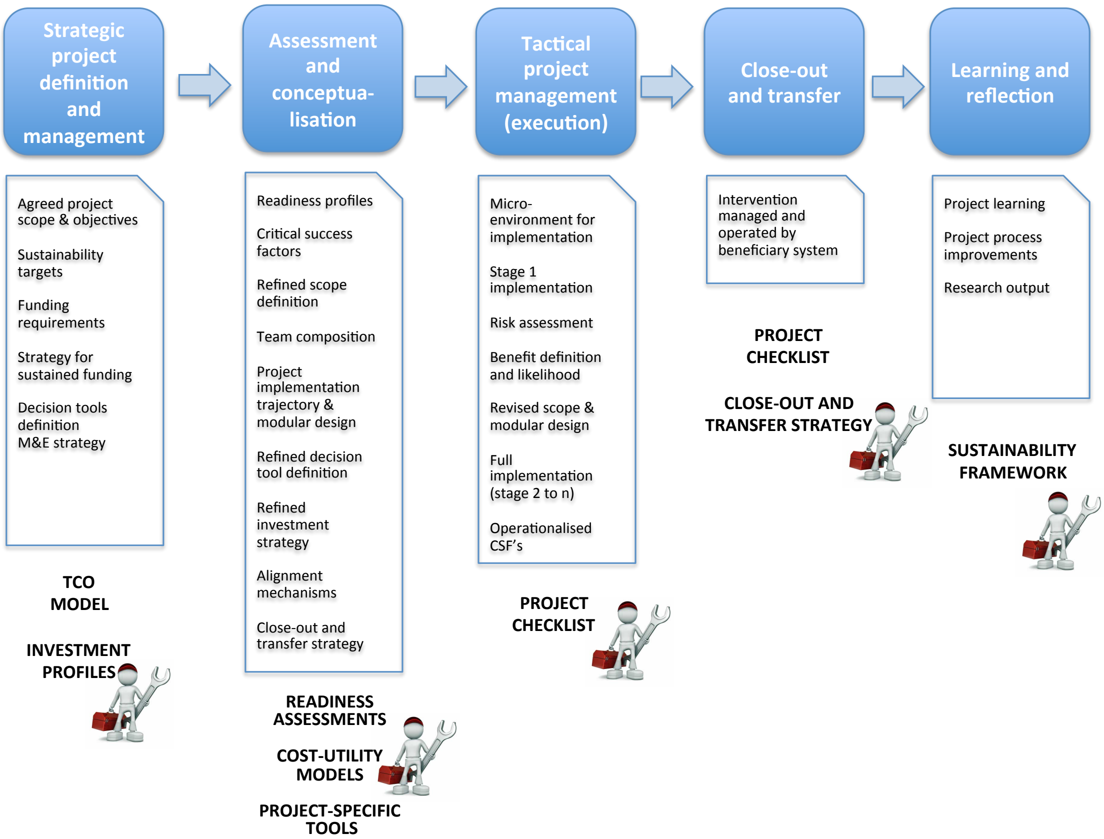


Figure 8.15 Project phases, deliverables, and decision support tools (Meyer et al., 2015)

In summary, this section outlined disablers of the ability of the project to sustain benefits, as perceived by project team members. It then positioned the project process as a means of facilitating sustained benefit through identifying and managing disablers of benefit, and defined specific project activities that could be undertaken to enable sustained benefit (such as definition of sustainability targets, close-out and transfer strategies, and others). Finally, it highlighted the nature of decision tools that could be employed in support of this process.

This analysis does not result in an exclusive project process. However, it serves to illustrate that the project process has the potential to disable or enable the capacity of the project team to deliver sustained benefit.

8.4.3.2. Interpretation: contribution of decision framework

The analysis in Section 8.4.3.1 indicates that the project process leaves opportunity for improvement with respect to sustaining project benefits. A project process was proposed that would address these opportunities, based on the assumption that enablers and disablers of benefit creation should be managed and that benefit should clearly be defined upfront.

Such an approach and process design contributes as follows to sustained benefit:

- An upfront definition of sustained benefit facilitates alignment of all role players with respect to benefit creation.
- A broader-than-project (strategic) view on benefits facilitates the development of appropriate and timeous transfer mechanisms.
- An upfront interrogation of enablers and disablers ensures that the project process is designed to cope with these.
- An upfront definition of sustainability targets provides room for designing the project towards such targets.
- An appropriately phased approach ensures that critical enablers are in place before implementation commences.
- Implementations can match readiness of sites, thus ensuring that gradual progress is made towards benefits.
- The approach makes provision for a modular approach that is aware of readiness, and (as before) enables controlled learning about what the system can absorb at a specific point in time, and the ability to develop the capacity to absorb more change over time.

Critical elements of this approach include the capacity of the project team to facilitate a broader view on benefits and constraints, beyond the definition of the project. In addition, the ability of all role players to define long-term benefit beyond their own pressures is essential to success.

As for the ICT4RED case, an upfront understanding of the aspects that affect sustainability (here, disablers and enablers) would have paved the way for monitoring and evaluation of key sustainability aspects. As before, coordination of decision-making has been highlighted by identifying and assessing decision-making in the context of value creation (see Section 8.4.1).

8.4.4. Summary

In Section 6.5.3, a summary a *conceptual* as well as *analytical* perspective on the decision framework was developed. The intention was that these perspectives are considered at the outset of the project, to inform project design for sustained benefit. The questions posed from these two perspectives have been addressed in the previous sections, and are summarised below.

Conceptual perspective

The conceptual perspective is intended to contribute alignment across decision-makers with respect to the intent of, and constraints to, value creation.

Table 8.15 Summary: conceptual perspective generated by the application of the decision framework

Question	Response	Reference (section)
How do we intend to create value through this intervention?	The Theory of Change was identified as the mechanism of value creation for this project. The analysis indicated that an extended definition of the Theory of Change, that takes a longer-term perspective on the overall implementation (not only technology delivery), would generate a focus on the long-term benefits that needs to be sustained. As such, it could serve to align decision-making and to create mechanisms that ensure appropriate transfer. An alternative and useful mechanism of value creation is the ICT4D value chain.	8.4.2 (Figure 8.11) 8.4.1 (Figure 8.9)
What value is created?	Value was defined in terms of delivery of technology. Reference was made to longer-term value creation, but without concrete actions to achieve the link between this project and longer-term benefit. Early definition, sharing, and clarification of objectives across all stakeholders would have implications for management of the project towards sustaining appropriate benefits. Specifically, linking mechanisms to longer-term value could be created.	8.4.2 (Table 8.12; 8.13)
What benefit needs to be sustained, by whom, for whom, and for how long?	These answers have not been made explicit during the project process – see Table 8.13 for a retrospective assessment An upfront understanding could have shifted the focus towards mechanisms that would sustain the benefits (adoption, uptake, services), rather than delivering and sustaining the inputs (technology). In addition, sustaining more inputs (services) would be a focus.	8.4.2 (Table 8.13)
What decision models are useful in supporting this process?	See Table 8.8 and Figure 8.10. Some decision models have been created during the project, and some of these were aimed at transcending the gap between technology and long-term benefit. The analysis highlighted a range of requirements that should be in place to create value from decision-making.	8.4.1.1 (B)
What is the nature of the project process that will foster decision-making for sustained benefit?	The DRDLR project process comprised a number of disablers. A project process was proposed that considers an upfront strategic view, and that deals with disablers and enablers of sustained benefit. The analysis indicated how such a process could contribute to sustained benefit.	8.4.3

Analytical perspective

This perspective is intended to contribute to structuring decision-making in the project in a way that would facilitate rather than frustrate sustained benefit. It largely reflects the perspective that was developed during the ICT4RED case analysis (Section 7.4.4).

Table 8.16 Summary: analytical perspective generated by the application of the decision framework

Question	Answer	Reference (section)
What decisions are we making in this process?	The analysis indicated a number of decisions that are or could be made a long a value chain	8.4.1.1 (B)
Where do they fit in terms of overall value creation?	A generic value chain (of Heeks, 2014b) as well as an outcomes chain was used to represent decision-making. The constructs of value creation that were created by the project (theory of change) did not contain steps to which decision-making and decision-makers could easily be linked. The implication is that various constructs of value creation should be explored when applying the decision framework. This echoes the ICT4D analysis.	8.4.1.1(B) 8.4.2.1
Which other decisions are they linked to (do they affect?)	The generic value chain links decisions to value creation, and therefore prioritises decisions relative to each other. The classification into strategic, tactical, and operational decisions introduces the scope of influence and therefore an additional way of linking decisions to each other.	8.4.1.1(B)
How do they enable value creation?	The generic value chain links decisions to steps towards value creation. The representation indicates that each decision in the sequence, as well as the decisions in combination, has an impact on overall value creation.	8.4.1.1(B)
How do they disable value creation?	Some potential conflicts in value creation were highlighted through the analysis. These specifically pertain to a limited view on project scope, and aspects resulting from a lack of alignment.	8.4.1.1(B)
What should change to ensure alignment with other decisions and value creation?	The analysis highlighted that decision-makers should collaborate with respect to a joint understanding of value and benefits, mechanisms of value creation, and constraints. The project design and project process should provide mechanisms and processes to ensure alignment.	8.4.1.1(B)
How should priority be given to different decisions, given the overall process	The analysis identified strategic, tactical, and operational decisions. This implies a natural priority and progression from strategic to operational, and emphasizes alignment across these levels with strategic intent. Further, the constructs of value creation imply an order of events, in which subsequent events cannot take place unless earlier decisions are not made well.	8.4.1.1
What decisions are we not making?	Some decisions were actively supported by decision models (e.g., costing, services portfolio). The value chain analysis highlighted a number of additional decisions that could be supported (e.g., site selection). Some decisions (specifically pertaining to institutionalisation and transfer) have not been identified upfront as critical to sustained benefit.	8.4.1.1(B)

As in the analysis of the ICT4RED case, the combination of a conceptual as well as an analytical perspective on decision-making provided additional view that could be used to align and structure decision-making in support of sustained benefit. The value chain approach proved to be a useful mechanism to elicit different perspectives.

8.5. IMPLICATIONS FOR DECISION FRAMEWORK

The purpose of the retrospective application of this decision framework was to:

Assess the usefulness of the framework
in guiding decision-making for sustained benefit

The purpose was to assess whether the application of the framework to a practical case would elicit new insights with respect to decision-making, as well as identify enhancements to the framework that would make it more useful to project teams in developing their decision-making towards sustained benefit.

As for the ICT4RED case, the elements were applied individually to the case. For each element, it was assessed whether new perspectives on decision-making were generated. By way of summary, the conceptual and analytical perspectives that were generated by the case analysis, were outlined (Section 8.4).

The benefits and omissions that were evident from the application of the framework to the DRDLR case are summarised in Table 8.17, in terms of the framework elements (A to D), as well as in terms of the different perspectives defined in Section 8.4). A number of these are similar to that of the ICT4RED case. Where relevant, these are repeated here, while new insights are summarised in italics.

Based on the summary in Table 8.17, the following changes to the framework are proposed (only aspects not addressed in the ICT4RED case are summarised):

- Develop a mechanism (toolkit) that is sufficiently detailed to compensate for any lack of experience on the part of the project team and related stakeholders.
- Ensure that the strategic/tactical/operational differentiation is interpreted in a useful manner in the toolkit.
- Emphasize the importance of the links between the various elements of the framework.
- Ensure that the toolkit translates into information that would guide the decision-making of the project team towards sustained benefit in a practical manner.

Table 8.17 Summary: new perspectives generated and omissions of the application of the decision framework

	Elements & perspectives	*New perspectives generated*	*Omissions or learning*	*Re-ference*
Framework elements	I. Network of decision-makers	Decision-makers at different spheres of influence were identified, *and omissions to include specific decision-makers were identified* A sequence in decisions as well as potential conflicts could be identified *Decisions were plot relative to value creation, as such highlighting shortcomings in the scope of decision-making.* *The influence of decision-making on different project process areas were identified*	The completeness of information would depend on the experience and insight of the project team. This may require repeated application of the framework. The prioritisation of decisions relative to sustained benefit may be required. *The value contributed by the Strategic/ Tactical/ Operational perspectives is not clear.*	8.4.1
	II. Value and sustained benefit	*A relatively limited (short term) view on benefits was identified, highlighting the need for a broader perspective, and for mechanisms that transcends the current project towards longer-term benefit.*	*A link is required between value creation and the way in which the project process can support value creation*	8.4.2
	III. Theory and construct of value creation	As above	As above A generic construct of value creation proved to be useful in reflecting the role of decision-makers.	8.4.2
	IV. Project process	*A project process could be defined that would address disablers of change, and facilitate enablers*	*Project process changes are linked to the view that is taken on value creation.* As before, this implies that a tight coupling between project process and other framework elements is required.	8.4.3.2
Perspectives	Conceptual perspective	*This perspective aided in highlighting the omissions in value creation, and the gap in translating short-term to long-term value creation*	The experience and skill of the analyst, and knowledge about the project environment, could influence the quality of the analysis. This analysis should be repeated more than once during the project process.	Section 8.4.4
	Analytical perspective	This perspective generated new insights with respect to the structuring of decision-making *and its influence on value creation.*	Some of the practical implications of this perspective are that conflicts and omissions in decision-making are highlighted. *However, more detail may be required to translate this into useful information for practitioners.*	Section 8.4.4

This case confirms the need that was expressed in the previous chapter to translate the diagrammatic framework concept into an easily applicable construct such as a checklist of questions or toolkit.

8.6. SUMMARY

This chapter comprises a second case analysis that was aimed at assessing whether the original decision framework contributes to practice, and to identify ways in which the framework should be revised to enhance its effectiveness. As such, the work was still in pursuit of answering the main research question of the thesis, namely:

What are the elements of a framework that support strategic decision-making for the design and implementation of ICT4D interventions in resource-constrained environments, in support of sustained benefit?

This question was answered by interrogating each of the framework elements relative to the DRDLR ICT Hub case. For each element, it was assessed whether new insights were developed with respect to decision-making towards sustained benefit. The analysis was summarised in terms of a conceptual perspective (broadly, is there alignment between decision-making and the overall strategic intent of the project) and an analytical perspective (is the project decision-making structured in a manner that supports sustained benefit).

The results of the analysis largely reflect the conclusions of the ICT4RED case. New insights were developed through the application of the framework, while some elements required further explanation. Both cases confirm that a closer integration between the elements of the framework needs to be emphasized. Importantly, a checklist or toolkit should be developed to enable the easy implementation of the framework in practice.

This chapter concludes the second of two case studies that are applied to test the framework. In the next chapter, learning from both cases will be integrated to develop the intermediate decision framework.

CHAPTER 9. INTERMEDIATE FRAMEWORK

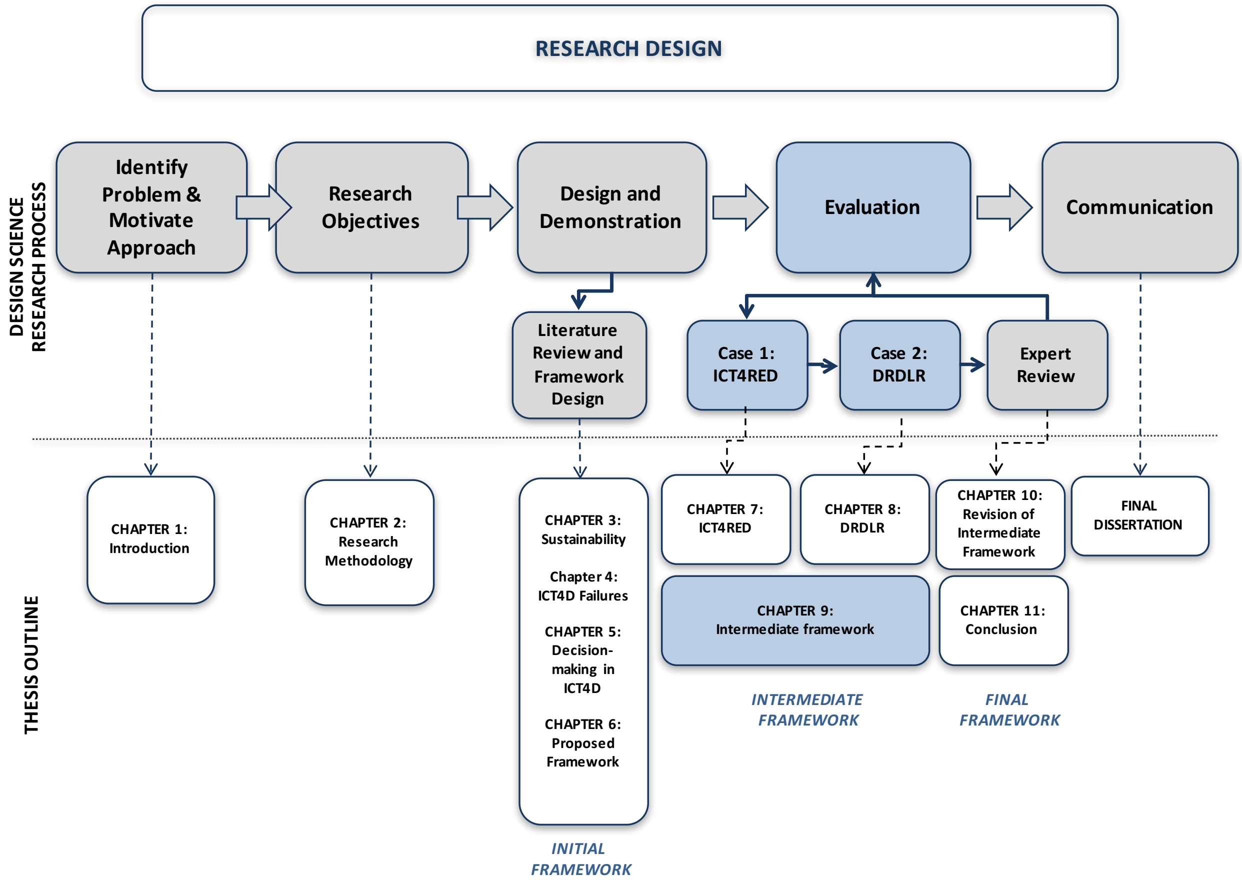


Figure 9.1 Research process and thesis outline: Chapter 9

9.1. INTRODUCTION

The previous two chapters described the application of the initial framework to two different case studies, culminating in recommendations for the improvement of the framework. This chapter undertakes a cross-case analysis, the purpose of which is to integrate the findings of the previous two chapters to develop an *intermediate* decision framework.

Consistent with the theory base of the previous two chapters, this cross-case analysis is framed in the context of the following case analysis approach, which states that cases:

> '*can be used in exploratory, explanatory or descriptive fashion (Yin, 2014), and can be employed for theory testing or theory building'* (Irani et al., 1999; Myers, 2013; see section 2.6.2)

In this cross-case analysis, the focus is on expanding the initial framework. That is, the theory testing of the previous two chapters is integrated to further develop the initial theory, the elements of which should comprise a decision framework. As for the within-case analyses, the cross-case analysis plays a role in terms of the *evaluation*, but also in the *demonstration* of the applicability of the framework, as defined by the Design Science Research Process of Peffers et al. (2006) (see Figures 2.4 and 9.1). It contributes towards answering the overall research question, namely:

What are the elements of a framework that support strategic decision-making for the design and implementation of ICT4D interventions in resource-constrained environments, in support of sustained benefit?

In this analysis, the generalizable elements from the two case studies are interpreted to develop the intermediate framework (see Table 2.5 for this overall case analysis process). Since the premise of this research includes a focus on the *operationalisation* of the concept of sustainability, the intermediate decision framework aims to define the decision elements in a manner that could be translated into a toolkit for practical application. However, note that it was indicated in Section 2.3.3 that the framework was intended for use as a *guideline* within which practitioners can '*develop their own approach* to the design of *ICT4D projects and programmes* with a view of creating benefits that last'. The toolkit will therefore serve to demonstrate the application of the framework, rather than being prescriptive in terms of exactly how the framework elements should be applied. The intent is to leave users of the framework the flexibility to interpret elements in a manner that is suitable to their implementation environment –

which is mostly characterised by high levels of uncertainty (Pries-Heje, & Baskerville, 2008; Section 5.2), and could therefore benefit from flexible approaches.

This chapter firstly elaborates somewhat on the approach to the cross-case analysis (Section 9.2), followed by the analysis itself (Section 9.3). Section 9.4 describes the *intermediate* decision framework. Finally, the practical application of the framework is discussed (Section 9.5), after which the chapter is summarised (Section 9.6).

9.2. APPROACH TO CROSS-CASE ANALYSIS

This research adopted a two-case analysis as a means of exploring whether the decision framework elements that were identified in the literature reviews are useful. A case analysis strategy was developed that would integrate the within-case and cross-case analyses so as to identify generalizable elements to be incorporated into the decision framework. This strategy, and the role of the cross-case analysis, was summarised in Table 2.5 (repeated here for convenience).

Table 9.1 Method of case analysis

Type of analysis	*Objective & activities*	*Method*
Within-case analysis	Identify and describe the context of the case. Identify the objective of the ICT4D intervention. Define the decision context (stakeholders, constraints, influences). Identify key themes that affect and inform decision-making.	The researcher will analyse and interpret project documentation, as well as notes from meetings, presentations and discussions to develop the context. Participant observation, as part of the sustainability modelling activity on each project, as well as learning during model development, will further inform the analysis. Decision maps and rich descriptions will be used to support the analysis, where appropriate.
Cross-case analysis	Identify generalizable elements across cases that would inform framework development.	A comparison of the within-case descriptions and analyses would enable the identification of elements to include in the framework, as well as the identification ways in which to enhance elements that have already been identified.
Interpretation	Integrate the generalizable elements that were defined in the cross-case analysis, to inform the revised decision framework	The relevance of the generalizable elements to the framework will be assessed, and its level of integration will be determined (i.e., does it constitute a new element, or a revision of an existing element). The framework will be adapted accordingly, to constitute the *intermediate* framework.

The individual case studies in the previous two chapters were used to demonstrate that each framework element contributes new perspectives in terms of the capacity of the project team and related stakeholders to make decisions that will sustain the benefits from the implementation. In this chapter, the cross-case analysis is intended to enhance the decision framework through the refinement of the existing framework elements, or through the identification of new perspectives. Given that the premise of this research is to contribute towards the operationalisation of the concept of sustainability, the intention of the analysis is to enhance the decision framework to a sufficient level of detail, so that it can fulfil its role in decision support.

Employing multiple cases in case study research has the intention of providing multiple perspectives on the phenomena under study. Eisenhardt (1989:533) highlights cross-case analysis as a means of 'forcing investigators to look beyond initial impressions and see evidence thru multiple lenses.' It enhances a search for patterns (Cresswell, 2007; Eisenhardt, 1989), and aims to overcome information analysis biases (Eisenhardt, 1989). Some of the tactics for a cross-case analysis include the (pairwise) comparison of cases against each other, the comparison of case data against a framework comprised of categories or dimensions (Cresswell, 2007; Eisenhardt, 1989; Yin, 2014), and the development of naturalistic generalisations through data analysis (Creswell, 2007). The latter framework could be informed by literature, or merely selected by the researcher (Eisenhard, 1989). Overall, the importance of cross-case analysis lies in its role to 'improve the likelihood of accurate and reliable theory' (Eisenhardt, 1989: 541).

The case descriptions in the previous two chapters examined the usefulness of the decision framework in highlighting new perspectives on the ability of the ICT4D intervention to sustain benefits. In addition, it outlined aspects that could be enhanced in the decision framework. For each case, new perspectives were generated, and omissions and learning from the case were summarised (see Tables 7.13 and 8.17). These summaries are used as a basis for the cross-case analysis. Based on this discussion, the following approach to the cross-case analysis is adopted:

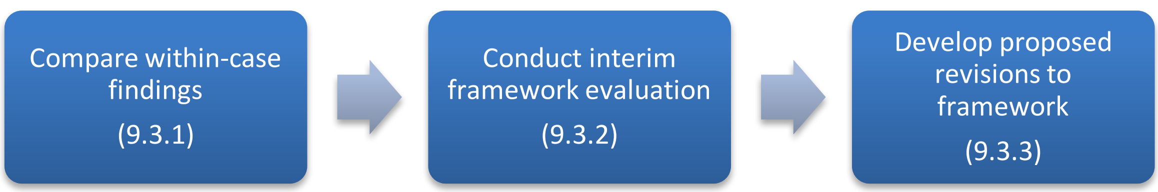


Figure 9.2 Cross-case analysis

The analysis comprises the following steps:

Step 1: Comparison of within-case findings (Section 9.3.1):

The purpose of this step is to compare the findings that were generated during the within-case analyses, as follows:

- Compare the case summaries (perspectives and omissions) that were developed in the previous two chapters, using the categories that were identified in the case analyses (framework elements, conceptual perspective, analytical perspective);
- Summarise the omissions or learning, based on the cross-case comparison; and
- Compare the revisions to the framework that were identified in each case, and enhance the list of proposed revisions based on this cross-case comparison.

Step 2: Interim framework evaluation (Section 9.3.2)

This step aims to develop further perspectives on the framework by evaluating it against predetermined criteria, based on the information that was generated during the within-case analysis, as follows:

- Evaluate the framework against the evaluation criteria developed in Chapter 2, based on the insights that were developed from the case comparisons; and
- Interpret any omissions that were identified.

Step 3: Proposed revisions (Section 9.3.3)

During this step, results from the previous two activities are integrated into proposed revisions:

- Conceptualise an appropriate modification to the framework, based on the proposed revisions.

Note that the intention is to have a framework that is grounded in theory (literature surveys; see Chapters 3–5) and case observations (Chapters 6–7), but that is at the same time applicable and usable in practice. The last step (conceptualisation of the framework, based on proposed revisions) will therefore be conducted with a practical perspective in mind. Thereafter, the framework will be adapted to reflect these revisions.

9.3. CROSS-CASE ANALYSIS

This section applies the cross-case analysis process outlined in Section 9.2. The within-case findings are compared (Section 9.3.1), followed by an interim framework evaluation (Section 9.3.2) and a summary of the proposed revisions (Section 9.3.3).

9.3.1. Comparison of within-case findings

A comparison of the case summaries of Chapters 6 and 7 yield the following cross-case perspectives, as well as omissions or learning, that emanated from the application of the framework (based on Tables 7.13 and 8.17; see Appendix D for more detail):

Table 9.2 Comparison of within-case findings: perspectives and omissions

Framework element	New perspectives generated	Omissions or learning
Network of decision-makers	*Views to include or consider:* • Decision-makers, their spheres of influence, and omitted decision-makers • The sequence of decision-making and potential conflicts • Decisions in support of value creation, and omissions • The influence of decisions on the project process	It may be necessary to prioritise decisions relative to sustained benefit. The value contributed by the Strategic/ Tactical/ Operational perspectives is not clear. The user's (analyst's) experience may influence the value from the decision framework.
Value and sustained benefit	Multiple values and benefits require communication and prioritisation. Short term perspectives on benefit require mechanisms to ensure long-term benefit	The framework could be enhanced by prioritisation of value and benefit, and by clarity about disablers and enablers of value creation. A link is required between value creation and the project process in support of value creation
Theory and construct of value creation	As above	A generic construct of value creation is useful in reflecting the role of decision-makers (instead of a theory of change).
Project process	A modular process supports sustained benefit A focus on disablers and enablers of change could be useful	A tight coupling between project process and other framework elements is required (to ensure that the process is in support of value creation).
Conceptual perspective	This perspective (questions asked) created new insights that made the following visible: ➢ mechanisms of value creation ➢ omissions in value creation ➢ the gap in translating short-term to long-term value creation	As before: the experience and skill of the analyst, and knowledge about the project environment, could influence the quality of the analysis. This analysis should be repeated more than once during the project process.
Analytical perspective	This perspective generated new insights with respect to: ➢ the structuring of decision-making ➢ its influence on value creation.	The practical implications of this perspective are not necessarily immediately clear. Conflicts and omissions in decision-making are highlighted. More detail may be required to translate this into useful information for practitioners.

Based on the learning from each of the case studies, the following changes to the decision framework are proposed (see Sections 7.5 and 8.5):

Table 9.3 Comparison of within-case findings: perspectives and omissions

ICT4RED (Section 7.5)	*DRDLR ICT Hubs (Section 8.5)*
Add a mechanism or questions that prioritise different benefits, as well as decisions relative to different benefits. Include questions that prompt thinking about enablers and disablers to value creation. Emphasise that generic value creation constructs (specifically, in the form of value chains) be defined for the purpose of the decision analysis. Emphasise the interrelatedness of the four components of the framework. Prompt the translation of concepts into practical implications for project design.	Develop a mechanism (toolkit) that is sufficiently detailed to compensate for any lack of experience on the part of the project team and related stakeholders. Ensure that the strategic/tactical/operational differentiation is interpreted in a useful manner in the toolkit. Emphasise the importance of the links between the various elements of the framework. Ensure that the toolkit translates into information that would guide the decision-making of the project team towards sustained benefit in a practical manner.

By integrating these two analyses (Tables 9.2 and 9.3), the following changes to the framework are proposed:

Table 9.4 Comparison of within-case findings: perspectives and omissions

Aspect	*Proposed changes*
Framework elements	Emphasise the interrelatedness of the four components of the framework, and establish appropriate links between them. Specifically: ➢ A tight coupling between project process and other framework elements is required (to ensure that the process is in support of value creation).
Framework content	Ensure that the strategic/tactical/operational differentiation is interpreted in a useful manner in the toolkit. Emphasise that generic value creation constructs (specifically, in the form of value chains) be defined for the purpose of the decision analysis. Add a mechanism or questions that prioritise different benefits, as well as decisions relative to different benefits. Include questions that prompt thinking about enablers and disablers to value creation
Project process	Prompt the translation of the concepts that are identified through the framework into practical implications for project design.
Framework application	Develop a mechanism (toolkit) that is sufficiently detailed to compensate for any lack of experience on the part of the project team and related stakeholders. Ensure that the toolkit translates into information that would guide the decision-making of the project team towards sustained benefit in a practical manner.

9.3.2. Interim framework evaluation

In Chapter 2, an evaluation strategy, as well as a number of properties, was identified for the evaluation of an artefact; the interpretation of each property for the decision framework was outlined (Section 2.6). This evaluation framework will primarily be used during the expert review of the framework, to assess and enhance its structure and content (see Chapter 10).

However, in this cross-case analysis, the data generated during the case applications (Tables 9.2 and 9.3) are used to do a brief interim self-assessment of the framework against the properties of the evaluation framework (Table 2.9). The intent is to identify enhancements to the framework, based on the case analyses. The following assessment is made:

Table 9.5 Properties of artefact to evaluate, based on systems evaluation (from Prat et al., 2014; see Table 2.9)

Property to evaluate	*Description*	*Applied to this decision framework*	*Framework assessment, based on case analyses*
Goal	Efficacy, validity, or generality of the framework	Is the framework effective in its goal of aiding decision-making, does it produce a valid outcome, and is it applicable to more than one decision situation?	***Efficacy:*** unclear at this stage, but the cases show the potential of the framework to generate new perspectives on project approach ***Validity:*** the framework's validity is only testable after application in a real project; however, it shows the promise of being able to influence the way of work in an ICT4D implementation ***Generality***: potential applicability has been demonstrated through application in more than one case study
Environment	Consistency of the artefact with the environment (people, processes, technology)	Is the framework eliciting decision-making that is relevant to the people, processes, and technology that are involved in the decision problem?	***People***: the framework identifies known decision-makers, but also role players that have been omitted from the process ***Processes:*** the framework engages with the project process, and recommendations are made to enhance this engagement at the practical level
Structure	Completeness, simplicity, clarity, style, level of detail and consistency of the artefact	Have critical elements been omitted from the decision framework?	***Critical elements***: no new elements have been identified during the case analysis; however, the links between elements need to be highlighted in a revised framework
Activity	Completeness of function, consistency of activity, accuracy and performance of the artefact	Is application of the decision framework yielding a usable and useful result?	Application to the two case studies yielded new perspectives that have the potential to enhance the ability to sustain benefits.
Evolution	Robustness and learning capability	It is possible to change the instantiation of the decision framework, based on learning that comes to light during its application?	The case analysis pointed to a number of aspects that could be improved, thus highlighting learning. The ability to adjust during application could be highlighted in the revised framework

This interim self-evaluation highlights one new issue to include in the revised framework, namely evolution – that is, a means of enabling the framework to adapt during application (or a means to highlight the current learning capabilities of the framework). In addition, the evaluation emphasises the importance of the already identified aspects (see Table 9.5):

- Environment (people): ensure that omitted decision-makers are captured by the process;
- Environment (process): the translation into practical implications for the project process is emphasised;
- Structure (critical elements): linkages between elements are important; and
- Evolution (learning): the capacity to adapt could be highlighted in the framework.

9.3.3. Proposed revisions to structure

Based on the discussion in the previous two sections, the proposed changes (see italics) to the framework are summarised as follows (i.e., Table 9.4 is enhanced based on the brief framework evaluation in section 9.3.2):

Table 9.6 Proposed changes to the evaluation framework

Aspect	*Proposed changes*
Framework elements	Emphasise the interrelatedness of the four components of the framework, and establish appropriate links between them. Specifically: ➢ A tight coupling between project process and other framework elements is required (to ensure that the process is in support of value creation).
Framework content	Ensure that the strategic/tactical/operational differentiation is interpreted in a useful manner in the toolkit. Emphasise that generic value creation constructs (specifically, in the form of value chains) be defined for the purpose of the decision analysis. Add a mechanism or questions that prioritise different benefits, as well as decisions relative to different benefits. Include questions that prompt thinking about enablers or disablers to value creation. *Ensure that there is a focus on what is omitted in the current approach (e.g., which decision-makers are excluded).*
Project process	Prompt the translation of the concepts that are identified through the framework into practical implications for project design.
Framework application	Develop a mechanism (toolkit) that is sufficiently detailed to compensate for any lack of experience on the part of the project team and related stakeholders. Ensure that the toolkit translates into information that would guide the decision-making of the project team towards sustained benefit in a practical manner. *Define the framework in such a manner that it allows for learning during application; highlight those elements or characteristics that ensure that learning can take place.*

9.4. INTERMEDIATE DECISION FRAMEWORK

The analysis in Section 9.3 highlighted a number of conceptual changes to different aspects of the decision framework. These have been classified as changes to framework elements, content, project process, and the application of the framework, respectively. This section presents the revised framework, based on the case analyses in Chapters 7 and 8, and the cross-case analysis in section 9.3.

First, Section 9.4.1 describes changes to the structure or concept of the framework, based on the recommendations in the first three aspects (elements, content, project process). Recommendations pertaining to the application of the framework emphasise the need for usability and practical application of the framework. This is also in line with the intent of this research to operationalise the concept of sustainability in practice. To this end, the content of the revised framework is described in the form of a "toolkit" for decision support towards sustained benefit (see section 9.4.2).

At this point of operationalising and adding detail to the framework, it is worth keeping in mind that this research set out to develop a *conceptual* framework, the intent of which was to inform later model development (Hassan, 2014; Section 2.3.2). It was intended to '*provide structure within the messy environment of delivering benefit from ICT4D projects'* and *'would serve as a guideline to enable decision-makers to consider the key elements that affect delivery of sustained benefit, and to manage their decisions accordingly'* (Section 2.3.2). The addition of detail, therefore, should serve to ***demonstrate*** rather than to prescribe the exact mechanisms of application of the framework, which should be:

> '…*sufficiently generic to be adaptable to a set of collective decisions in any context, and supports Snowden and Boone's (2007) notion that simple, complicated, complex, chaotic 'decisions require leaders to diagnose situations and to act in contextually appropriate ways"* (Section 6.5.1).

The toolkit is therefore not descriptive, but provides guidelines and examples of how the framework elements could be analysed and debated by a project team. It is aligned with the earlier quoted perspective of Moore and Thomas (1988), in which the process of structuring the decision problem is seen as a learning process (Moore and Thomas, 1988; Section 6.3.2), which in itself may lead to a solution before complex analytical or modelling work is done.

9.4.1. Revised structure

In revising the structure of the decision framework, a reminder of the intent or premise of the research is useful (summarised from Chapters 1 and 2):

- Sustainability is poorly defined, and does not inform practice (Section 3.4.3).
- ICT4D implementations take place in complex environments. Development projects have specific context-related challenges, and can be defined as "messy" problems (Section 1.3.3).
- The value created by an organisation (in this case the collective of organisations involved with an ICT4D implementation) is as good as the sum of its decision-making (Blenko et al., 2010).
- Sustained benefit is a representative term for the benefits that the stakeholders want to achieve through the ICT4D implementation (Section 1.3.1).
- The decision framework is intended to provide a means of operationalising the concept of sustained benefit, and to structure decision-making in these messy environments in support of sustained benefit (Section 1.3.1).

In summary, the intent is to develop a usable, practical tool that could inform project level decision-making (strategic, tactical, operational) towards sustained benefit.

Based on literature reviews, the initial framework defined four framework elements that were loosely interrelated (Section 6.5.2):

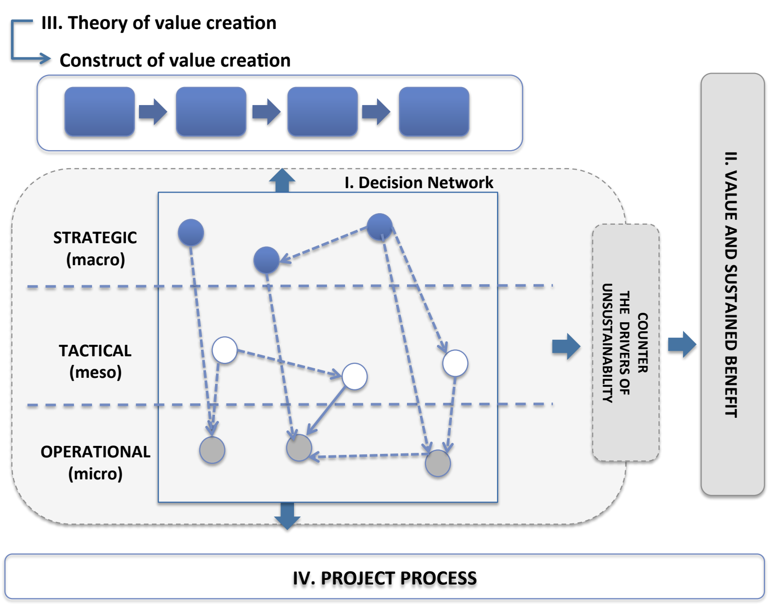


Figure 9.3 Initial decision framework

While the framework elements were identified and conceptually defined based on the literature reviews, they were not operationalised in detail. The application in the case studies served to interrogate this aspect.

Based on the recommendations that were developed as a result of the case analyses, it is proposed that the framework be operationalised as a process within which the following elements are explored by the project team (Figure 9.4).

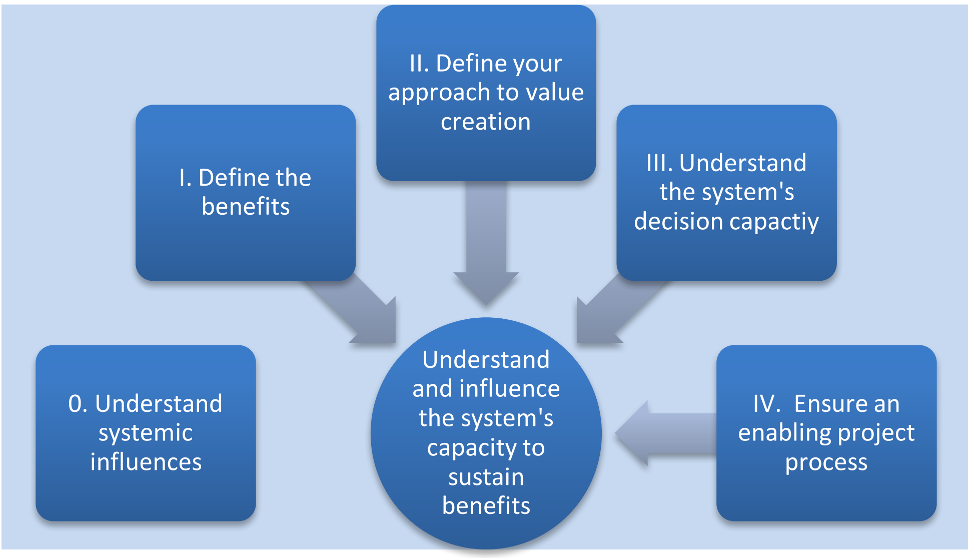


Figure 9.4 Intermediate decision framework

This revised representation depicts the *intermediate decision framework*. It is supported by a set of questions or discussions (see the toolkit in Section 9.4.2) that would assist the project team to understand the way in which the ICT4D implementation would create value in the beneficiary system, and how their implementation should be structured in a manner that would best sustain benefits.

All of the elements of the initial framework have been retained. However, the intermediate framework differs from the initial framework in the following important respects:

- *Central focus point: Understand and influence the system's capacity to sustain benefits:* The initial framework defined value and sustained benefit as the objective of decision-making. An understanding of the system's capacity to sustain benefits represents a revised goal, and shifts the focus from the intervention towards the system within which the intervention will play out. It forces decision-makers to deal with the underlying aspects in the system that they seek to influence. In addition, it emphasises the systemic nature of the ICT4D implementation in its implementation context, and repositions the intervention as a mechanism that will create benefits by aligning itself with the underlying system.

- *Element 0: Understand systemic influences:* This element was earlier included as '*counter the drivers of unsustainability*.' However, it was not operationalised and considered as part of the analysis. It is introduced here in support of the central focus point outlined in the previous paragraph, and to address the following proposed changes to the framework (Table 9.6):
    - 'prompt thinking about enablers or disablers to value creation'; and
    - 'Emphasise the interrelatedness of the four components of the framework.'
- *Toolkit Implementation: Support each element by questions or discussions:* In the initial framework, the framework elements were defined from a conceptual perspective, and did not include detail. The case analysis explored some detail, and developed some representations for each framework element. These discussions and representations will be developed (see toolkit, Section 9.4.2) to contain sufficient detail to aid decision-makers in arriving at practical conclusions. In addition, the detail within each element will allow for representations that explore and define the relationships between elements. The detail will serve as example of how the framework can be operationalised, without being prescriptive.

This revised framework definition was developed to addresses the recommendations derived in the previous Section (Table 9.6).

The mechanism through which each recommendation is addressed, is outlined in Table 9.7.

Table 9.7 How framework revisions address the proposed changes

Aspect	Proposed changes, based on case analysis	Response (framework change)
Framework elements	Emphasise the interrelatedness of the four components of the framework, and establish appropriate links between them. Specifically: ➢ A tight coupling between project process and other framework elements is required (to ensure that the process is in support of value creation).	The detail within each component will reflect linkages between components The project process element will include mapping to other framework elements (specifically decision-making- element I), and will comprise characteristics that will be aimed at sustained benefit (element II).
Framework content	Ensure that the strategic/tactical/operational differentiation is interpreted in a useful manner in the toolkit Emphasise that generic value creation constructs (specifically, in the form of value chains) be defined for the purpose of the decision analysis. Add a mechanism or questions that prioritise different benefits, as well as decisions relative to different benefits. Include questions that prompt thinking about enablers and disablers to value creation Ensure that there is a focus on what is omitted in the current approach (e.g., which decision-makers are excluded).	The mapping of decision-making (element I) will prompt users to interpret their mapping of the strategic / tactical/ operational perspective The remainder of the points listed here are dealt with in the detail (mapping, discussion, or reflection) of each framework element
Project process	Prompt the translation of the concepts that are identified through the framework into practical implications for project design.	Questions are included in the reflection on various framework elements to address this aspect.
Framework application	Develop a mechanism (toolkit) that is sufficiently detailed to compensate for any lack of experience on the part of the project team and related stakeholders. Ensure that the toolkit translates into information that would guide the decision-making of the project team towards sustained benefit in a practical manner. Define the framework in such a manner that it allows for learning during application; highlight those elements or characteristics that ensure that learning can take place.	The first two points are addressed by the detail of the content of each framework element. The learning element is addressed in the project process characteristics, as well as in the manner in which the framework is applied (section 9.5).

The detail pertaining to each framework element is contained in the description of the toolkit in the next section.

9.4.2. Toolkit: decisions that sustain benefit

9.4.2.1. Intended use

It is foreseen that the toolkit will be used by people that have an influence over the way in which the ICT4D initiative is designed and implemented. This implies that it would be used by a project management team or steering committee, or an organised group of stakeholders. The toolkit is aimed at eliciting multiple perspectives, and it should therefore be used by a collection of decision-makers that represent the role players that influence the implementation (in its broadest sense) as comprehensively as possible. It intends to assist role players in identifying their blind spots with respect to the ability to sustain benefits, thus prompting them to adjust their approach, where necessary. As highlighted in Section 2.3.2, the framework needs to be cognisant of imbalances in the ability of various stakeholders to influence decision-making. This aspect is effected at the stage of framework implementation, through the inclusiveness with which the participant group (from here: decision-makers) is established.

The intermediate framework firstly prompts decision-makers to reflect on the broader system within which they want to intervene, followed by a more detailed analysis of the capacity of the intervention to work towards sustaining benefits:

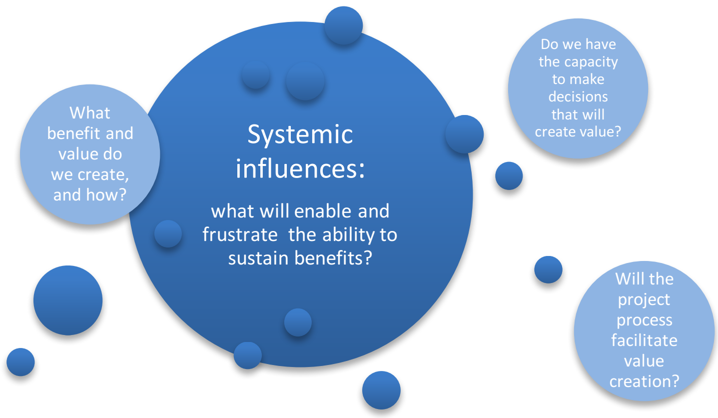
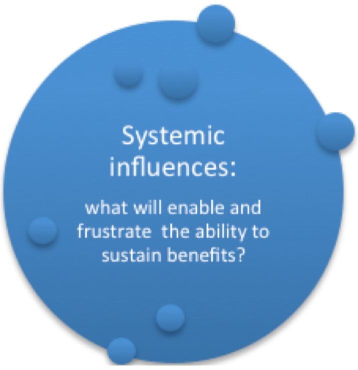


Figure 9.5 Representation of intermediate framework.

This section describes (that is, provide examples for) the detail within each framework element. It comprises a description of the assumptions that are made for each element (see: *background*). The element is then described (see: *element* description) by highlighting its purpose, providing ***guidelines*** and ***examples*** of how the element can be described (that is, in terms of a questionnaire, discussion, or diagram) and summarising some points for reflection when debating the element. Some of the examples from the case analyses (Chapters 7 and 8) are used to illustrate selected aspects, where appropriate.

9.4.2.2. Element 0: Understand systemic influences

Background



The initial decision framework implied that the drivers of unsustainability would be countered by integration of the various elements of the decision framework; it indicated this by including a component named *Counter the drivers of unsustainability.* In the intermediate decision framework, this concept is introduced as a separate element, representing the decision-makers' understanding of the capacity of the system to sustain benefits. As such, it places the focus of the framework and of decision-making on alignment with systemic change.

Turpin (2012) highlights the difficulty in describing and assessing ICT4D's impact on the larger social system, and questions the view that sustainability of the information system is a proxy for 'sustainability or the development of the larger social system' (Turpin, 2012:2). A similar systems-related view is taken by Ospina and Heeks (2016), who examine the effect of development interventions on the capacity (i.e., resilience) of a system (community, etc.) to respond to external shocks.

This research seeks to define the link between the intended benefits from the ICT4D intervention and the change that is to be effected in the larger social system (i.e., the underlying development reality) – thus positioning itself relative to the debate about the impact of ICT4D. In Section 1.3.1, sustained benefit was defined as something:

> *'that will result when the relationships that support sustained change in the system of participants have been enabled to the extent that benefits will continue to be generated in the long run'* (Marais & Meyer, 2015; Section 1.3.1).

It is further assumed that sustained change in the participant system is a precursor for the delivery of sustained benefit (Section 1.3.1). As such, this research circumvents the underlying development philosophy, and instead aims at aligning the *intended change*, as defined by all stakeholders, with their collective decision-making. In being non-prescriptive, it allows the framework to be applicable to a spectrum of situations, ranging from ones that are aimed at delivering benefits for a rather short period of time (e.g., for research or testing purposes), to those that need to sustain benefits in the medium to longer term. Importantly, alignment of the intent of the intervention with systemic change is sought.

In addition, it is assumed that the extent to which benefits are sustained in the beneficiary system depends on the extent to which capacity and relationships are disrupted or developed to sustain change in the system – for example, the development of entrepreneurs that support technology may lead to sustained availability of technology at an ICT centre, while political agendas may lead to a boycott of the centre. Ideally, development of capacity and relationships would unlock activities and forces that would create their own benefit. Given this conceptualisation, practitioners need to understand the systemic influences on their intervention, and design the intervention to align with, or counter, these influences in a manner that supports the capacity to sustain benefits. Similarly, they should seek to understand the unintended consequences of their intervention, and manage their work accordingly, where possible. For example, access to the Internet for educational purposes may result in access to inappropriate content for children, which in turn needs to be dealt with by the collective of decision-makers.

Element description

Purpose
Ensure that the intervention is aligned with the dynamics of the beneficiary system that will facilitate or disable sustained benefit, and that these are influenced appropriately

This element is aimed at focusing the attention of decision-makers on the alignment between their intended benefits and the forces in the underlying socio-technical system that may counter the realisation of such benefits. It differentiates between two levels of drivers, namely those that are inherent in the nature of the beneficiary system, and those that are inherent in the nature of the development intervention. It is presented in the form of a number of questions to be debated around each of the two levels.

Based on earlier observations from the two cases under consideration and discussions with development practitioners (Marais & Meyer, 2015; Van Rensburg, 2017), it is proposed that decision-makers explore the following topics to develop a perspective on drivers for and against change:

Table 9.8 Framework element 0: assessment of drivers for and against change

Change drivers in the beneficiary system	Alignment of the development intervention
Who initiates change in the beneficiary system? Is the intervention aligned with change drivers in the beneficiary system? ***What level and type of change is possible?*** Disruptive or incremental? ***Is current change understood?*** Who are the change agents? ***Is the intended change appropriate?*** Is the relevance of the intervention on the underlying reality proven? ***Is the proposed change aligned with the readiness of the system for change?*** • Literacy • Management capacity • Capacity • Etc. ***What are the possible unintended consequences of the intervention?***	***Strategic intent and funding*** Is the intent of the funding aligned with the needs of the beneficiaries? Do multiple funding sources (if relevant) have conflicting objectives? Is the intent of the implementing agency aligned with the need of the beneficiaries? Will all benefits be delivered within the time span of the available funding? Is all funding available to cover the objectives, or is it required to source more funding during the current span of funding? ***Adaptive project design*** Is the design differentiated for different levels of readiness? Is the design flexible and adaptable to different implementation environments? ***Familiarity with environment*** Are the conditions under which technology will be rolled out understood? Has the management capacity for taking over the project been assessed? Is the capacity for uptake of technology understood? ***Resource-hungry solutions in resource-poor environments*** Have the resource demands of the solution been assessed? Is the availability of critical resources and capacity known?

The analysis is intended to generate a list of drivers for and against change, and a rating of the relative importance of the drivers (e.g., see Fig. 9.6)

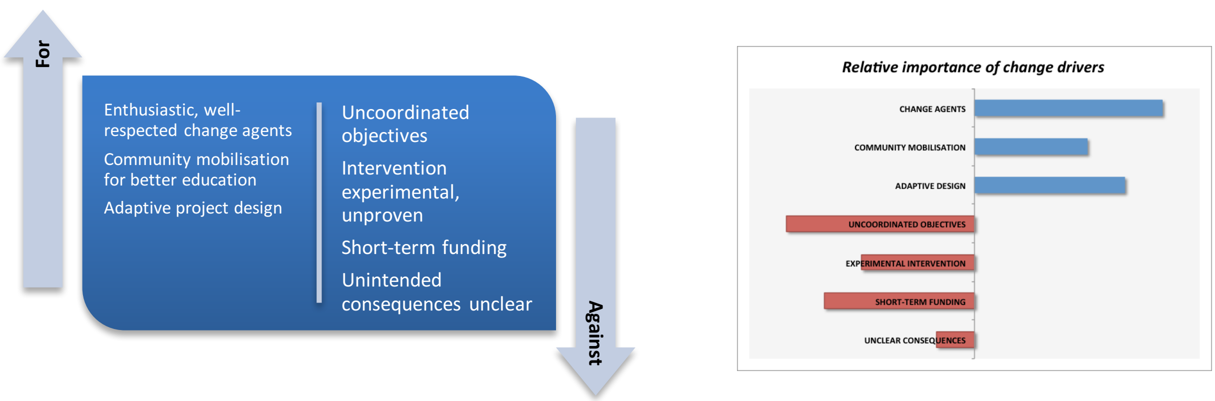


Figure 9.6 Representations of drivers for and against change (example)

Participants in the analysis should interpret their discussion in terms of the following (or similar) questions, and adapt the intervention design accordingly.

Interpretation
Are drivers against sustainability understood, or is more work required?
Is an understanding of drivers shared among shareholders?
Are mechanisms in place to counter such drivers and manage risks?
Are mechanisms in place to manage possible unintended consequences?

9.4.2.3. Element 1: Define the benefits to be sustained

Background

This element is concerned with defining the intended benefits of the intervention, that is, the benefits that need to be sustained within the beneficiary system. The literature review on sustainability (Chapter 3) concluded that the concept is poorly understood, and that authors and practitioners are often not clear on what they mean by sustainability. It then proceeded to define various perspectives that are taken on sustainability, as well as the characteristics thereof.

This research proceeded to assume a systemic view on sustained benefit (see Fig 3.11; Section 3.4.3.3), as such adopting the definition of sustained benefit that was outlined in Section 9.4.2.2. Assuming then that sustained benefit results from sustained change, the perspectives of Organisational Change Management literature are helpful in exploring systemic change. From this perspective, clarity about the goal of change (in our case, the nature of the benefits to be sustained) is essential to successful organisational change (e.g., Miller, 2004). This research assumes that such goal clarity is also beneficial to effect change through ICT4D implementations.

For the purpose of attaining common ground and goal clarity around the benefits that are to be sustained from a specific ICT4D implementation, the following questions (as defined in Table 3.8, and adopted in the conceptual perspective on the decision framework; Section 6.5.3) are therefore proposed for consideration by decision-makers:

- *Which benefits need to be sustained?*
- *By whom?*

- *For whom?*
- *For how long?*
- *What are the relative priorities of these benefits?*

Stakeholders are further expected to define how a particular benefit influences the underlying beneficiary system, and to consider the potential unintended consequences thereof. In addition, they are prompted to consider whether a view is taken on sustained benefit that balances multiple perspectives in an appropriate manner.

In addition to the assumption that goal clarity is essential to sustaining benefits, it is also assumed that a consideration of multiple rather than single dimensions of sustainability would enhance the probability of sustaining benefits. This assumption adopts the dimensional view on sustainability, and is based on the extensive work that was done to define and verify multiple dimensions of sustainability (Section 3.4.3.3; Fig 3.11), which are adopted here for the concept of sustained benefit.

Element description

Purpose
Obtain clarity, visibility, and agreement among stakeholders of the benefits that need to be sustained, in sufficient detail to inform appropriate intervention design

This element requires decision-makers to define their views on the benefits that need to be sustained by an intervention. Based on the background to this element, two discussions are proposed:

1. *Define the intended benefits, intended influence, and possible unintended consequences for the underlying system; and*
2. *Explore the extent to which there is balance in the exploration of the various dimensions of sustainability.*

Examples of the outcomes of such a discussion are provided in Table 9.9 and Figure 9.7. These examples are based on the implementation of ICT Hubs in rural areas.

Question 1: Define the intended benefits, influence, and consequences on the underlying system

Table 9.9 Benefits and their intended influence (example: ICT Hubs)

BENEFITS					SYSTEMIC EFFECT	
What?	**For whom?**	**By whom?**	**For how long?**	**Starting when?**	**What is the systemic influence/ disruption?**	**What are the possible unintended consequences?**
Technology access	Community members Entrepreneurs Students	Project funders	Until the selected technology is out-dated	On roll-out	On-going low-cost access to ICT capacity	Access to inappropriate content by youth Theft Corruption
Economic activity	Community	Financially sustainable community ownership of Hub	7 years after completion of the project	After adoption of technology	Income generated from local activity instead of external influx (grants, remittances)	Business development without adequate local market and external market access
Economic activity	Commercial enterprises	Financially sustainable community ownership of Hub	7 years after completion of the project	After adoption of technology	Development of consumer power Consumer access to wider ranges of goods and services	Rapid business growth without an enabling environment
Etc.						

This information could be used to validate a number of design aspects, such as whether the scope of the intervention extends across the appropriate time line for delivery of benefits (see section 9.4.2.4), and that deliverables are targeted to achieve benefits of appropriate nature and at appropriate points in time. Similarly, an understanding of the systemic influence and unintended consequences could assist in defining what needs to be in place (that is outside the scope of the current intervention) to facilitate such disruption.

Question 2. To what extent are the following dimensions of sustainability engaged to make sure that these benefits are sustained?

The rating across dimensions is intended to give stakeholders a sense of the relative balance of their investment for developing the capacity to sustain benefits.

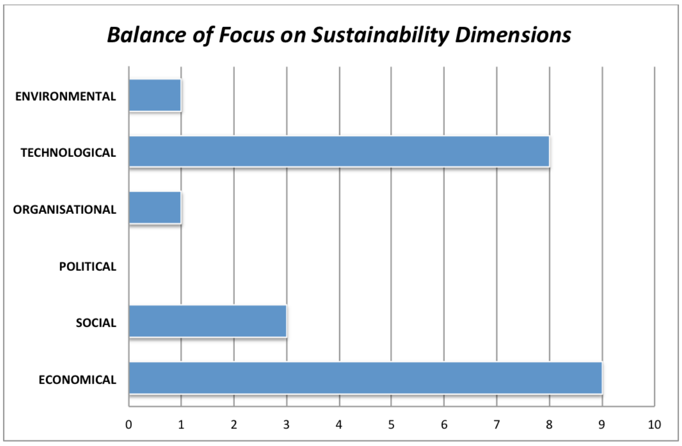


Figure 9.7 Assessment of balance of focus in sustaining benefits (example)

In the DRDLR ICT Hub case, for

example, it was concluded that the project has a high risk for technology dumping, given the imbalance in focus between technology sustainability (high maturity) and the other dimensions of sustainability (which were of low maturity) (see Section 8.3.3).

This element could be interpreted through a discussion of the following questions:

Interpretation
Are all benefits defined in sufficient detail? Are all beneficiaries identified and participating in design? Is the point of realisation, and duration, of the intended benefits accounted for by intervention design? Are adequate mechanisms in place to transfer the realisation of benefits between parties (by whom')? Are systemic influences understood and risks mitigated as far as possible? Is the balance in focus between dimensions of sustainability adequate, or should the intervention design be adapted?

9.4.2.4. Element 2: Define your approach to value creation

Background

This research assumes that decision-making should be guided by the manner in which value is created through the ICT4D intervention (Section 6.4.4). As such, it sees decisions as *'milestones on a path towards value creation, and that choices between options are guided by the extent to which they contribute to, or detract from, long-term value creation*' (Section 6.3.2.2). It requires decision-makers to define the premise upon which they intend to create value, and states '*the objective of decision-making is to contribute to overall value creation by aligning decisions and decision-makers relative to a construct of value creation.*' (Section 6.3.3).

The research therefore assumes that:

- By defining the process of value creation, the manner in which benefits are created becomes clear (see Unwin, 2009; Section 3.4.4.4);
- An explicit value creation process will provide a means of focusing decision-making (see Keeney, 1992; Section 6.4.4.3);
- Value-focused decision-making will improve the capacity to sustain benefit; and
- Management of risks to sustained benefit will improve the realisation of benefit.

Support for these assumptions include the view of Unwin (2009), who argues that interventions that deliver value (by meeting the needs of communities) are inherently sustainable, provided that they are undertaken in a cost-effective manner (Unwin, 2009; Section 3.4.4.4). In addition, Keeney (1992) advocates value-based decision-making, and '*emphasizes a process in which values are articulated and used to identify decision opportunities, as opposed to alternative-focused decision-making that solve decision problems by choosing between alternatives'* (Section 6.4.4.3).

Numerous constructs of value creation could be defined, such as the ICT4D value chain of Heeks (2014b); some further examples are provided in Chapter 6. As before, this work is not prescriptive in terms of the manner in which value creation should be expressed. However, the essence of value creation should be captured, that is, an indication should be given of the various steps that are employed to change something through the ICT4D intervention, and how the steps are organised to create value.

Element description

Purpose
Obtain clarity, visibility, and agreement among stakeholders of the manner in which value will be created by the intervention, in such a way that a critical path towards value becomes clear

The element could be addressed by debating and answering the following questions:

1. *Describe your path towards value creation: that is, on what premise are you creating value; what needs to happen and in which order (if any)? What value is created at each step?*
2. *Where is the focus of the intervention, as per its current definition? Does the scope of the intervention align with the scope of value to be created?*
3. *Where along the process are critical risks or disablers to sustained benefit, as the intervention is currently defined?*

All questions are answered relative to the construct that the decision-makers choose to define in Question 1.

The ICT4D value chain of Heeks is used for the purpose of illustration in this element description. However, any other conceptualisation could be considered.

Question 1: Describe path towards value creation

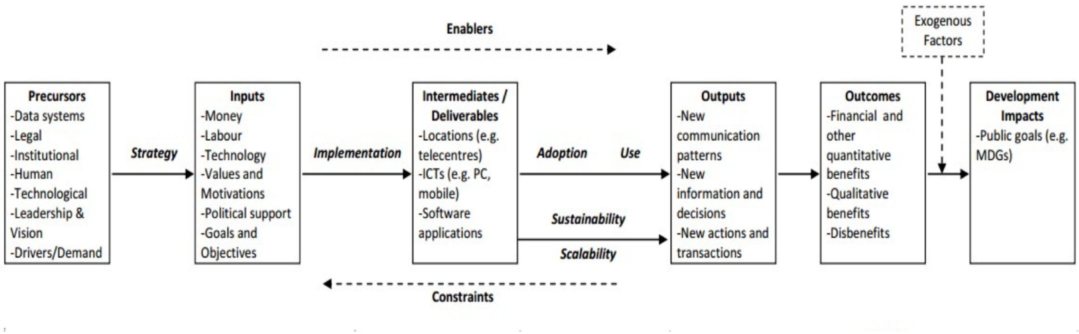


Figure 9.8 ICT4D value chain (Heeks, 2014b)

The ICT4D value chain could be replaced with any other, such as Roduner's interpretation of the agricultural value chain in International Development (Roduner, 2005:13; see Section 6.4.4.1).

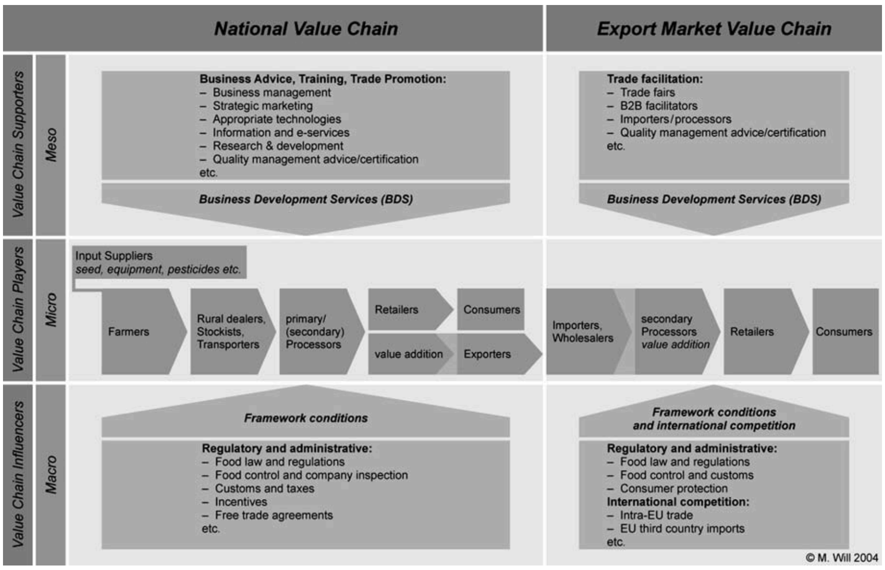


Figure 9.9 Agricultural value chain (Roduner, 2005:13)

This representation places the value chain in a broader context of influencers and enablers.

Depending on the application, less linear constructs such as networks of value creation or circular (iterative) paths could also be considered.

Question 2: Where is the focus of the intervention, as per its current definition? Does the scope of the intervention align with the scope of value to be created?

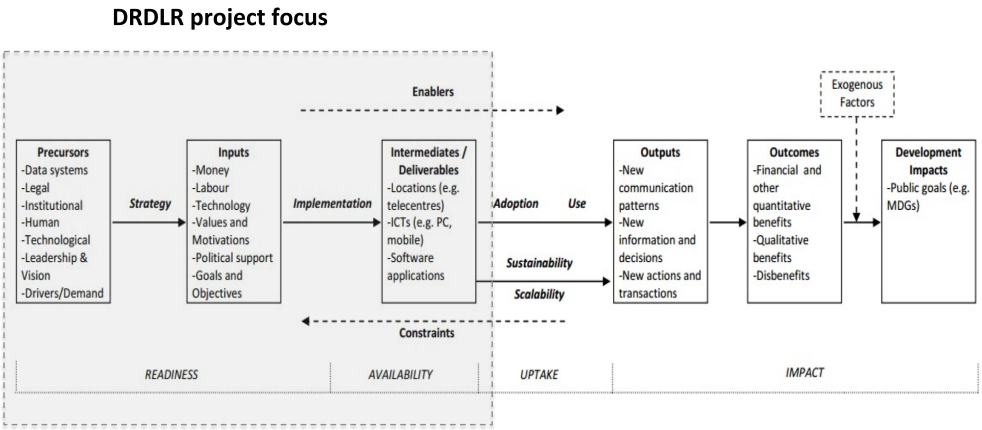


Figure 9.10 Project focus along the value chain (example: ICT Hubs)

This representation of the focus of the ICT Hub project emphasises the disjunct between the limited scope of the project and the way in which value is ultimately to be created. This disjunct emphasises the need for strategies that bridge the gap and ensure that value creation moves beyond the availability of technology to uptake and impact.

Question 3: Where along the process are critical risks or disablers to sustained benefit, as the intervention is currently defined?

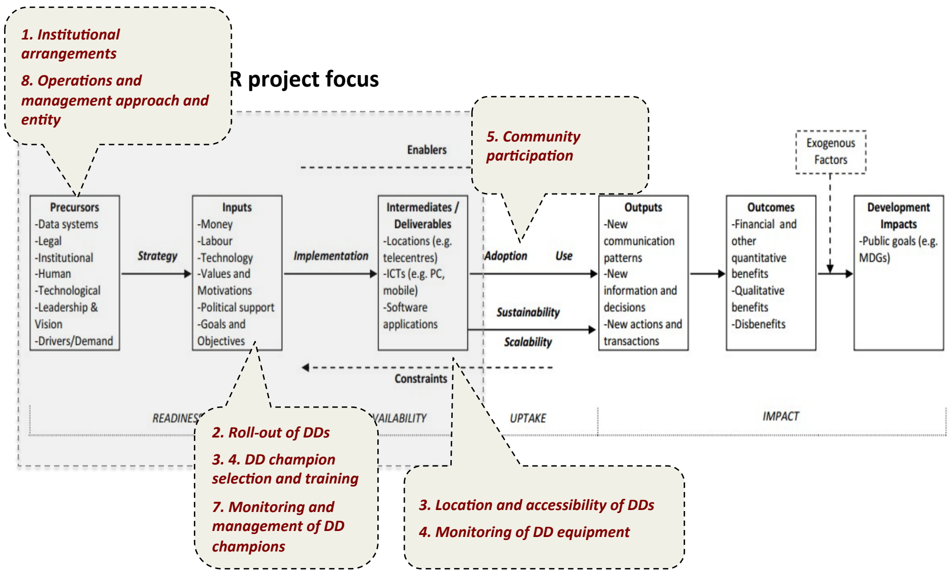


Figure 9.11 Critical enablers and disablers (example: ICT Hubs)

The critical enablers and disablers were identified from an M&E assessment of the ICT Hub project towards the end of its life cycle. It emphasises the key points with which the project was struggling at the time of assessment. Should these be identified upfront, appropriate mitigation mechanisms could be instituted. The benefit in highlighting this relative to value creation lies in the emphasis that is placed on the loss of value (and hence investment) activities that are critical to sustain benefit, are not managed.

The assessment of this element could be guided by the following questions:

Interpretation
Is the process of value creation clear and shared with all stakeholders? Is the scope of the intervention covering all intended benefits? If not, are mechanisms in place to bridge intervention activities to ensure future benefits? Are risks and disablers known and managed?

9.4.2.5. Element 3: Understand the system's decision capacity

Background

The key assumption of this element is that the combination of decisions that are made has a significant influence on the outcome of the ICT4D intervention (see Blenko et al., 2010; Pinson & Moraitis, 1996; Section 6.3.2.2).

It is further assumed that:

- The visibility of all decision-makers and a focus on the impact of their decisions will reduce conflict and improve alignment towards a common goal;
- Decisions are made in the context of an (organisational) system, which needs to be considered for improved outcomes (Snowden & Boone, 2007);
- Visibility of decisions along a process of value creation will ensure that appropriate decisions are taken; and
- Appropriate use of decision support tools and mechanisms can improve success (Courtney et al., 2013).

The focus on decision-making predominantly takes an organisational perspective on sustainability, in alignment with the view of Batchelor et al. (2003) that institutional sustainability is achieved when prevailing structures and processes have the capacity to perform their functions over the long term (Batchelor et al., 2003, as quoted by Talyarkhan, 2004) and that of Russow and Schoemaker (2002:3), who state '*your best hope for a good decision outcome is a good decision process*'.

Finally, this element considers decision-making in the context of a *network*. This is aligned with the work of Rick Davies, who suggests that network models are appropriate to apply for operational benefits in the following situations (Davies, 2003, as quoted by Ramalingam, 2011):

- Where there are many actors (people and/or organisations) who are fairly autonomous and where there is no central authority;
- In large projects with many stakeholders, rather than small projects with few, where a single authority is less likely to be found;
- In projects with no single objective but many alternative and/or competing objectives; and
- In projects deliberately designed to function as networks.

Element description

Purpose
Understand the influences of the multiple role players on decision-making and value creation, and mitigate the influences that oppose value creation

The element is described with a view of capturing its networked nature, and the influences of decisions on value creation. The following questions are considered:

1. *Who are the role players and what is their sphere of influence?*
2. *What decisions are made (and what gaps are there) in support of value creation?*
3. *What decision support tools could be useful to support value creation?*

Some examples of responses to these questions are presented here. As before, these are not intended to be prescriptive.

Question 1: Who are the role players and what is their sphere of influence?

a. Network map

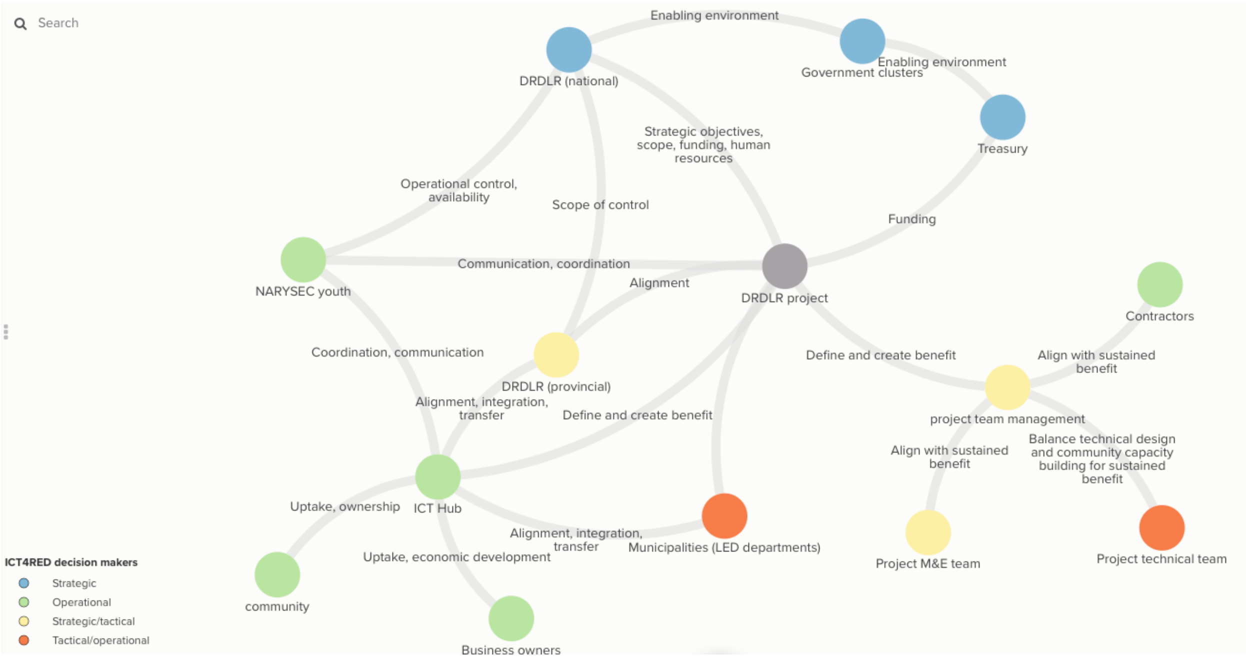


Figure 9.12 Network map (example: ICT Hubs)

This network map represents the decision-makers (nodes), their role in decision-making (links), and who influences whom (connected nodes). It could be used to ensure that all role players are connected (and involved) in the relevant decision-making, and to communicate the full complement of decision-makers to all stakeholders. This would ensure role clarity and facilitate coordination within the network. Role players that are not adequately connected or considered in decision-making would be visible.

The differentiation between strategic, tactical, and operational roles (node colours) further aid in ensuring that the appropriate role players are involved at the various levels of decision-making, and that the relevant role players across different levels are engaged when specific decision problems are addressed.

b. Sphere of influence

This representation primarily highlights the level of decision-making of different stakeholders. It can be used to make the extent of stakeholders visible to all, and to assess the completeness of the involvement of decision-makers in resolving issues related to the intervention.

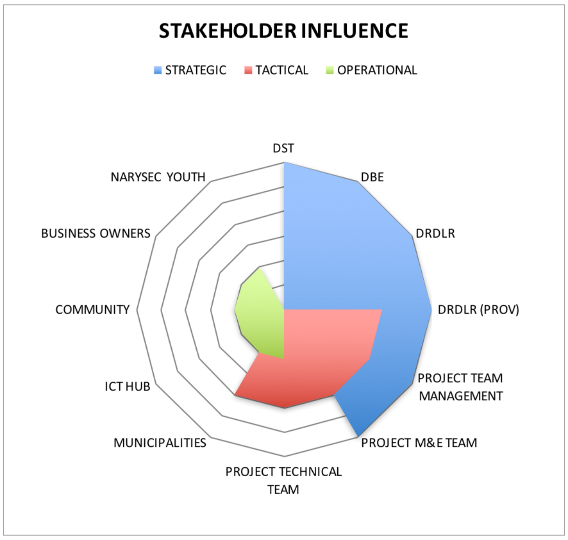


Figure 9.13 Stakeholder influence (example)

c. Decision-makers and their role in value creation

The representation in Fig. 9.14 was developed to demonstrate a possible presentation of decision-makers relative to a process of value creation. It outlines which decision-makers are involved with which part of value creation, as well as how they are connected to each other. Note that the process of value creation is expressed here in terms of activities that collectively create value; they are not necessarily sequential.

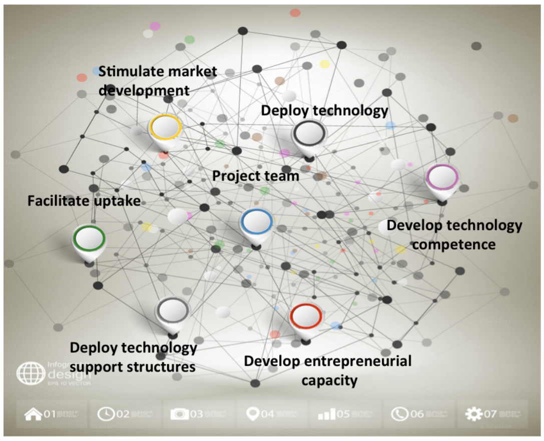


Figure 9.14 Decision-makers and value creation (example)

A potential interpretation for an ICT Hub project is given in Fig. 9.15.

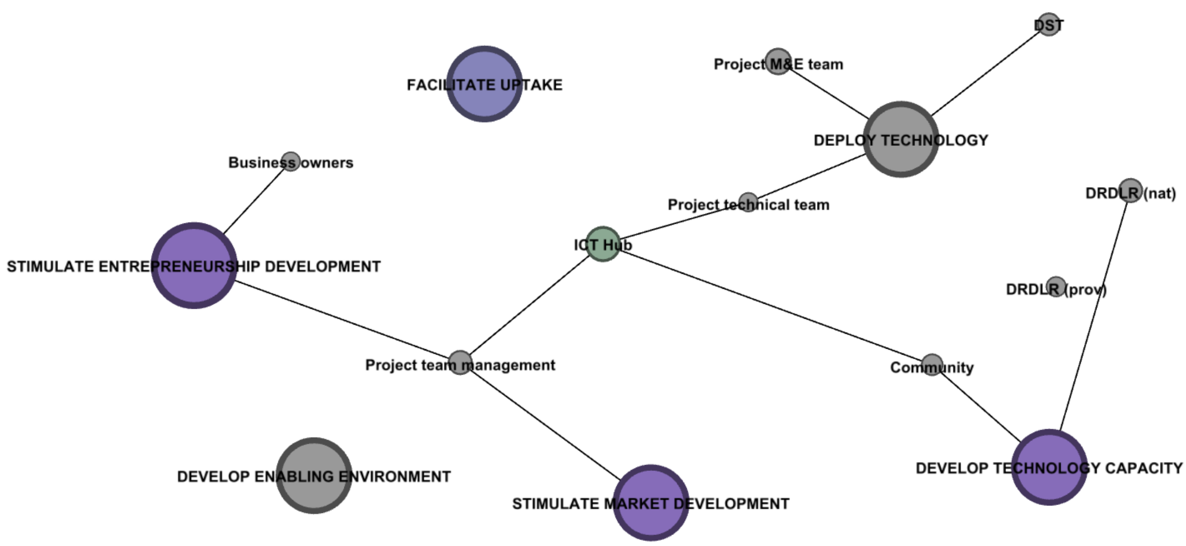


Figure 9.15 Decision-makers and value creation (example: ICT Hubs)

This representation has the value-creation activities as focus, and highlights the connection between stakeholders and value creation. It demonstrates a focus on technology deployment, with exclusion of key activities such as uptake and development of an enabling environment. Further, it highlights role players that are not connected to any value creation activities (note: they may be connected to specific phases of the project process; however, their absence from value creation activities indicate potential inefficiency, obsolescence or loss of value creation).

Making the role of decision-makers in value creation explicit allows for the relative importance of different role players in different value creation activities. It allows for some measure of prioritisation (over time if appropriate, but explicitly also over process).

In addition, it allows for value creation to be expressed as a non-linear process (compare other representations under question 2), and as an (often unknown) path towards value creation. As such, it is aligned with incremental, non-linear views of development such as Bricolage (Ciborra, 2002; Section 6.4.5.4), as well as with the need expressed by Davies (2003) to pay attention to ecological rather temporal relationships when representing and analysing development aid interventions.

Question 2: What decisions are made (and what gaps are there) in support of value creation?

The representation in Figure 9.16 indicates the key strategic, tactical, and operational decisions that are made along the construct of value creation, as well as the requirements that need to be in place to facilitate these decisions.

It highlights critical decisions that need to be facilitated between the relevant decision-makers, as a matter of priority, to ensure that value creation takes place. This mechanism is key in an environment of multiple, uncoordinated decision-makers; it aims to create value by focusing individual decision-making towards joint decision-making.

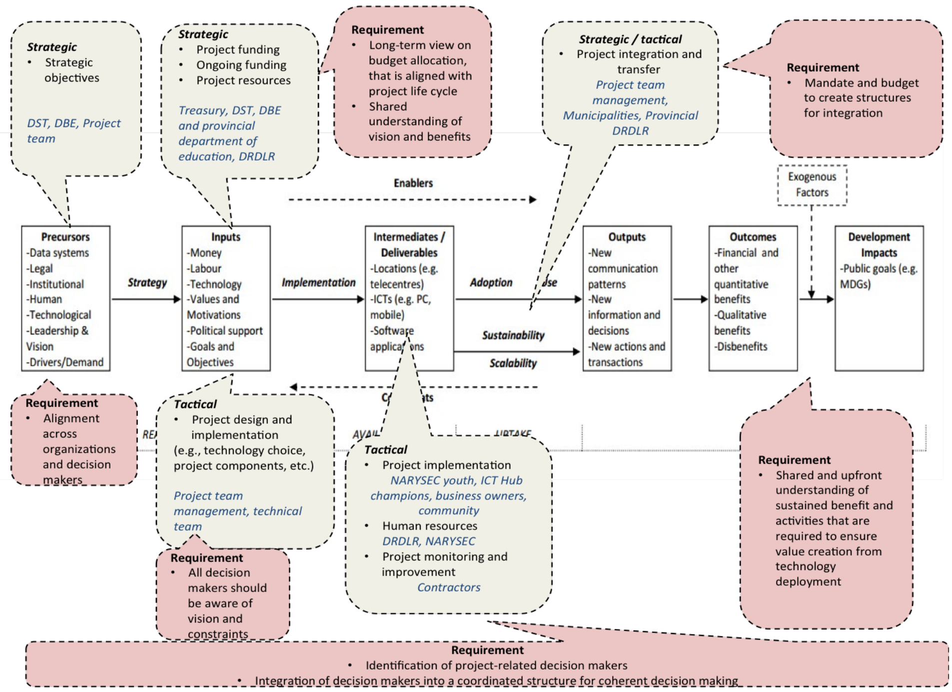


Figure 9.16 Critical decisions in support of value creation (example: ICT Hubs)

Question 3: What decision support tools could be useful to support value creation?

Decision support tools or models have been discussed as mechanisms that could enhance decision-making in complex decision problems (Section 6.3; Chapter 5). This question structures decision support tools relative to the construct of value creation. As such, it serves to put the tools in perspective to each other. This allows decision-makers to appropriate results from decision support tools appropriately. For example, an over-focus on a cost model, without equal attention to support of other critical decisions, could constrain overall value creation. In addition, it allows for critical (omitted) decision support mechanisms and tools to be identified.

As an example, Fig. 9.17 presents decision models along a chain that depicts value for money in the ICT Hub project (Chapter 8).

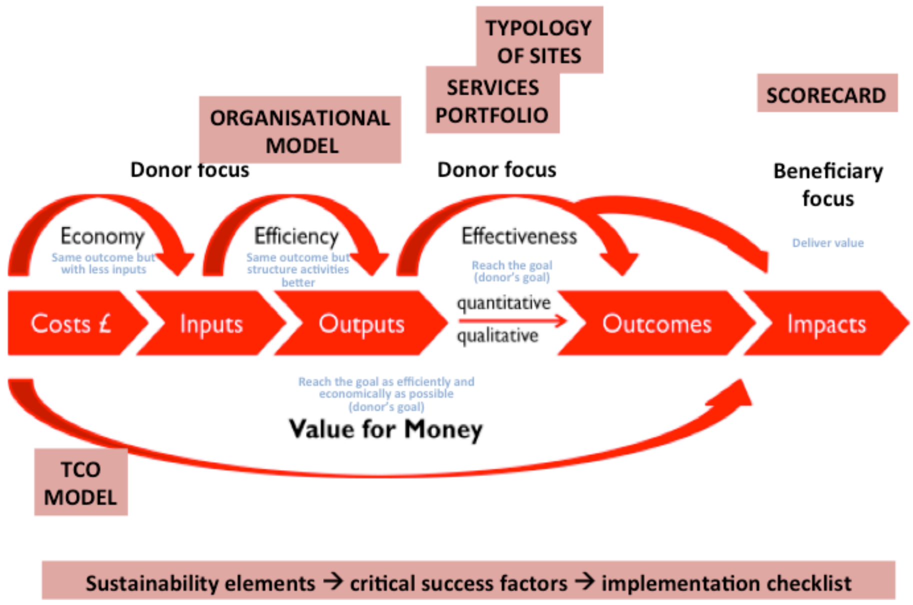


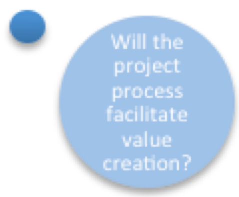
Figure 9.17 Decision support tools in support of value creation (example: ICT Hubs)

The discussion related to this element (the decision capacity of the system) can be debated by the following questions:

Interpretation
Are all stakeholders and their influences on each other known?
Are their involvement and influence in individual (value-affecting) decisions understood?
Are all (relevant) stakeholders engaged when specific decisions are taken?
Are plans in place to address the decisions that are not currently addressed?
Are plans in place to mitigate decisions and influences that distract from value creation?
Are decision support tools or mechanisms defined and used to add value, where appropriate?

Element 4: Ensure an enabling project process

Background



While the main focus of this research is decision-making and sustained benefit, the project process is seen as an important enabler or disabler of value creation (e.g., 8.4.3.1). Specifically, it is assumed to have the potential to facilitate or frustrate coordination between relevant decision-makers at appropriate points in time. In addition, its structure may or may not support the inherent nature of the development process, which is not necessarily linear.

Most (external) ICT4D interventions are conceptualised in terms of a project process, thus emphasising the need to consider project process as an integral part of the framework. This is, for example, recognised in the RABIT framework – in which an understanding of systemic influences 'is linked to concrete stages of the project cycle' (Ospina & Heeks, 2016:5). The need for a focus on project process is further confirmed by the view that standard project management processes are not appropriate, given the peculiarities of development projects (Ciaghi et al., 2014).

This framework element is expressed in terms of a checklist of project characteristics that are considered to be conducive to sustained benefit. The characteristics of ***readiness***, ***transfer***, and ***flexibility*** were derived from literature as well as project experience (see Section 8.4.3.1; Meyer et al., 2015). In Chapter 6, it was stated that the project process should differentiate between the readiness of different project participants, allow for iteration of (selected) project elements, and be flexible *in terms of what is delivered* – all of which implicate flexibility in process-level decision-making (Section 6.5.2).

This element assumes that the project process should accommodate non-linearity, be flexible and adaptable to differences in the readiness of implementation environments, and facilitate a shared and common goal. These characteristics are supported by views on a development process that is incremental and iterative, such as bricolage (Ciborra, 2002), as well as definitions of sustainability as 'dynamic and context dependent, hence giving it a process focus' (Larsson & Gronlund, 2014:146). As noted earlier (Section 3.4.4.4), such views are also in support of the concept of pathways towards a desired state (rather than linearity), and the possibility of continuous correction of the process and adjustment to a dynamic environment (Pade et al., 2006; Pouezevara et al., 2014; Walton & Heeks, 2011).

Element Description

This element prompts the decision-maker to deal with the following two questions:

Purpose

Ensure that the project process allows rather than frustrates decision-making towards value creation

1. *Is the project process enabling benefits to be sustained?*
2. *Is decision-making enabling or disabling the project process?*

Examples of how these questions could be approached are given below:

Question 1: Is the project process enabling benefits to be sustained?

It is proposed that the project process be evaluated against a number of characteristics (see discussion above). The extent to which the various characteristics are addressed could be assessed in the following checklist (an example rating is given here), and results could be represented graphically as in Figure 9.18:

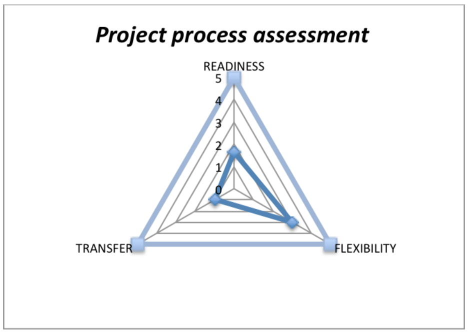


Figure 9.18 Project process assessment (example)

Table 9.10 Example: Ensuring an enabling project process (see discussion above)

Ensuring an enabling project process	1	3	5
Readiness			
Process allows for readiness assessment		x	
Intervention design allows for different levels of readiness	x		
Intervention design allows for appropriate sequence of tasks; for example, technology access should not be available without appropriate preparation, etc.	x		
Average		1.67	
Flexibility			
Project process has a modular nature		x	
Intervention design allows for learning and adaptation			x
Monitoring and evaluation pro-actively informs decision-making at all levels	x		
Average		3	
Transfer			
Intervention design allows for structures to transfer the intervention	x		
Intervention design allows for timeous transfer	x		
Intervention design addresses the appropriate scope of the ICT4D value chain	x		
Average		1	

This assessment is an example of how project process elements can be assessed, and corrected before project implementation. It calls for a consideration of the fundamental nature of the project process, and adaptation thereof to the specific ICT4D intervention. The intent is, amongst others, to highlight process inadequacies in cases where a traditional, linear project process is applied to a development intervention.

Question 2: Is decision-making enabling or disabling the project process?

This question aims to highlight potential conflicts in decision-making (relative to the project process) that will affect the ability to sustain benefits. The intent is to represent the influence of different decision-makers on the project process. Various representations can be employed, for example:

BUILD → OPERATE → TRANSFER

	PROJECT CONCEPTUA-LISATION	(ICT) SOLUTION DESIGN	TECHNICAL DEVELOPMENT	IMPLEMEN-TATION	TRANSFER OF ICT SOLUTION	ONGOING OPERATIONS
DONOR/PROJECT OWNER	Clarify objectives	Define services to be delivered Community participation	Community participation	Manage ad-hoc (political) requests Community engagement	Stakeholder liaison National-provincial alignment Community engagement Local political context	
IMPLEMENTA-TION AGENCY	Clarify objectives Internal cooperation & communication					
PROJECT TEAM	Clarify objectives Enhance existing development activities ICT policy awareness Involve team in proposal Project champion	Holistic approach CSIR processes Training & capacity building Plan for customisation Appropriate technology & software	Strategic management Governance Supplier relations Resource planning	Visibility of roll-out plan Pre-installation site visit Enroll NARYSEC youth Customise & contextualise Community readiness & uptake	Understand local political context Ensure working hardware & software	
IMPLEMENTATION STRUCTURE	Project champion	Financial objectives Service offering Funding model Critical costs to cover Ownership model Governance Authority		Vision & purpose Project champion Location	HR Operations Ongoing support	Ongoing support Sustain working hardware & software Involve local competencies

Figure 9.19 Influence of decision-makers on the project process (example: ICT Hubs)

This assessment is similar to that of the influence of decision-makers on value creation (Framework element 3). It seeks to highlight gaps in decision-maker involvement on the project process, and to identify decision-makers that are critical to specific project elements. In this example, a linear project process is assumed. However, similar analyses should be done for non-linear processes. The following questions could be debated to ensure that the project process is in support of sustained benefit:

Interpretation
Do the characteristics of the project process facilitate benefits to be sustained? Is the influence of all relevant stakeholders on the project process understood? Are all relevant stakeholders engaged in each step of the project process? Are mechanisms in place to strengthen the capacity of decision-makers relative to the project? Are critical decision-makers and their (positive or negative) influence on the process recognised and managed Are the gaps or negative consequences of decision-making clear to all stakeholders? Are these gaps mitigated and/or managed?

9.5. FRAMEWORK APPLICATION

The intended manner of application of the initial decision framework was described in Section 6.5.3, at a somewhat high level. Subsequently, the application of the framework to two case studies concluded that more detail should be provided. This is contained in the *toolkit* presented here. In practice, the four elements of the framework need to be examined to assess the capacity of the stakeholders associated with the intervention to sustain benefits. The toolkit presented here provides an example of how these four elements could be assessed and debated.

As indicated before, the intention is that the framework primarily be applied during the planning phase of the intervention, but also during implementation. The assessment of each element of the framework is intended to generate new views on the implementation, such as:

- Visibility of, and agreement on, the benefits that are to be sustained;
- Agreement on the manner in which value is created;
- Visibility of decision-makers and their influences on value creation and project process;
- Gaps in the involvement of, and coordination between, decision-makers; and
- The appropriateness of the project process as a vehicle within which sustained benefit can be facilitated.

These views should lead to changes into aspects such as the intervention approach, the manner in which stakeholders interact, the scope of the intervention, and the focus on value creation throughout the project process. Repetitive applications would confirm on-going alignment between stakeholders, and allow for project mechanisms (e.g., communication and coordination processes) to be refined.

9.6. SUMMARY

The aim of this chapter was to integrate the findings of the two case analyses in Chapters 6 and 7, and to revise the initial decision framework based on the findings of a cross-case analysis. As such, it was concerned with providing a revised framework in response to the main research question of the thesis, namely:

What are the elements of a framework that support strategic decision-making for the design and implementation of ICT4D interventions in resource-constrained environments, in support of sustained benefit?

The analysis first comprised a cross-case comparison of earlier case analysis findings (Section 9.3.1), followed by an interim evaluation of the initial framework (Section 9.3.2). The results of these two activities were integrated into a revised decision framework (Section 9.3.3). Revisions to the framework addressed its structure, content, application, as well as the project process.

A key recommendation of the analysis comprised the integration between framework elements. This was addressed by adding an element that has a systemic focus, and that serves to integrate the remaining elements by highlighting the effect on systemic change (Section 9.4.1).

Another key recommendation included the need to provide more detail, so that the application of the framework and its use to practitioners is clear. This was done by developing the toolkit *Decisions that Sustain Benefit* (Section 9.4.2). As outlined during the definition of the research problem, the framework is intended for use as a *guideline* within which practitioners can '*develop their own approach to the design of ICT4D projects and programmes* with a view of creating benefits that last' (Section 2.3.3). Instead of being prescriptive, the purpose of the toolkit is therefore to demonstrate how the framework could be applied in practice. For each element, background is provided as an explanation and reminder of the theory in support of the element, and the assumptions that are made. The element is then described in terms of its purpose, examples of how it can be analysed, and a summary of key questions to be debated.

The chapter concludes with comments pertaining to framework application. At this point, the framework was developed from a review of the literature, and revised based on the application of two case studies and an interim self-evaluation. While practical experience has been incorporated in the development process, it has not been opened to scrutiny by external parties. Next, the framework will be provided to development practitioners for comment and input. This is discussed in Chapter 10.

CHAPTER 10. REVISION OF INTERMEDIATE FRAMEWORK

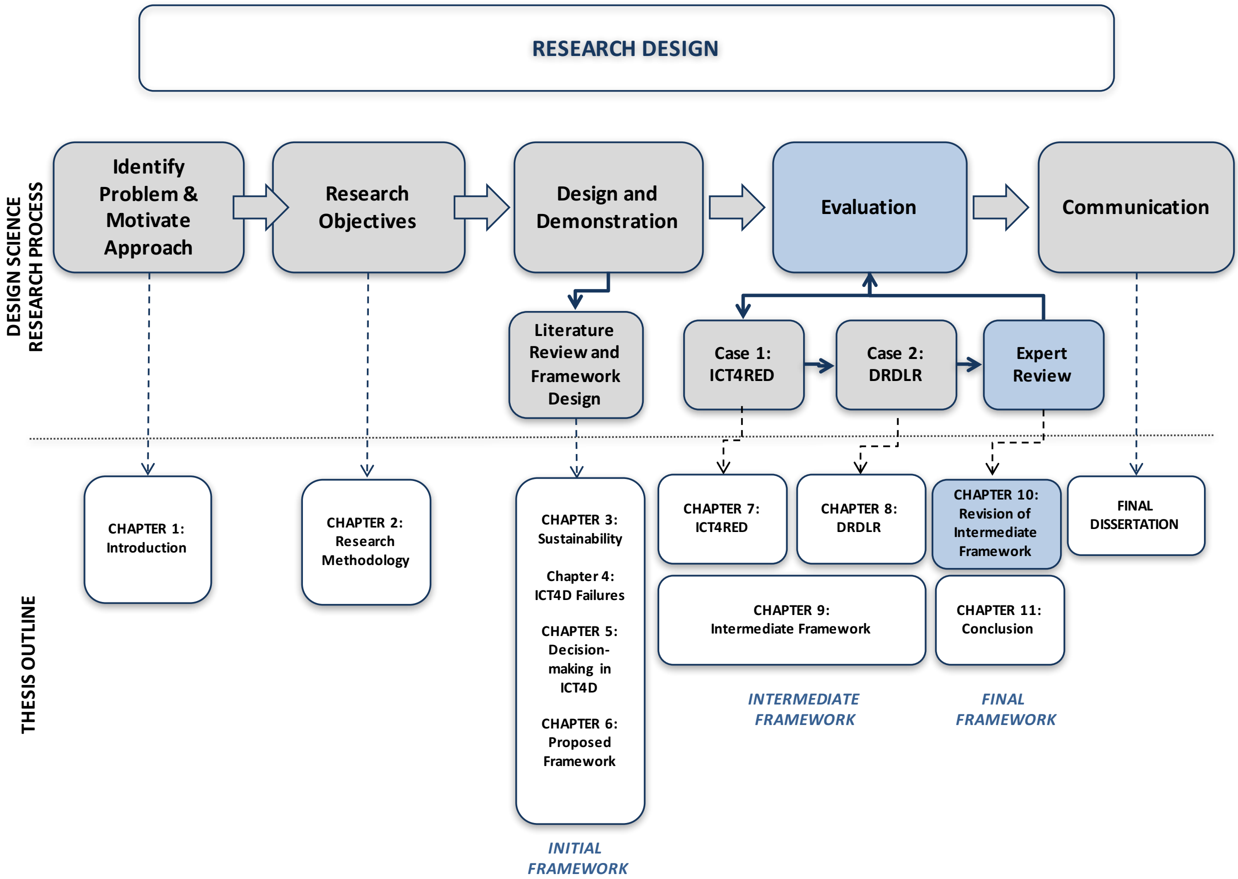


Figure 10.1 Research process and thesis outline: Chapter 10

10.1. INTRODUCTION

Based on the cross-case analysis of Chapter 9, the initial decision framework was revised into the intermediate decision framework. Thereafter, the revised framework was presented to experts for their review and comment. This chapter discusses the expert review process, and the subsequent recommendations. Expert feedback was used to make an assessment of the extent to which the decision framework succeeds in answering the main research question, namely,

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

The expert review was used to identify changes to the intermediate framework, as well as areas for future research. As such, it functioned as a *formative* evaluation.

In addition, the expert review informed the development of the final decision framework. As such, it forms part of the *final* or *summative evaluation* of the design science research process, which is depicted as the second-last step in the development of the artefact (See Figure 10.2).

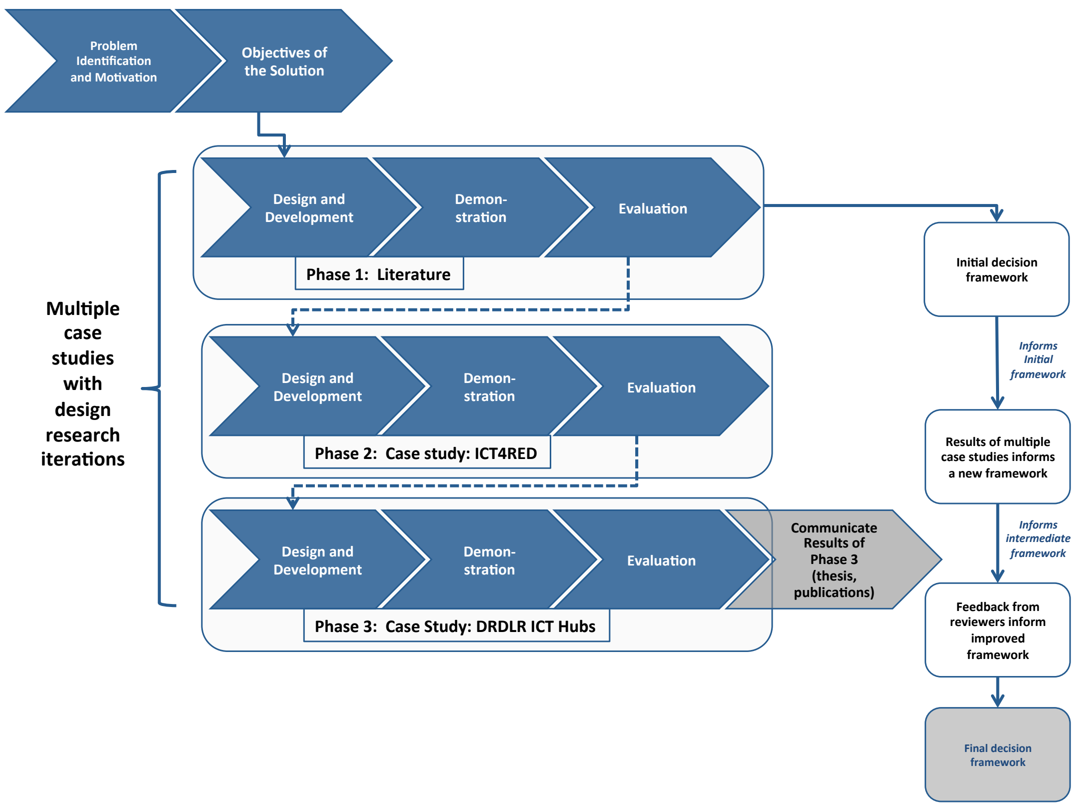


Figure 10.2 Design research iterations in this project (from Herselman & Botha, 2014; Peffers et al., 2007)

This chapter firstly discusses the expert review evaluation method, outlining both the approach to the review and the review instrument (Section 10.2). Thereafter, the experts' feedback is represented and interpreted (Section 10.3). This is followed by a discussion of the implications for the decision framework, either in terms of changes to the framework, or through identification of opportunities for further work (Section 10.4). A reflection on the expert review process is presented in Section 10.5, while Section 10.6 summarises the chapter.

10.2. EVALUATION METHOD

10.2.1. Approach

Different authors express the purpose of evaluation in Design Science and Design Science Research in different manners. For example, Sein et al. (2011:39) position the role of evaluation after artefact building to 'assesses whether the intended outcomes were realized'. Pries-Heje and Barkerville (2008:12) indicate that 'justification and evaluation of the resulting artefacts should focus on whether the artefact operates in the problem setting', while Gregor and Hevner (2013:351) identify a number of criteria in terms of which the artefact should be evaluated, and indicate that 'any evidence for the worth of the artefact should be given'.

In addition, it is worth noting that evaluation of artefacts in Design Science is seen as an iterative process (Carlsson et al., 2011; Sein et al., 2011), leading to 'evidence saturation' (Carlsson et al., 2011:117). An *appropriate* rather than *optimal* solution is sought. This is particularly relevant in instances where the artefact that is developed represents a new contribution to the IS field, rather than a repetition or improvement of existing work. In such cases, where nothing exists against which to compare the artefact, its adequacy rather than its optimality is relevant (Carlsson et al., 2011).

These somewhat varying statements leave the researcher with the challenge to develop an appropriate and consistent manner of evaluating the artefact under consideration.

In Chapter 2, an approach to the evaluation of the product of this research was defined, based on an integration of the work on artefact evaluation in Design Science Research by Prat et al. (2014) and Venable et al. (2016). The derived approach was translated into a four-step evaluation strategy (Table 2.7). This, in turn, was translated into an evaluation method (Table 2.8) and an evaluation process (Section 2.6.4).

The evaluation process derived in Chapter 2 defined the following steps (See Section 2.6.4):

- *Three formative evaluations are undertaken during the development of the artefact (case studies, **expert review**).*
- *Each evaluation will assess the usefulness of the decision framework at the particular stage of its development (initial, intermediate), and expand the design.*
- *Case studies: the case study evaluations will be done by the researcher.*
- ***Expert review: a final formative evaluation will be done by researchers and practitioners that have not been exposed to the artefact during its development process. While this evaluation may inform the decision framework, some pointers may be left for future research. It is therefore of a formative as well as summative nature.***
- *The evaluation instrument will evaluate the properties identified through Prat et al.'s (2014) systems evaluation approach.*

This chapter discusses the *expert review*, and this section describes the derivation of the evaluation instrument that was used for the expert review. By employing both case studies and an expert review, the evaluation process supports the assertion by Gregor and Hevner (2013:351) that multiple techniques should be used to provide 'any evidence for the worth of the artefact'.

An expert review provides the opportunity to assess the potential usability of an artefact, without involving the end users thereof (Agerfalk, 2003), and constitutes an accepted method to 'gather meaning, experiences and insights from (domain) experts' (Moonen & Von Hillegersberg, 2011:148). Experts 'are more adept at assessing possibilities, judging problems, and proposing solutions' (Chen et al., 2011:5), and have the ability to evaluate systems that are in the early stages of development (Chen et al., 2011). Expert reviews have been proven to be efficient in a number of Information Systems applications (e.g., Bertelson, 2004; Korhonen, 2010).

Chapter 2 culminated in the identification of the properties of the artefact to be evaluated, based on the work of Prat et al. (2014) and Venable et al. (2016). As such, the evaluation approach comprises a goal-based, criteria-based evaluation, which is well suited to an expert review approach (Chen et al., 2011). In developing an instrument by which to conduct the expert review, these properties, as well as the criteria for artefact evaluation put forward by Gregor and Hevner (2013), were considered. The latter include validity, utility, quality, and efficacy. The development of the expert review instrument is outlined in Section 10.2.2.

10.2.2. Expert review survey instrument

The properties that were identified in Chapter 2 for the evaluation of the artefact are repeated in Table 10.1 for convenience. For each of the properties of the artefact, the way in which it should be interpreted for this research (i.e., for evaluation of the decision framework) is outlined.

Table 10.1 Properties of artefact to evaluate, based on systems evaluation (from Prat et al., 2014)

Property	*Description*	*Applied to this decision framework*
Goal	Efficacy, validity, or generality of the framework	Is the framework effective in its goal of aiding decision-making, does it produce a valid outcome, and is it applicable to more than one decision situation?
Environment	Consistency of the artefact with the environment (people, processes, technology)	Is the framework eliciting decision-making that is relevant to the people, processes, and technology that are involved in the decision problem?
Structure	Completeness, simplicity, clarity, style, level of detail and consistency of the artefact	Have critical elements been omitted from the decision framework?
Activity	Completeness of function, consistency of activity, accuracy and performance of the artefact	Is application of the decision framework yielding a usable and useful result?
Evolution	Robustness and learning capability	It is possible to change the instantiation of the decision framework, based on learning that comes to light during its application?

In their discussion on how to position Design Science Research for maximum impact, Gregor and Hevner (2013) identify four criteria for the evaluation of an artefact:

- ***Validity*** refers to goal achievement, and assesses whether the artefact *'…work(s) and does what it is supposed to do; and is it dependable in operational terms in achieving its goals.'* (Gregor & Hevner, 2013:351).
- ***Utility*** refers to its usefulness in multiple environments, and can be assessed by the following: *'Does the achievement of goals have value outside the development environment?'* (Gregor & Hevner, 2013:350–351).
- While ***quality*** and ***efficiency*** are listed but not explicitly defined, it is assumed that these refer to the usual interpretations of delivering a good and comprehensive answer (quality) and doing so in an optimal (least wasteful) manner.

In Table 10.2, Gregor and Hevner's (2013) criteria for artefact evaluation are interpreted in terms of the evaluation properties derived in Chapter 2.

Table 10.2 Mapping of Gregor and Hevner's (2013) criteria to the properties for framework evaluation

Property	Description	Applied to this decision framework	Evaluation criteria (Gregor & Hevner, 2013)
Goal	Efficacy, validity, or generality of the framework	Is the framework effective in its goal of aiding decision-making, does it produce a valid outcome, and is it applicable to more than one decision situation?	Validity Utility (generality)
Environment	Consistency of the artefact with the environment (people, processes, technology)	Is the framework eliciting decision-making that is relevant to the people, processes, and technology that are involved in the decision problem?	Quality Utility
Structure	Completeness, simplicity, clarity, style, level of detail and consistency of the artefact	Have critical elements been omitted from the decision framework?	Validity Quality Efficiency
Activity	Completeness of function, consistency of activity, accuracy and performance of the artefact	Is application of the decision framework yielding a usable and useful result?	Validity Quality Efficiency
Evolution	Robustness and learning capability	It is possible to change the instantiation of the decision framework, based on learning that comes to light during its application?	Utility Efficiency

While the criteria have been interpreted and applied in Table 10.2 in their broadest context, it was possible to allocate all the criteria across the various properties that have been identified for framework evaluation. These properties therefore collectively address the criteria proposed by Gregor and Hevner. As such, the five properties in Table 10.2 are used as a baseline for the development of an expert review instrument, which was derived by translating the different properties into seven survey questions. These questions are outlined in Table 10.3. For each property, the original interpretation as well as the survey question is listed.

The process by which data were collected, as well as a description and interpretation of results, are discussed in Section 10.3.

Table 10.3 Derivation of survey questions

<table>
<tr><th>Property</th><th>Description</th><th>Applied to this decision framework</th><th>Relevant evaluation criteria of Gregor and Hevner (2013)</th></tr>
<tr><td>Goal</td><td>Efficacy, validity, or generality of the framework</td><td>Is the framework effective in its goal of aiding decision-making, does it produce a valid outcome, and is it applicable to more than one decision situation?</td><td>Validity
Utility (generality)</td></tr>
<tr><td colspan="4">Survey question 1: Rate the extent to which the framework will enable practitioners to:
• Understand the influence of the various stakeholders on decision-making
• Make each stakeholder's perception of benefit visible
• Develop agreement on the benefits to be sustained
• Adjust project planning towards sustained benefit
• Enhance the ability to sustain benefits from an ICT4D implementation
(not at all; undecided; somewhat; good; excellent)</td></tr>
<tr><td>Environment</td><td>Consistency of the artefact with the environment (people, processes, technology)</td><td>Is the framework eliciting decision-making that is relevant to the people, processes, and technology that are involved in the decision problem?</td><td>Validity
Utility (generality)</td></tr>
<tr><td colspan="4">Survey question 2: Rate the extent to which the framework is relevant to the following aspects to ICT4D problems:
➢ People: The community of decision-makers that affect the ability to sustain benefit
➢ Process: The spectrum of processes and organisational structures that affect the ability to sustain benefit
➢ Technology: The spectrum of technologies that could be applied in ICT4D problems
(not at all; somewhat, but not sufficient; undecided; relevant; very relevant)</td></tr>
<tr><td>Structure</td><td>Completeness, simplicity, clarity, style, level of detail and consistency of the artefact</td><td>Have critical elements been omitted from the decision framework?</td><td>Validity
Quality
Efficiency</td></tr>
<tr><td colspan="4">Survey question 3: How relevant is each of the following framework elements to the goal of guiding decision-making towards sustained benefit?
(not at all; somewhat relevant; neutral; relevant; very relevant)

Survey question 4: How important is each of the following framework elements to the goal of guiding decision-making towards sustained benefit?
(not important at all; somewhat unimportant; neutral; somewhat important; very important)
➢ Understand systemic influences
➢ Define the benefits
➢ Define the approach to value creation
➢ Understand the system's decision capacity
➢ Ensure an enabling project process

Survey question 5: Have any critical elements been omitted from the framework? If so, describe the omissions? (Yes, no, unsure)</td></tr>
<tr><td>Activity</td><td>Completeness of function, consistency of activity, accuracy and performance of the artefact</td><td>Is application of the decision framework yielding a usable and useful result?</td><td>• Validity
• Quality
• Efficiency</td></tr>
<tr><td colspan="4">Survey question 6: Do you expect the framework to deliver a useful result?
(No, not at all; it could be somewhat useful; unclear; yes, it will be useful; it will be very useful)</td></tr>
<tr><td>Evolution</td><td>Robustness and learning capability</td><td>It is possible to change the instantiation of the decision framework, based on learning that comes to light during its application?</td><td>• Utility
• Efficiency</td></tr>
<tr><td colspan="4">Survey question 7: The framework leaves the way in which the various elements are implemented, open to the practitioner. As such, it allows for learning and change between different iterations of the framework. Rate the adequacy of this mechanism in enabling the evolution of the framework
(Not adequate at all; somewhat adequate; neutral; adequate; completely adequate)</td></tr>
</table>

10.3. EXPERT REVIEW

This section describes the expert review process, and analyses the data that were collected during the review. It describes the data collection method (Section 10.3.1), summarises the expert opinions (Section 10.3.2), and provides an interpretation thereof (Section 10.3.3).

10.3.1. Data collection

For this review, experts were selected from the fields of Information Systems (with a focus on ICT4D), and decision modelling and analysis or Operations Research. Practitioners and researchers, as well as individuals that function in both of these roles, were selected. Convenience sampling was used to inform the selection of experts—that is, selection of experts was based on their accessibility and ability to participate (Saunders et al., 2016). Experts therefore comprised individuals that were known to the researcher and/or the promoters of the thesis. Some experts recommended their colleagues for participation. International as well as South African reviewers were included, so as to obtain a broad spectrum of insights while acknowledging familiarity with the local environment in the review process. Experts were selected that did not have previous exposure to the work, so as to ensure a non-biased review. Eleven reviewers, with the following fields of expertise, completed the survey:

Table 10.4 Reviewers' biography

Reviewer	Field of expertise	Role	Years of experience	Local / International
Reviewer 1	ICT4D, rural development, decision support	Researcher, Practitioner	> 25	Local
Reviewer 2	ICT4D, decision support systems, systems thinking	Researcher	> 25	Local
Reviewer 3	Information systems, community informatics, development informatics	Researcher	> 25	International
Reviewer 4	Operations Research, Decision modelling, local government planning	Researcher	> 25	Local
Reviewer 5	Information systems, digital innovation, decision-making in health care	Researcher	> 15	International
Reviewer 6	Information systems, e-Education, Human-computer interaction	Researcher	> 10	Local
Reviewer 7	Information systems, e-Education	Researcher, Practitioner	> 25	Local
Reviewer 8	Decision modelling, Operations Research	Researcher, consultant	> 25	Local
Reviewer 9	Information systems, community informatics, social informatics	Researcher	> 25	International
Reviewer 10	Information systems research, e-readiness, mobile data services	Researcher	> 25	Local
Reviewer 11	Information systems research, telecentres, e-governance, e-democracy	Researcher	> 25	Local

Literature is not prescriptive in terms of the number of experts required to perform an expert review in information systems. The assumption is that more evaluators will identify more areas for improvement, as is the case in *Heuristic Evaluation*, a form of expert review of the usability of information systems interfaces (Nielsen, 1995).

The review comprised the distribution of an electronic questionnaire (see Appendix E), facilitated by the SurveyMonkey© web interface (SurveyMonkey, 2017). Reviewers were introduced to the research, and invited to participate, via e-mail. On agreement to participate, the link to the survey was distributed. The survey contained a brief description of the work, as well as links to a somewhat more detailed description of the various framework elements. The latter was based on the *Practitioners' toolkit* that was described in Section 9.4.2. Reviewers were assured that their anonymity would be retained during the analysis and presentation of results.

10.3.2. Summary of results

For each review question, experts' responses are summarised in a quantitative format, indicating the average rating across all experts for a specific question. In addition, key themes are identified from the comments to each question. These are differentiated into positive points (✓) and questions or omissions (*?*). For each review question, a summary is inferred, based on the responses.

10.3.2.1. Question 1: Goal

Rate the extent to which the decision framework will enable practitioners to perform the various aspects listed.

- The framework is in support of the goals listed, with the average response of all experts that is higher than 3.7 for all objectives.
- The ability of the framework to sustain benefits is considered to be high (average 4.1).

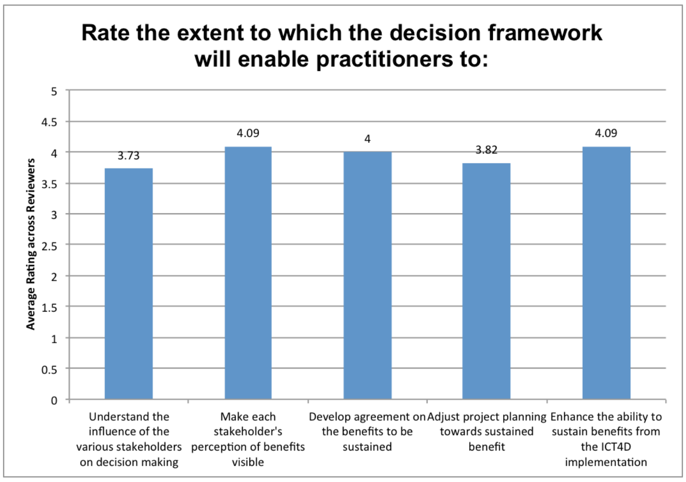


Figure 10.3 Expert review: Extent to which framework support goals

The comments that were made by reviewers are classified as follows:

Table 10.5 Expert review comments: Extent to which framework is in support of goals

Theme	Comment
✓ Well developed ? Change, power relationships	I think that overall this is good, and as far as a framework can go, I think it **well developed**. There are issues of **power and relationships**, particularly with disruptive change, that it does not appear to capture well, and I'm not sure that it can. From the start there is a need to **identify all stakeholders** including those that are potentially going to be influenced in a negative sense. Depending on the project and the nature of the context, some stakeholders may not agree with the project, its goals or the impact it will have on them. This requires **workaround strategies** or at least ways of managing their concerns, which may be more than showing the benefits but justifying the change. How will **consensus** (agreement) be reached? How do different objectives / interests / views / **agendas** get **reconciled**?
✓ Potential for risk mitigation	I think it's excellent - useful not only to practitioners but to funding/management agencies. I'm thinking particularly of the Tech4RED project, where DST was the 'funding/management agency'. The framework would have helped **them identify red flags** and would have helped them **mitigate these risks**. Instead they tried to use 'traditional' government ways of managing projects (which may work for standard, non-developmental projects), but which don't work in complex ICT4D environments - i.e., management by committee, letters of agreement/support at a political level, but without any real decision-making capacity at a government official level.
✓ Comprehensive ? Address resources?	It's a lot to absorb if you need to go to each link about each element in the survey (a lot of work for a survey). That is why I am saying 'good' rather than excellent, but it appears to **cover all the bases**. I just hope that some discussion of **resources** is in there...
✓ Value creation focus ? Demanding	I liked the framework very much...particularly the focus on **value creation**. I think it will be **demanding** on practitioners to use as it requires high levels of 'thoughtfulness' and in many cases 'speculative thoughtfulness' (!) but this is clearly **something to be encouraged** and promoted.
✓ Logical	Very **logical** flow of the process to determine and achieve sustainable benefits.
? Shared understanding of system?	I am missing a process /decision element that will ensure a **shared understanding** of the techno-socio system that is targeted, i.e., a shared /agreed on view /description of processes, flows and drivers. The summary and Element 0 only mentions 'drivers' and it might assume an agreed on systems description but I think it might be better to prompt for and **ensure such a systems description**. If there is no such shared view of the system, all other elements become a bit 'ungrounded' and open for different interpretations by different stakeholders. The ratings had been done as if such an agreed 'systems description' had been facilitated by the framework.
? Consensus?	How will consensus (agreement) be reached? How do different objectives / interests / views / agendas get reconciled?
	It is at this stage not clear how agreement will be reached. How will conflict resolution be achieved? How will communication be conducted? You mentioned '(t)he intent is that the coordinators of an ICT4D intervention would brainstorm the five elements with all the stakeholders involved in the intervention.' Your action verbs in the framework are defined, understand, and ensure. It all sounds idealistic enough but the practical aspects are not dealt with. This may, however, come through later.

Question 1: Summary

The analysis of the descriptive statistics as well as the comments indicate that the experts consider the framework to be in support of the objectives stated, potentially useful, and comprehensive. Omitted aspects include a lack of a focus on power relationships, lack of a shared, clear understanding of the system, and a lack of clarity about the manner in which resources are addressed. In addition, the manner in which consensus will be reached among stakeholders is not clear. A concern is raised about the demands that are placed on practitioners in facilitating the application of the framework.

10.3.2.2. Question 2: Consistency with environment

Rate the extent to which the decision framework is relevant to the following aspects of ICT4D problems: people, process, and technology

- The framework is considered to be relevant to the community of decision-makers, the processes, and the organisational structures that affect sustained benefit.
- Reviewers are indifferent with respect to the relevance of the framework for technology support.

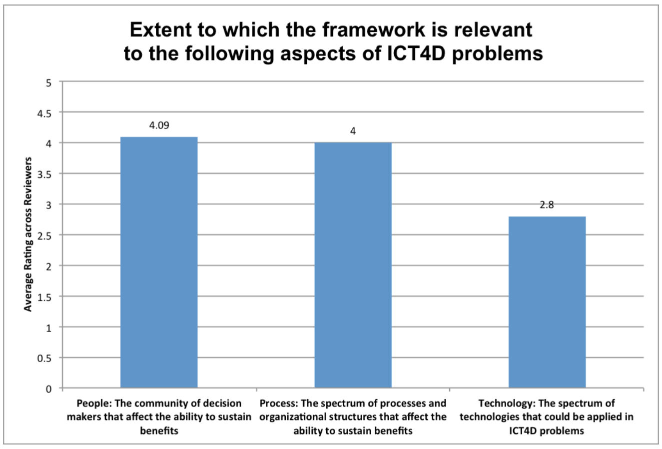


Figure 10.4 Expert review: Extent to which framework is relevant to ICT4D

Table 10.6 Expert review comments: Extent to which framework is relevant to ICT4D problem dimensions

Theme	Comment
? *Influence of external forces* ? *Spectrum of technologies*	For the first two, see my comments on the previous screen - there may be **external forces** that are not friendly to the project, but again these **may be difficult to capture**. There may also be more general market forces or government policies that may change over short periods of time and may either make some aspects of the project redundant may require changes to the way the project has been conceived. I think this is particularly the case with community-based projects in developing areas. For the third point, I don't really see where the **spectrum of technologies** available is specifically dealt with. I think that this aspect **could usefully be made more** explicit. Is the framework not **too silent or uncommitted about the specific possible technologies? Different technologies have different affordances, which may require different approaches.** I am **not sufficiently informed about the technologies** that could be applied in ICT4D to comment reliably on the last aspect. My guess would be that the framework would be relevant.
? *Managing risk in a changing environment?* ? *Early integration as indicator of sustained benefit?*	I think the main challenge is **how to manage risks** regarding people, process and technology throughout the project. Everything may start well, but there could be political **change**, people move, disenchantment (things not changing quickly enough?), etc. How do you keep people actively engaged (particularly where they are already busy with other duties)? Are some indicators for sustained benefit the fact that the **project is integrated early on into the system** (e.g., they create new structures, roles & responsibilities and processes)? (I'm feeling a bit demotivated regarding an **inherently dysfunctional system's ability to absorb any change...)**
? *Social and cultural perspectives* ? *Neutrality of value creation*	I have not found too many indications of ways in which the framework will focus attention on behaviour and **social contexts and cultural perspectives of 'benefit'**. I would also suggest a rethink on the frequent use of the term '**value creation**' and would consider something **more neutral** like '**influence exercised**'.
? *Spectrum of technologies*	Is the framework not too silent or uncommitted about the specific possible technologies? Different technologies have different affordances which may require different approaches e.g., macro-initiatives (Open Data) versus micro-initiatives (a telecentre or Mobile-agro-MOOC); software (mobile app) vs. hardware (new networking device) vs. systems (crowdsourcing).
	I didn't see anything about technologies so far - only drivers against sustainability. Did I miss something?

Question 2: Summary

The framework is consistent with the environment in its support of people and processes. However, consistency with technology support is not clear. Concerns include the influence of external forces, the ability to manage risk in a changing *environment, explicit inclusion of social and cultural perspectives, and the lack of neutrality of the use of the concept of value creation.*

10.3.2.3. Question 3: Structure – Relevance

How relevant is each of the framework elements to the goal of guiding decision-making towards sustained benefit?

- All of the elements of the framework are considered relevant to the goal of guiding decision-making towards sustained benefit, with an average score of over 4.3.
- The ability to understand systemic influences is rated as having the most influence (rating of 4.8), while an enabling project process is rated as having the least influence (rating of 4.3). Note that the ratings are within a small range of each other.

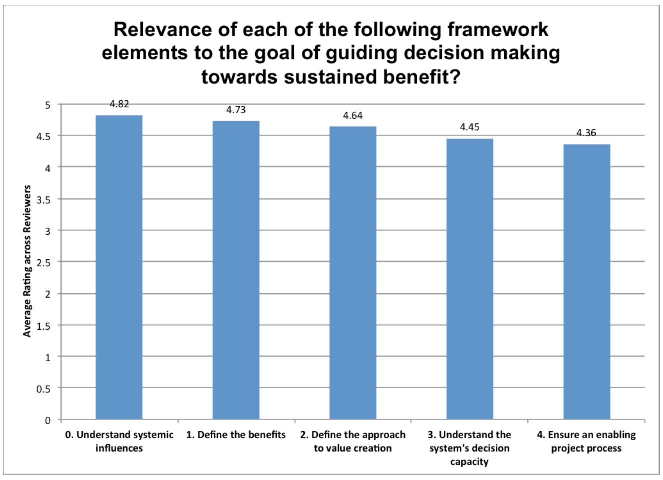


Figure 10.5 Expert review: Relevance of framework elements

Question 3: Summary

Experts consider all of the framework elements as relevant in terms of guiding decision-making towards sustained benefit. An understanding of systemic influences is rated as the most relevant, and the role of the project process as the least relevant. However, the difference in the ratings of these elements is small.

10.3.2.4. Question 4: Structure – Importance

How important is each of the framework elements to the goal of guiding decision-making towards sustained benefit?

- All of the framework elements are considered important in achieving the goal of guiding decision-making towards sustained benefit, with an average rating of more than 4.4.
- An understanding of systemic influences is considered the most

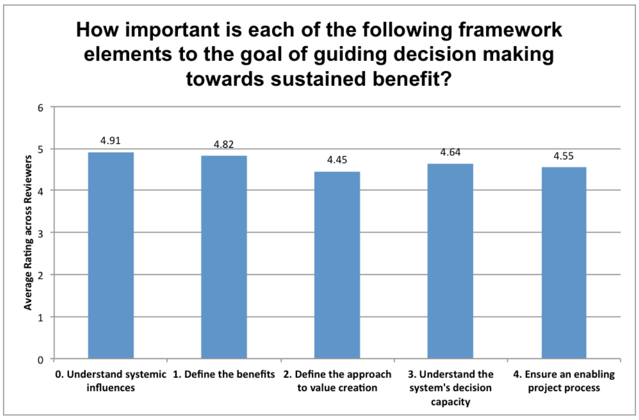


Figure 10.6 Expert review: Importance of framework elements

important (rating of 4.9), while the definition of the approach to value creation is considered the least important (rating of 4.4). As before, the ratings are within a small range of each other.

Table 10.7 Expert review comments: Importance of framework elements

Theme	Comment
✓ *All elements important*	**All very important.**
? *Relative importance?*	The above assessment doesn't give any indication of the **relative importance** of each element. I think they are all extremely important but there might be a sense in which some are more important than others (e.g., **more important to get 'right'** or have more enabling potential...with respect to the other elements).
? *Comprehensiveness of project process?* ? *Overarching logic?*	The evaluation on the importance of the various elements is being influenced by my evaluation of the various elements as described in the material given. I am currently not convinced of the **comprehensiveness** of the measures to '**ensure an enabling project process**' and am experiencing a bit of a 'logical leap' from element 3 to 4. It might be because the **overarching logic** in the framework eludes me...
? Extent of theory	It's a bit difficult to say at this stage. The explanations are thorough but there is no practical application yet. It is a Type 1 theory in terms of Gregor's classification i.e., (t)he theory does not extend beyond analysis and description. No causal relationships among phenomena are specified and no predictions are made.

Question 4: Summary

Experts consider all of the framework elements as important in terms of guiding decision-making towards sustained benefit. Some elements may be relatively more important, and this has not been indicated by the framework. The comprehensiveness of the measures to ensure an enabling project process is not clear.

10.3.2.5. Question 5: Structure – Critical elements

Have any critical elements been omitted from the framework? If so, describe the omissions?

- The majority of experts (80%) are unsure as to whether or not critical elements have been omitted from the framework.

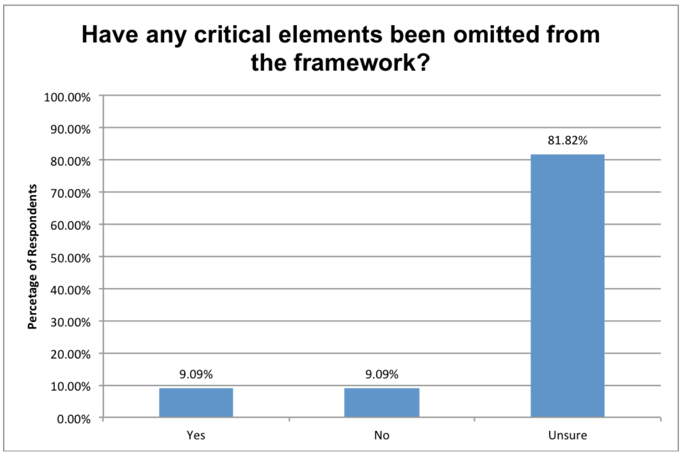


Figure 10.7 Expert review: Have critical elements been omitted?

Table 10.8 Expert review comments: Have critical elements been omitted?

Theme	Comment
? *Immediate, short and long-term benefits?* ? *Participative process?*	- Unfortunately I could not return to view all the details of framework after I pressed 'next' too soon... - I presume the traditional way of viewing benefits in terms of outputs/outcomes/impact (moving from the immediately tangible, short term benefits to the less tangible, long term systemic benefits) has been in some way incorporated when engaging with stakeholders about benefits? - I also assume there is emphasis on the **importance of a participative process** where stakeholders are encouraged to develop a shared mind-set - this is not about the content of a framework but about **role-players understanding each other better**, and learning to **understand the community environment better**.
✓ *Near comprehensive* ? *Expert knowledge and experience* ? *Power issues* ? *Technology choice* ? *External influences on change*	Overall I think the framework is **near comprehensive** and I think that while some things may be missing, they may also be difficult to capture. To some extent a model like this can be an effective aid, but it cannot substitute for **knowledge on the ground and experience**. The **power issues**, particularly in relation to disruptive projects, should not be underestimated. Other than that questions of **technology choice** are important - from the perspectives of knowing what is available, what will work best not just from the technical perspective but also from the point of on-going **use and affordability**, and what is most **culturally and/or socially appropriate**. And the **ability of government policy and market forces to change the environment** in which the project operates is also important.
? *Project initiator* ? *Politics* ? *Accountability, credibility*	I didn't notice anything around **who initiates the project** (not sure if it's important in the context of your framework though). But I think it is an **indicator towards sustained benefit** - is this something that has been asked for by the beneficiary environment to solve a critical issue they are experiencing? Or is this something that a funder thinks could solve a critical problem and they are 'introducing' the technology into the environment. Also issues like **politics, accountability, credibility (of various stakeholders).**
✓ *Adaptable to any value system* ? *Unexpected events*	Something **unanticipated** always comes up -- the model needs to have provision for this (if it doesn't) I also see the framework as generic one -- it could be **adapted to any value system** (I suppose that you would put this under II)
✓ *Comprehensive* ✓ *Supportive*	None that I can think of. This seems an extremely comprehensive and supportive framework.
? *Validation*	In the modelling building process which is very similar to what is proposed here there is the element/step where one 'test' the results, to ensure all aspects are addressed, etc. it is called validation in the modelling building framework. Is that not something one should consider here? It is not clear whether the framework as it stands currently makes provision for the aspect of validation.
? *Social constructs and contexts*	I have not found indications of elements that will focus attention on the behaviour and underlying mind-sets (**social constructs and contexts**) of participants, whether funders, recipients and /or implementers. It might feature as part of the 'systems description' if done extensively but there is no evidence in the material provided.

Question 5: Summary

The majority of experts are unclear as to whether any elements have been omitted from the framework. Some experts consider the model as comprehensive, supportive, and adaptable to any value system. The presence of a number of aspects was not clear (or were assumed to exist as part of the framework elements). These included the timeframe associated with benefits, and participation. Some omissions were identified: cultural and social aspects, power issues, accountability and credibility, and unexpected events. Model validation was highlighted as something to be addressed.

10.3.2.6. Question 6: Activity

Do you expect the framework to deliver a useful result?

- The majority of experts expect the framework to deliver a useful (45%) or very useful (27%) result.

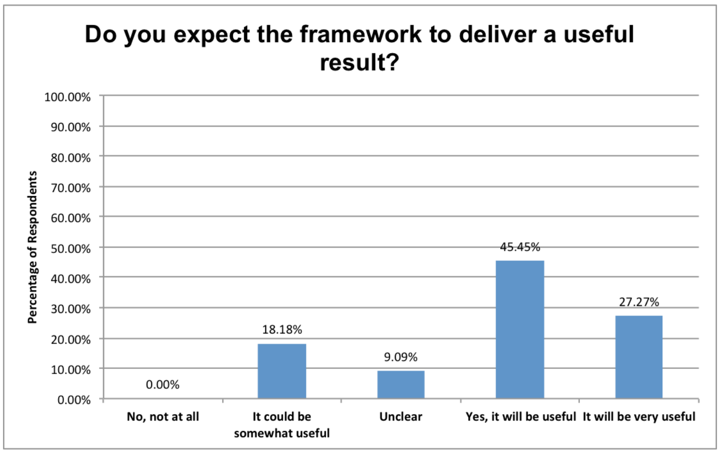


Figure 10.8 Expert review: Will framework deliver a useful result?

Table 10.9 Expert review comments: Will the framework deliver a useful result?

Theme	Comment
✓ *Useful* ? *Facilitated environment*	I think it can be useful **in a facilitated environment** where an ICT4D champion is able (and available) to translate the content into practical action. It cannot be given in its current form to stakeholders who are not necessarily versed in the language and terminology used.
✓ *Absolutely useful* ? *Facilitated approach* ? *Manage complexities*	Absolutely, provided someone can **manage the complexities** and it is a **facilitated approach** with very clear, pragmatic processes and solutions
✓ *Coordination*	It all depends if an **ICT4D project/coordinator** could bring all the people and elements together to go through the process in a reasonably tidy way.
✓ *Very useful*	I'm a little uncomfortable being as dogmatic as to say 'It WILL be very useful'(!)...however, my view is that this is a **very useful** framework which I would expect to **produce tangible benefits**
✓ *At least useful*	Difficult to say it will be 'very useful' - one needs some experience in using it. From what is outlined it seems it **will be at least useful.**
? *Depends on application*	It all depends on **who is utilising** the framework and **how it is applied**
	? To early too say. I would like to know more about it.
✓ *At least useful towards shared view and design*	It at least guides towards a **shared view and design** of what is to be achieved for whom and by whom.

Question 6: Summary

The majority of experts agree that the framework will be useful in guiding decision-making towards sustained benefit. A large percentage of respondents state that usefulness will depend on successful facilitation of the use of the framework.

10.3.2.7. Question 7: Evolution

The framework leaves the way in which the various elements are implemented, open to the practitioner. As such, it allows for learning and change between different iterations of the framework. Rate the adequacy of this mechanism in enabling the evolution of the framework.

- The majority of experts rate the mechanism of learning as adequate (63%), or completely adequate (18%).

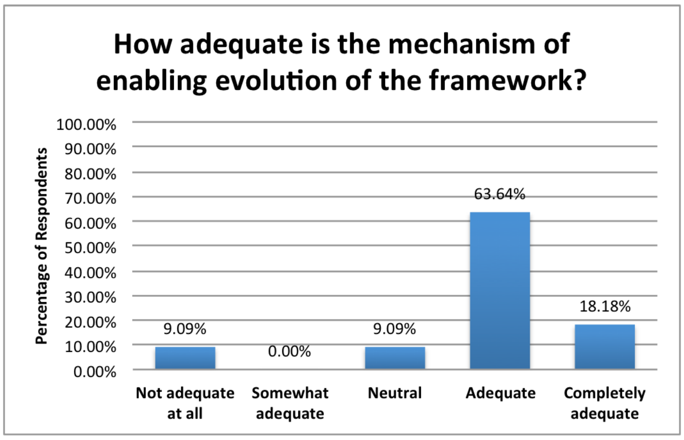


Figure 10.9 Expert review: How adequate is the mechanism of evolution?

Table 10.10 Expert review comments: How adequate is the mechanism of evolution?

Theme	Comment
✓ *Supportive tool* ? *Dependent on practitioner knowledge and experience*	Like all frameworks, it **will rely on the knowledge and experience** of those using it to implement it and develop it. The framework appears to provide them with a useful tool to support that process.
? *Dependent on practitioner knowledge and experience* ? *Needs practitioners guide*	It really depends on the **quality, experience, ability of the practitioner**. Perhaps there needs to be a very pragmatic **'practitioners' guide'** that works through a case study?
✓ *Good approach* ? *Daunting for first time users* ? *Extensive examples*	Yes, I think this is a **good approach**. It may be a little **daunting for a first time** user who would benefit from **extensive examples** of how the framework has been used in practice, whilst still allowing for flexible and creative use of the structure.
✓ *Will evolve*	I believe it is necessary and inevitable that **evolution is going to take place**
? *Logic / rationale* ? *Checklist only?*	I am unclear as to the logic / rationale in the framework and to some extent am left with the feeling of a 'summary of lessons learned'. What will make it attractive for continued improvement if it is only a (high level) 'checklist'?
? *Room for coherence*	There is room for progressive coherence. At this stage it is all very general.

Question 7: Summary

The majority of experts agree that the mechanism of evolution is adequate, but respondents also indicate that guidance is required in the use of the framework. Concerns include that the framework logic is not clear and that it hence appears as a checklist, which will not be useful.

10.3.3. Interpretation

This expert review was designed to allow experts in ICT4D and decision-making to assess the validity of the decision framework relative to the properties defined in Section 10.2.2. The review can be interpreted from two perspectives: first, to determine whether the framework displays evidence of validity against the defined properties and, second, to identify areas of improvement. Results are discussed accordingly.

10.3.3.1. Framework validity

The validity of the framework was tested in the questionnaire through the evaluation of a number of properties, as outlined in Tables 10.1–10.3. The results of the evaluation is summarised in Table 10.11, where the quantitative evaluation results for the questions relevant to each of the properties are summarised.

Table 10.11 Summary of qualitative evaluation of framework properties

Property	*Description* / *Evaluation Criteria (Gregor & Hevner, 2013)*	*Applied to this decision framework*	*Evaluation result*
Goal	Efficacy, validity, or generality of the framework Validity Utility (generality)	Is the framework effective in its goal of aiding decision-making, does it produce a valid outcome, and is it applicable to more than one decision situation?	Q1: Support the different goals? 3.67 – 4.22
Environment	Consistency of the artefact with the environment (people, processes, technology) Validity Quality Efficiency	Is the framework eliciting decision-making that is relevant to the people, processes, and technology that are involved in the decision problem?	Q2: Relevant to environment? 3 – 4
Structure	Completeness, simplicity, clarity, style, level of detail and consistency of the artefact Validity Quality Efficiency	Have critical elements been omitted from the decision framework?	Q3: Elements relevant? 4.33 – 4.78 Q4: Elements important? 4.33 – 4.89 Q5: Elements omitted? Unsure (3.89)
Activity	Completeness of function, consistency of activity, accuracy and performance of the artefact Validity Quality Efficiency	Is application of the decision framework yielding a usable and useful result?	Q6: Framework useful or very useful: 3.85
Evolution	Robustness and learning capability Utility Efficiency	It is possible to change the instantiation of the decision framework, based on learning that comes to light during its application?	Q7: Adequately supports evolution? 3.4

The expert responses indicate that the framework displays validity against the properties that were evaluated. Options were scored in such a way that 1 and 2 represents under-performance, 3 represents indifference, and 4 or 5 represents adequacy or over-performance. None of the elements rate less than 3, indicating that they are considered as adequate or more. Note that, while all elements were rated as important and relevant, a high percentage of reviewers (77%) were unsure of the completeness of the framework (all elements included?). In terms of usefulness, 77% of respondents indicated that the framework would be useful or very useful, while one respondent indicated that it could be somewhat useful (a rating of 2).

Summary: The scores allocated by reviewers indicate that the framework performs well against the properties that were evaluated—that is, performance in terms of goal, environment, structure, activity, and evolution. In terms of Gregor and Hevner's (2013) perspective, the framework performs well in terms of validity, utility, quality, and efficiency.

10.3.3.2. Areas of improvement

The comments made by the reviewers are summarised in Tables 10.5–10.10. Comments comprise both affirmation of the framework, and pointers towards areas for improvement. The latter are summarised into themes and interpreted in Table 10.12. For each theme, the relevant text is paraphrased from the comment. The researcher's interpretation of the grouped responses is then indicated. To facilitate a more structured response to the different themes, they are grouped into different focus areas.

In Table 10.13, a proposed response is listed to each theme of comments (i.e., will expansion of the framework be considered based on the reviewers' comments, or will the comments inform future work). These proposed responses are further discussed in Section 10.4.

Note that some comments by a reviewer were split into multiple comments in the tables, so as to be able to differentiate separate themes. In addition, some researchers repeated a comment across multiple questions. The frequency of comments is therefore not necessarily an indication of the number of experts that raised a specific comment. The researchers' response to comments is therefore made at the *theme* level, and each theme is given equal consideration.

Table 10.12 Summary of qualitative evaluation of framework properties

Focus	Theme	Comment	Interpretation
Framework comprehensiveness	Power relationships	• There are issues of power and relationships, particularly with disruptive change, that it does not appear to capture well, and I'm not sure that it can. ➢ Identify all stakeholders, also those influenced negatively ➢ Workaround strategies for stakeholders that are not positive • External, unfriendly forces…may be difficult to capture. • The power issues, particularly in relation to disruptive projects, should not be underestimated. • Also issues like politics, accountability, credibility (of various stakeholders). • It is at this stage not clear how agreement will be reached. How will conflict resolution be achieved? How will communication be conducted? You mentioned '(t)he intent is that the coordinators of an ICT4D intervention would brainstorm the five elements with all the stakeholders involved in the intervention.' Your action verbs in the framework are define, understand, and ensure. It all sounds idealistic enough but the practical aspects are not dealt with. This may, however, come later. • How will consensus (agreement) be reached? How do different objectives / interests / views / agendas get reconciled?	Power relationships have a significant potential to affect sustained benefit
	External influences and risk	• General market forces or government policies…may change over short periods of time .. may require changes to the way the project has been conceived. • The ability of government policy and market forces to change the environment in which the project operates is also important • I think the main challenge is how to manage risks regarding people, process and technology throughout the project….may start well, but there could be political change, people move, disenchantment (things not changing quickly enough?), etc. How do you keep people actively engaged? • Something unanticipated always comes up -- the model needs to have provision for this (if it doesn't)	External changes affect the project's relevance and people's commitment and create risk to sustained benefit
	Problem ownership	• I didn't notice anything around who initiates the project (not sure if it's important in the context of your framework though). Asked for by beneficiary to solve problem or funder 'introducing' the technology. Critical indicator for sustainability.	The origin of project affects sustained benefit
	Social and cultural aspects	• I have not found indications of elements that will focus attention on the behaviour and underlying mind-sets (social constructs and contexts) of participants, whether funders, recipients and /or implementers. It might feature as part of the 'systems description' if done extensively but there is no evidence in the material provided.	Social and cultural constructs of participants should be explicitly provided for
	Resources	I just hope that some discussion of resources is in there...	Resources should be explicitly addressed
	Time frame of benefits	• I presume the traditional way of viewing benefits in terms of outputs/outcomes/impact (moving from the immediately tangible, short term benefits to the less tangible, long term systemic benefits) has been in some way incorporated when engaging with stakeholders about benefits?	Different time frames need to be placed on benefits
	Technology choice	• I don't really see where the spectrum of technologies available is specifically dealt with. This could usefully be made more explicit. • Questions of technology choice are important - knowing what is available, what will work best, from the technical and also from the perspective of on-going use and affordability, and what is most culturally and/or socially appropriate. • Is the framework not too silent or uncommitted about the specific possible technologies? Different technologies have different affordances which may require different approaches e.g., macro-initiatives (Open Data) versus micro-initiatives (a telecentre or Mobile-agro-MOOC); software (mobile app) vs. hardware (new networking device) vs. systems (crowdsourcing)	Technology choice affects sustained benefit and should be explicitly addressed
	Shared systems understanding	• I am missing a process /decision element that will ensure a shared understanding of the techno-socio system that is targeted, i.e., a shared /agreed on view /description of processes, flows and drivers. The summary and Element 0 only mentions 'drivers' and it might assume an agreed on systems description but I think it might be better to prompt for and	A shared systems description should clearly be elicited The role and integration of

	and project integration	ensure such a systems description. If there is no such shared view of the system, all other elements become a bit 'ungrounded' and open for different interpretations by different stakeholders. The ratings had been done as if such an agreed 'systems description' had been facilitated by the framework. • Are some indicators for sustained benefit the fact that the project is integrated early on into the system (e.g., they create new structures, roles & responsibilities and processes)?	the project into the system should be clear
Framework coherence and structure	Integration of elements	• I am unclear as to the logic /rationale in the framework and to some extent am left with the feeling of a 'summary of lessons learned'. What will make it attractive for continued improvement if it is only a (high level) 'checklist'? • The above assessment doesn't give any indication of the relative importance of each element. I think they are all extremely important but there might be a sense in which some are more important than others (e.g., more important to get 'right' or have more enabling potential...with respect to the other elements). • There is room for progressive coherence. At this stage it is all very general. • It's a bit difficult to say at this stage. The explanations are thorough but there is no practical application yet. It is a Type 1 theory in terms of Gregor's classification i.e., (t)he theory does not extend beyond analysis and description. No causal relationships among phenomena are specified and no predictions are made.	The underlying logic of the framework should be clear
	Neutrality of value creation	• I would also suggest a rethink on the frequent use of the term 'value creation' and would consider something more neutral like 'influence exercised'.	Value creation as an overarching goal is contested
	Project process	• I am currently not convinced of the comprehensiveness of the measures to 'ensure an enabling project process' and am experiencing a bit of a 'logical leap' from element 3 to 4	Clarity about the project process element is required
Framework use	Participatory process	• I assume there is emphasis on the importance of a participative process where stakeholders are encouraged to develop a shared mindset - this is not about the content of a framework but about role-players understanding each other better, and learning to understand the community environment.	A participatory approach is required for use of the framework
	Expert knowledge, facilitation	• It will be demanding on practitioners to use as it requires high levels of 'thoughtfulness' and in many cases 'speculative thoughtfulness' (!) but this is clearly something to be encouraged and promoted. • A model like this can be an effective aid, but it cannot substitute for knowledge and experience. • It can be useful in a facilitated environment where an ICT4D champion is able (and available) to translate the content into practical action. It cannot be given in its current form to stakeholders who are not necessarily versed in the language and terminology used. • Absolutely, provided someone can manage the complexities and it is a facilitated approach with very clear, pragmatic processes and solutions • It all depends if an ICT4D project/coordinator could bring all the people and elements together to go through the process in a reasonably tidy way. • Like all frameworks, it will rely on the knowledge and experience of those using it to implement it and develop it. The framework appears to provide them with a useful tool to support that process. • It really depends on the quality, experience, ability of the practitioner. Perhaps there needs to be a very pragmatic 'practitioners' guide' that works through a case study? • It may be a little daunting for a first time user who would benefit from extensive examples of how the framework has been used in practice, whilst still allowing for flexible and creative use of the structure.	The framework should be applied within a facilitated process The skill and experience of the facilitator is critical A 'practitioners guide' is required
	Validation	• In the modelling building process which is very similar to what is proposed here there is the element/step where one 'test' the results, to ensure all aspects are addressed - validation in the modelling building framework. Is that not something one should consider? It is not clear whether the framework as it stands currently makes provision for the aspect of validation.	Framework validation needs to be addressed

The responses of experts, as outlined in Table 10.2, were summarised into three different focus areas: aspects related to the ***comprehensiveness*** of the framework (i.e., specific issues that are not addressed, but that could affect sustained benefit), the ***coherence and structure*** of the framework (i.e., is the framework well integrated relative to its purpose), and the ***use*** of the framework (i.e., how to apply the framework in practice). A choice has been made as to how to respond to each of the themes or categories. This is summarised in Table 10.13, and discussed below the table.

Table 10.13 Summary of themes in the qualitative evaluation of framework properties

Focus area	*Theme*	*Interpretation*	*Response*
A. Framework comprehensiveness	Power relationships	Power relationships have a significant potential to affect sustained benefit	Addressed in Element 0: *Understand systemic influences* and Element 3: *Understand the system's decision capacity*
	External influences and risk	External changes affect the project's relevance and people's commitment and create risk to sustained benefit	Addressed in Element 0: *Understand systemic influences*
	Problem ownership	The origin of project affects sustained benefit	Addressed in Element I: *Understand systemic influences*
	Social and cultural aspects	Social and cultural constructs of participants should be explicitly provided for	Addressed in Element 0: *Understand systemic influences*
	Resources	Resources should be explicitly addressed	Addressed in Element II: *Define your approach to value creation*
	Time frame of benefits	Different time frames need to be placed on benefits	Addressed in Element I: *Define the benefits*
	Technology choice	Technology choice affects sustained benefit. It is context-specific, and should be addressed explicitly	Addressed in Element II: *Define your approach to value creation*
	Shared systems understanding and project integration	A shared socio-technical systems description should clearly be elicited The role and integration of the project into the system should be clear	Addressed in Element II: *Define your approach to value creation*
B. Framework coherence and structure	Integration of elements	The underlying logic of the framework should be clear	Future work: A clear explanation and positioning of the framework is required to enable practitioners to use it appropriately
	Neutrality of value creation	Value creation as an overarching goal is contested	
	Project process	Clarity about the project process element is required	
C. Framework use	Participatory process	A participatory approach is required for use of the framework	Future work: Guidelines are required to enable practitioners to use the framework appropriately
	Expert knowledge, facilitation	The framework should be applied within a facilitated process The skill and experience of the facilitator is critical A 'practitioners guide' is required	
	Validation	Framework validation needs to be addressed	

A. Framework comprehensiveness

For practical reasons, reviewers were provided with limited detail pertaining to the decision framework. The reviewers' responses that were related to issues that were not addressed by the framework, but refer to a number of issues that are critical to the ability to sustain benefit. However, these are mostly provided for by the framework. The extent to which the issues are addressed depend on the manner in which the framework is applied and the level of detail that is incorporated in the analysis. This may not have been clear to the reviewers, given the limited information that they had at their disposal.

Each of the concerns raised by reviewers is addressed by one or more of the framework elements, as summarised in Table 10.13. For example, the influence of power relationships, as well as social and cultural aspects, was highlighted by reviewers as omissions. However, the framework indicates that an analysis of systemic influences is required (element 0). Depending on the focus of this systemic analysis, it would elicit the influence of both of these aspects on the proposed implementation. Similarly, the choice of technology could be addressed when the approach to value creation is explored (element II). One comment calls for the development of a shared understanding of the technical system that will result from the ICT4D intervention. This understanding could be integrated under element II. However, reference to the socio-technical system (i.e., the interaction between the ICT4D solution and the social environment) is not explicit in the definition of the element. It is therefore proposed that the explanation of the element needs to be upgraded accordingly.

Table 10.13 indicates that it was possible to do a complete mapping between the concerns that were raised and the framework elements. This serves to confirm that the framework is comprehensive in dealing with aspects that reviewers considered as critical to sustained benefit. As demonstrated, some specific framework element detail could be enhanced. In addition, reviewers could not identify all their concerns as being addressed by the framework. This confirms that the manner in which the use of the framework is clarified and communicated needs to be addressed.

Summary:
Retain framework elements as is
Incorporate detail into the practitioner's guide (C) to reflect reviewer relevant comments, where appropriate

B. Framework coherence and structure

Reviewer comments related to this aspect addressed the manner in which framework elements and the logic between them collectively address the framework objective. They specifically identified a need to clarify the underlying logic (including the relative importance of the various elements), and the role of the project process element.

The identification of the various framework elements resulted from a literature review of three different topics, and the elements were related to each other within the broad contexts of decision support, sustained benefit, and a systemic understanding of the problem environment. It was assumed to be independent of an underlying development theory. However, this underlying rationale may not be immediately clear to the users of the artefact. The reviewer comments have an implication for the ease with which practitioners could adopt and use the framework: should the logic be clear, it would be easier for practitioners to adopt and use. It is therefore proposed that any explanation of the framework for practitioners includes a clear explanation and positioning of its rationale, to enable practitioners to use it appropriately.

In addition to questioning the interaction between elements, one reviewer questioned value creation as an overarching goal of the framework. This goal was introduced, based on the perspective adopted from sustainability and failure literature that ICT4D problems aim to achieve some objective (Table 6.1), and on the manner in which such a goal focus is pursued for different types of decision problems (Sections 6.3.2.2; 6.3.3). Another reviewer appreciated the focus on value creation, as follows:

'I liked the framework very much...particularly the focus on value creation.'

Value creation is an essential component and focal point of the framework, and proved potentially useful in the two case studies under consideration. Since the framework has not yet been tested in practice, it is not possible to indicate whether a focus on value creation is an appropriate enhancement to the current standards of ICT4D practice. This focus will therefore be retained in the decision framework, with alternative formulations of the value creation left for future exploration.

Summary
Develop a clear description of the underlying logic of the framework, to enable practitioners to interpret and adopt the framework for their problem environment

C. Framework use

A large number of comments indicated that the framework, in its current form, is not easy to use and requires a skilled, experienced facilitator to unlock its value. These comments were based on the information available to the reviewers, which included a high level description of the framework, as well as the 'toolkit' that was developed in Section 9.4.2. The latter was developed in response to the cross-case review, with the aim of providing more detail and explanation around each element, and to assist practitioners in its use (See Table 9.7). All three categories of comments by reviewers indicate that this toolkit does not sufficiently guide practitioners in the implementation and use of the framework. Note that this toolkit does not address the key research question, but was aimed at explaining the framework elements in more detail. Therefore, future work should focus on developing an improved toolkit or mechanism that would enable practitioners to easily interpret the framework, adopt it for their work, and use it to enhance their standard of practice.

One comment relates to an element of *validation* of the framework. The expert review and preceding case studies form part of a validation process of the generic framework, within the overall design science research process. However, it is assumed that this comment relates to the validation of an instantiation of the framework, that is, an adaptation of the framework for a specific problem environment. In other words, how does a practitioner know that the framework, as applied within a specific environment, is valid and complete. This concept could in future be explored and incorporated within the practitioner toolkit (see Section 10.4).

Summary:
Develop a practitioners' guide that will enable easy interpretation and use of the framework.
Consider the inclusion of framework validation in the toolkit.

10.3.3.3. Response to the primary research question

The evaluation of this research is in the first place concerned with the validity of the artefact as an answer to the primary research question, namely:

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

The expert review confirmed the validity of the artefact as an answer to this research question, as is evident from the following qualitative results:

- The framework is rated high in terms of the relevance (review question 3) and importance (review question 4) of all elements.
- The framework rates high in its ability to reach its goal (review question 1), being consistent with the environment (review question 2), and delivering a useful result (review question 6).

While experts are unsure as to whether any elements have been omitted from the framework (review question 5), it was shown that the possible omissions that they raised in the comments (qualitative review) could all be accommodated within the existing framework elements. Therefore, revisions are proposed to the detail within some of the elements, but the high-level definition of the elements is considered to be adequate (even though they may not be exclusive).

Based on this interpretation, it is therefore concluded that the experts consider the framework as a valid answer to the primary research question.

10.4. REVISIONS AND RECOMMENDATIONS

10.4.1. Summary of recommendations

Based on the analysis and interpretation of expert responses in Section 10.3, it is concluded that the high-level framework does not require revision (that is, that framework elements do not need to be added or modified). However, the experts' responses indicate that guidance is required with respect to the implementation of the framework.

The following recommendations are therefore made, based in the expert review:

- ***Recommendation 1:***
  Retain the proposed elements of the decision framework, without further additions. The *intermediate decision framework* therefore becomes the *final decision framework*.
- ***Recommendation 2:***
  Develop an adequate explanation of the rationale behind the framework.
- ***Recommendation 3:***
  Develop a practitioners' guide, to facilitate implementation of the framework.

It is proposed that recommendations 2 and 3 be addressed within the same practitioners' guide.

Reviewer responses strongly indicated that guidance is required with respect to the implementation of the framework—thus indicating that the current practitioners' toolkit is not sufficient. However, the purpose of this research was to identify the elements of the decision framework, rather than to develop a mechanism for the implementation thereof, as is summarised by the following:

> *Since the premise of this research includes a focus on the operationalization of the concept of sustainability, the intermediate decision framework aims* ***to define the decision elements in a manner that could be translated*** *into a toolkit for practical application.* (Section 9.1)

The practitioners' toolkit (Section 9.4.2), that was used to demonstrate the framework during the expert review, was developed in response to a need to indicate how the framework would be implemented in practice (Section 9.4.1). This need was identified during the case evaluations. However, the toolkit does not form part of the artefact that is developed as a result of this research. Instead, it was intended to bridge the gap between concept and implementation (Section 9.4.1).

Based on this explanation, it is proposed that the development of a practitioners' guide is undertaken as future work, rather than as part of the artefact produced by this research. This future work would include an explanation of the rationale of the framework, and would therefore represent the response to recommendations 2 and 3.

However, to guide such future development, this thesis positions the role of the practitioners' guide (Section 10.4.1) and provides a foundation upon which to base the future development of the practitioners' guide (see Section 10.4.2). This information is based on the element descriptions of Section 9.4.2, and is enhanced with the analysis of reviewer comments in Section 10.3.3.

10.4.1. Practitioners' guide: role

The role of the practitioners' guide is positioned as follows:

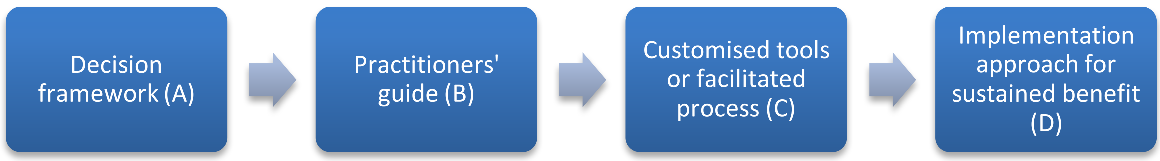


Figure 10.10 Role of practitioners' guide

The practitioners' guide (B) is intended to assist the practitioner in assessing the specific ICT4D implementation environment, and in developing an approach to the ICT4D implementation that would enable benefits to be sustained. The decision framework defines the guidelines in terms of which the practitioner thinks about the assessment of the problem environment. Based on these guidelines (i.e., the practitioners' guide), the practitioner can develop customised tools or a customised facilitated process within which the specific implementation environment can be assessed. These customised tools or the customised process become the instantiation of the artefact (decision framework).

In Chapter 9, a 'toolkit' was presented, with examples of tools that could be used to assess the problem environment. The revised process in Figure 10.10 calls for guidance in terms of which the practitioner could select or develop tools that are appropriate for the assessment of the problem environment. The baseline information that should inform the development of the practitioners guide is described in Section 10.4.2. The information is based on earlier work (Section 9.4.2) and reviewer feedback, and comprises a description of baseline information for the rationale behind the framework (recommendation 1), and baseline information for each framework element.

Note that the detailed development of the practitioners' guide is left to future work.

10.4.2. Practitioners' guide: baseline information

Rationale

It is proposed that the following key points are captured in the explanation of the rationale behind the decision framework:

- The framework aims to guide *decision-making*. As such, it considers a problem environment (systemic influences), an objective (*benefits to be sustained* and *value to be created)*, and constraints (*the system's decision capacity*).
- Operational integration of activities between multiple role players has the potential to prevent execution of tasks. The nature of the project process is therefore an element of the framework.
- The analysis should elicit multiple perspectives on the decision problem.
- The analysis should inform the focus with which decisions are made, and the way in which the implementation is structured, so that value is created and benefits are sustained.
- All of framework elements are equally important in gaining a complete picture of the decision problem. However, the extent to which each is described may depend on the specific problem environment.

Content

The toolkit that was provided in Section 9.4.2 was considered complex and in some instances inadequate. It contained a description of the background to each element and its purpose. In addition, it contained examples of or concepts that could be used to analyse each element, and questions that should be asked when interpreting results.

It is proposed that the summary detail in Table 10.14 below be reflected for each framework element in the practitioners' guide. The summarised detail primarily captures the purpose and points of reflection of the various elements, as outlined in Section 9.4.2. The content of some of the elements was modified, based on the expert review (Tables 10.12 and 10.13). In addition, minimum requirements for assessment tools were added.

Modifications to the original information are indicated in *italics*.

Table 10.14 Baseline information for practitioners' guide

Element	*Purpose*	*Reflection*	*Minimum requirement*
Element 0: **Understand systemic influences**	Ensure that the intervention is aligned with the dynamics of the beneficiary system that will facilitate or disable sustained benefit, and that these are influenced appropriately.	Are drivers against sustained benefit understood, or is more work required? Is an understanding of these drivers shared among shareholders? Are mechanisms in place to counter such drivers and manage risks? Are mechanisms in place to manage possible unintended consequences? *Are mechanisms in place to identify and respond to (political, organisational) changes in the external environment during implementation that could affect benefit?*	*A list of all drivers for and against sustained benefit* *Identification of risks* *Responses to risks*
Element I: **Define the benefits**	Obtain clarity, visibility, and agreement among stakeholders of the benefits that need to be sustained, in sufficient detail to inform appropriate intervention design	Are all benefits defined in sufficient detail? Are all beneficiaries identified and participating in design? Is the point of realisation, and duration, of the intended benefits accounted for by intervention design? Are adequate mechanisms in place to transfer the realisation of benefits between parties (by whom')? Are systemic influences understood and risks mitigated as far as possible? Is the balance in focus between dimensions of sustainability adequate, or should the intervention design be adapted?	*A definition of benefits, in the following terms:* • *What?* • *For whom?* • *By whom?* • *For how long?* • *Starting when?* • *What is the systemic influence?* • *What are the possible unintended consequences?*
Element II: **Define your approach to value creation**	Obtain clarity, visibility, and agreement among stakeholders of the manner in which value will be created by the intervention, in such a way that a critical path towards value becomes clear. *Ensure a joint understanding of the socio-technical system, and the integration of the intervention into the environment.*	Is the process of value creation clear and shared with all stakeholders? Is the scope of the intervention covering all intended benefits? If not, are mechanisms in place to bridge intervention activities to ensure future benefits? Are risks and disablers known and managed? *Is a picture of the socio-technical system that will result from the intervention clear to all stakeholders?*	*At least one diagrammatic representation of the goal of the intervention, expressed as a process of value creation, to allow the development of a shared understanding thereof.* *At least one diagrammatic representation of the socio-technical system*

Element	*Purpose*	*Reflection*	*Minimum requirement*
Element III: **Understand the system's decision capacity**	Understand the influences of the multiple role players on decision-making and value creation, and mitigate the influences that oppose value creation	Are all stakeholders and their influences on each other known? Are their involvement and influence *(relative power)* in individual (value-affecting) decisions understood? Are all (relevant) stakeholders engaged when specific decisions are taken? Are plans in place to address the decisions that are not currently addressed? Are plans in place to mitigate decisions and influences that distract from value creation? Are decision support tools or mechanisms defined and used to add value, where appropriate?	*List of stakeholders and their sphere of influence* *A map of stakeholders and the critical decisions on which they have an influence* *A map of critical decisions relative to the process of value creation*
Element IV: **Ensure an enabling project process**	Ensure that the project process allows rather than frustrates decision-making towards value creation	Do the characteristics of the project process facilitate benefits to be sustained? Is the influence of all relevant stakeholders on the project process understood? Are all relevant stakeholders engaged in each step of the project process? Are mechanisms in place to strengthen the capacity of decision-makers relative to the project? Are critical decision-makers and their (positive or negative) influence on the process recognised and managed Are the gaps or negative consequences of decision-making clear to all stakeholders? Are these gaps mitigated and/or managed?	*A map of the influence of decision-makers on the project process* *An assessment of the appropriateness of the project process to an ICT4D project, in terms of:* • *Accommodating different levels of readiness for intervention* • *Flexibility of the process* • *Transfer and integration of the intervention into the environment*

10.5. REFLECTION

An expert review is proposed by Gregor and Hevner as one of the methods to provide 'any evidence for the worth of the artefact' (Gregor & Hevner, 2013:351). Expert reviews were chosen as a formative and summative evaluation in this research (see Section 10.1) for its potential to contribute to the design science process by adding additional perspectives to the work, that have not previously been introduced.

The expert review process proved useful in its ability to provide comment on the artefact relative to the various properties that were identified, and also to identify aspects that were not earlier addressed through the literature reviews and case studies that informed the development of the framework (see Section 10.3.3). As such, the review succeeded to 'gather meaning, experiences and insights from (domain) experts' (Moonen & Von Hillegersberg, 2011:148; see section 10.2.1).

Experts were expected to review an artefact that has been demonstrated as potentially useful through case studies, but that has not been applied in practice. In addition, they were expected to review a new artefact, for which comparative artefacts do not readily exist. As such, their evaluation could at best contribute to improving the artefact, rather than to the derivation of an optimal artefact (Carlsson, et al., 2011; see Section 10.2.1). The nature of the reviewers' comments and the resulting recommendations that the researcher could develop from their comments, indicate that the expert review succeeded in contributing in this manner (see Sections 10.3 and 10.4).

In order for the expert review survey to remain practically executable within a reasonable time frame, experts were presented with limited information pertaining to the artefact. This may have impaired to completeness with which participants could contribute, as is reflected by the following participant comments:

'The evaluation on the importance of the various elements is being influenced by my evaluation of the various elements as described in the material given.'

'It's a lot to absorb if you need to go to each link about each element in the survey (a lot of work for a survey). That is why I am saying 'good' rather than excellent, but it appears to cover all the bases.'

'It might feature as part of the 'systems description' if done extensively but there is no evidence in the material provided'

Assuming that experts would have more time available, and were therefore given access to more information, the quality and extent of the review may have been influenced. However, in an academic environment where experts volunteer their time to participate, this may not be possible. Strategies to mitigate this aspect could include a more structured approach to the selection of information to present to experts, or deliberate strategies to guide them through, and focus on, various aspects of the framework—similar to the strategies followed in the review of artefacts such as user interfaces (see, for example, Chen et al., 2011; Korhonen, 2010). Alternatively, multiple rounds of surveys could be done, to enable more detail to be gathered following the initial responses (see, for example, Kriglstein, Leitner, & Kabicher-Fuchs, 2016).

The selection of experts was done by convenience sampling and through referrals. The inclusion of a different sample of experts may have lead to different approaches. However, a number of experts identified similar aspects of omission (e.g., cultural and social aspects), which to some extent points to the validity of the review in the sense that multiple experts independently expected the inclusion of specific elements in a complete framework, and identified the omission thereof.

Summary: While a different approach to the expert review and the provision of more information could have led to different perspectives on the framework, the review did succeed in its original intent of providing evidence of the potential usefulness of the artefact, and in identifying potential areas of improvement.

10.6. SUMMARY

This chapter presented the result of the final evaluation of the decision framework, based on an expert review. It reported on a formative and summative evaluation aimed at answering the appropriateness of the decision framework to the main research question of the thesis, namely:

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

The expert review was based on an evaluation instrument that evaluated specific properties of the framework. These were derived by integrating the views of by Prat et al. (2014) and Venable et al. (2016) on the evaluation of Design Science artefacts. It was shown that the properties used for framework evaluation were also consistent with the criteria for the evaluation of framework design, as proposed by Gregor and Hevner (2013).

The expert review resulted in the following key conclusions:

- The framework performs well with respect to goal, environment, structure, activity, and evolution—Prat's (2014) evaluation properties.
- The framework performs well in terms of validity, utility, quality, and efficiency—Gregor and Hevner's (2007) perspective.
- The concerns raised by experts in terms of *comprehensiveness* of the framework could all be accommodated by the existing framework elements.
- Concerns raised with respect to the *structure and coherence* of the framework indicated that better explanation of the rationale of the framework is required for practitioners.
- Concerns raised with respect to the *use* of the framework strongly indicated that the implementation of the framework requires guidance.

Based on these, the following recommendations are made:

- ***Recommendation 1:***
  Retain the proposed elements of the decision framework, without further additions. The *intermediate decision framework* therefore becomes the *final decision framework*.
- ***Recommendation 2:***
  Develop an adequate explanation of the rationale behind the framework.
- ***Recommendation 3:***
  Develop a practitioners' guide, to facilitate implementation of the framework.

Recommendations 2 and 3 require work that is beyond the scope of this research, and point to follow-up research. To inform this future work, baseline information was derived from the work done in Chapter 9 (practitioners' toolkit) and from reviewers' comments.

The changes to the framework, based on the recommendations of the expert review, can be summarised diagrammatically as follows (Figs. 10.11 and 10.12):

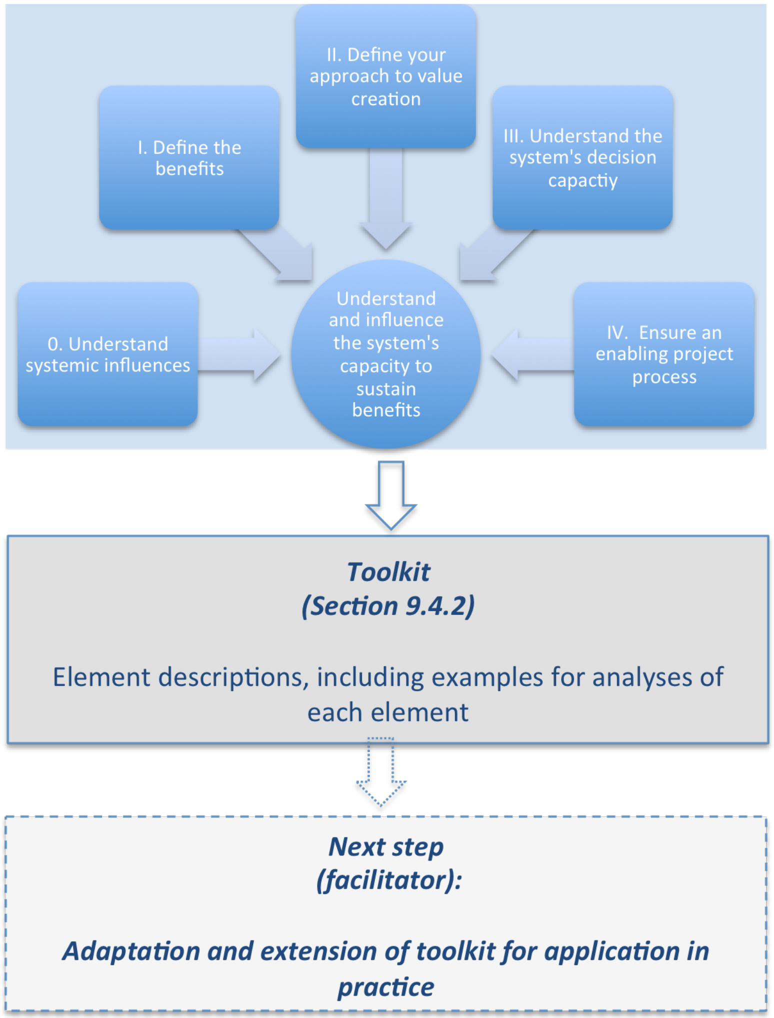
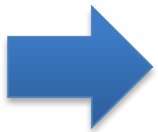


Figure 10.11 Intermediate decision framework



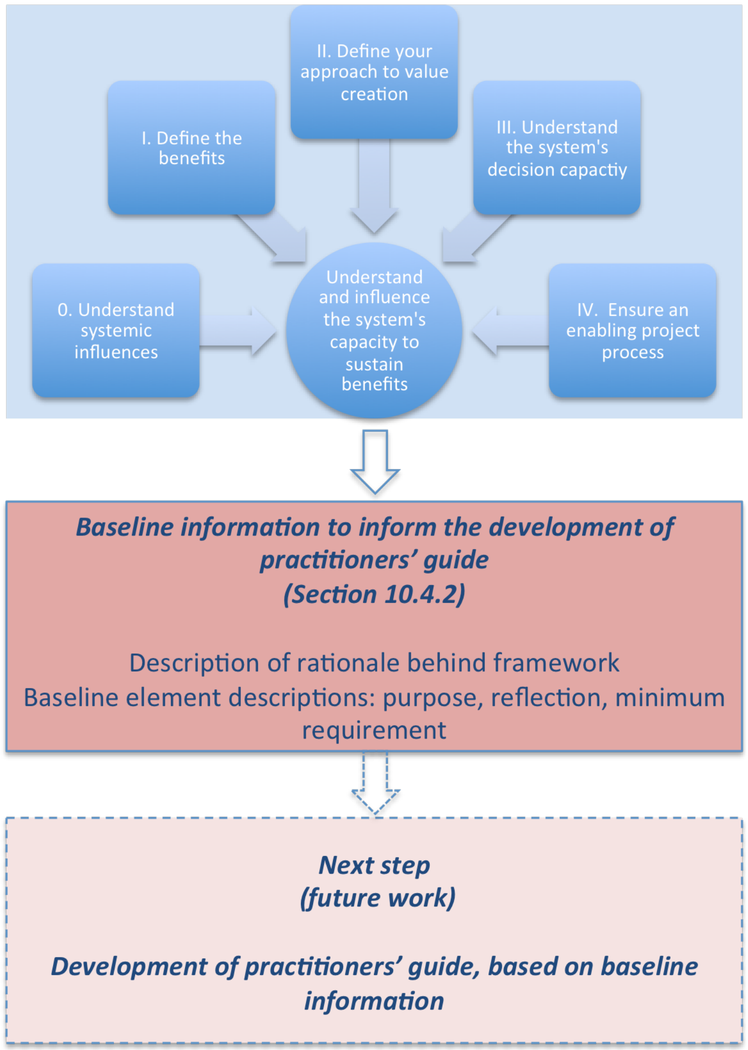


Figure 10.12 Final decision framework

This chapter represents the final activity of the *Evaluation* phase of the Design Science research process (see Fig. 10.1). It culminated in a final decision framework, as well as the definition of future work that would enhance the value and applicability of the framework in ICT4D interventions. The next chapter concludes this research by reflecting on the work that was done and its contribution to sustaining benefit from ICT4D interventions.

CHAPTER 11. CONCLUSION

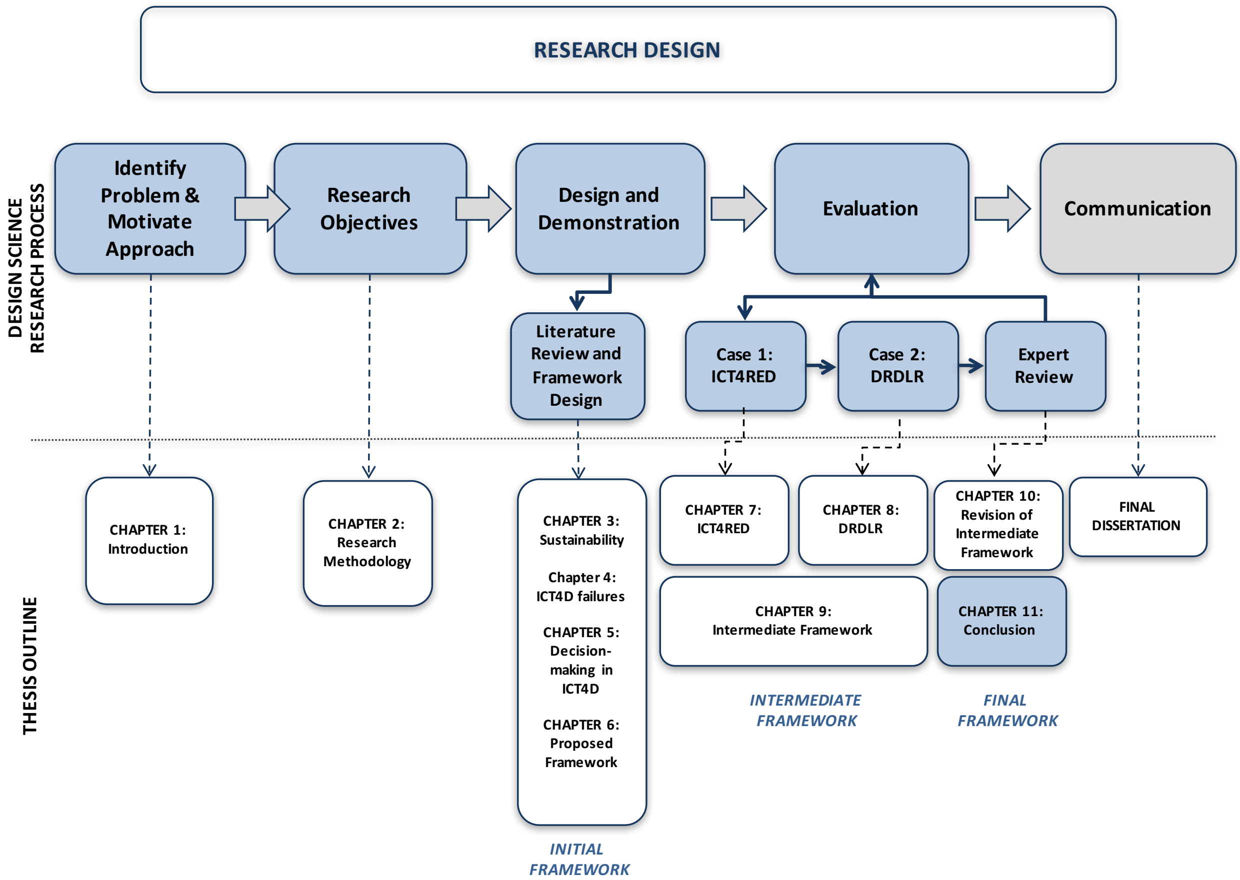


Figure 11.1 Research process and thesis outline: Chapter 11

11.1. INTRODUCTION

You do like to change things, don't you?
For the better, I hope
Out of Africa (Sydney Pollack, 1985)

East Africa of the early 20th century was characterised by colonialism, and Karen Blixen's memoirs tell a story of development that was all about 'upliftment' (Blixen, 1937). From the romanticized version of Blixen's years in Africa (Pollack, 1985), the dilemmas of earlier development contexts are clear – amongst others, power imbalances, patronising attitudes, and unilateral decision-making on behalf of the 'recipients' of aid.

As much as development thinking has evolved over time – with concepts of pro-poor and per-poor development (Heeks, 2008), and of development as choice and freedom (Sen, 1992) – researchers and practitioners are still grappling with the complexities of change through development. In the world of Karen Blixen, the perception of 'for the better' remains an unresolved concept that needs interrogation: better for whom, to what end, and for how long? Who decides, and who benefits? Ultimately, what does change look like – what do people choose, and how to they do so?

This thesis is in the first instance about sustaining change. Against the background of ICT4D it considers how benefits are sustained (or not) through the decisions that are made when 'we change things for the better'. Consequently, it also considers what is 'better'. This leads to an exploration, through a number of research questions, of the concepts of decision-making and sustained benefit in ICT4D.

The preceding chapters explored the main and secondary research questions by means of a design science research process. In this chapter, the researcher reflects on the research process and the resultant learning. The knowledge contribution, as well as the limitations of the research and areas for future investigation, is assessed.

In the quest for *development*, ICT4D has been seen as a means of bridging the gaps and narrowing the divides. However, its success has been contested. This research sets out to seek a mechanism of sustaining the benefits from ICT4D interventions. It adopted the position that the ability to sustain benefits is the result of the collective decision-making of the individuals and organisations that are involved with the ICT4D intervention. It focused on decision-making as a path towards action and hence a contributor to value creation, and positioned decision-making at the confluence of multiple decision-makers, worldviews, and agendas. Accordingly, it set a goal of defining a framework within which decision-makers could explore the aspects that would affect their collective ability to sustain benefits, and position their work in a manner that would align their decisions towards sustained benefit.

Given this approach, the work was positioned as the development of a practitioners' tool that could be applied at the level of ICT4D interventions. In answering the main research question, the research had the additional goal of exploring the concept of *sustainability*. As such, it sought to make visible the various perspectives on sustainability, to clarity a somewhat vague concept, and to make the concept useful at the level of the ICT4D intervention. By positioning the work as a decision framework, it was confronted with the challenge of defining the *decision problem* in the context of ICT4D interventions.

The overall goal was to contribute to the manner in which ICT4D interventions create lasting benefits – that is, to ensure that the effort that is expended on development is *useful* and *lasting* in its contribution to bridging the various divides. In this process, the research was defined to remain independent of the many different approaches and underlying philosophies that drive development activities. It sought to develop a research product that would enable benefits to be sustained, regardless of whether development is seen as *aid* or as *choice*, or somewhere in between.

Section 11.2 summarises the research, both the approach that was followed and the questions that were answered. This is followed by a positioning of the contribution of the work (Section 11.3), and a critical reflection (Section 11.4). Limitations of the research and opportunities for future research are outlined in Section 11.5, with a summary in Section 11.6.

11.2. SUMMARY OF RESEARCH

11.2.1. Research problem, approach, and process

This research aimed to develop a mechanism to sustain the benefits from an ICT4D intervention. It postulated that the solution would be found at the confluence of the current understanding of ICT4D failures, sustainability, and decision-making. Based on the formalisation and structuring of these diverse concepts, an *artefact* would be designed that could be useful in influencing ICT4D practice. The research therefore needed to *design* and *test* an artefact, based on the conceptualisation and integration of somewhat diverse concepts.

In Chapter 2, *Design Science* was motivated as an appropriate approach for the exploration of the research problem. It provided for the iterative development of an artefact (initial framework) through multiple literature surveys, and the iterative testing thereof through application in case studies and expert reviews (intermediate and final frameworks). In addition to providing a framework that addresses aspects of rigor and relevance, the process also provided for the development of solutions and the creation of knowledge. Further, it provided a platform in which the role of ICT4D as a bridge between technology, people, and organisations could be explored (Section 2.5.3).

The multiple literature surveys (Chapters 3 to 5) provided the opportunity to explore the research problem from multiple perspectives. It elicited diverse perspectives on the concept of sustainability and its evolution, and highlighted the inconsistency with which the concept is referred to in literature. It explored the *what* and the *how* of ICT4D failure, but also summarised the application of this knowledge – i.e., how this understanding is applied for improvement. Chapter 5 focused on how decision-making is used in ICT4D, and how this understanding should inform the decision framework.

The initial decision framework (Chapter 6) integrated the concepts of the literature reviews into a single framework. In addition, this work contributed a definition of the decision problem and decision-making in ICT4D (Section 6.3.3), which formed the basis for the framework.

The iterative application of case studies allowed for shortcomings and enhancements of the framework to be identified (Chapters 7 and 8). These led to the addition of a 'Practitioners' toolkit' to the intermediate framework (Chapter 9). However, the expert review found this toolkit to be inadequate and complex to implement (Chapter 10). To address this aspect, guidelines for the future development of a practitioners' guide were defined.

11.2.2. Research questions and answers

The main research question was incrementally answered and validated throughout the various phases of the Design Science research process. The question is as follows:

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D interventions in resource-constrained environments?

The resolution of this question resulted in the following decision framework:

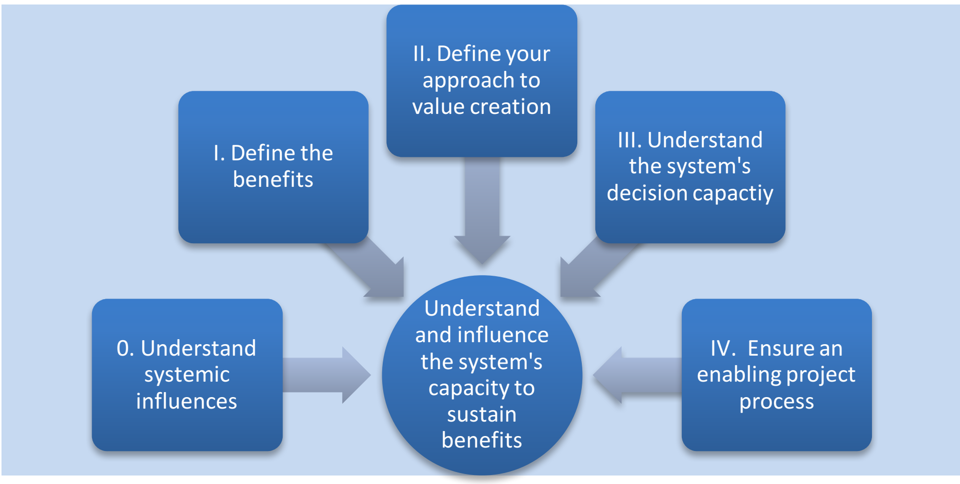


Figure 11.2 Final decision framework

The framework captures the various elements, as sought by the main research question. An overview was developed for each element, comprising the purpose, description, and interpretation of the element (see Chapter 9). However, the manner of implementation of the framework was not defined. Instead, some guidelines for the development of a practitioners' guide were outlined (Section 10.4.2).

In answering the main research question, the following sub-questions were explored and answered:

Table 11.1 Research sub-questions and answers

		Sub-question	Summary answer	Reference to discussion
Sustained benefit and failure	QN 1	What are the elements of sustained benefit that need to be considered, in the context of ICT4D interventions?	See: ➢ Characteristics of sustained benefit to inform framework ➢ Generic definition of sustained benefit ➢ Specific definition of benefits	 Table 3.8 Section 3.4 Table 10.14
	QN 2	How can the understanding of ICT failures be used within a decision framework to reduce the failure of ICT4D interventions?	See: ➢ Themes in ICT4D failures ➢ Application of failure concepts for improvement ➢ Learning from failure, to inform decision framework	 Figure 4.8 Table 4.5 Table 4.6
Decisions and Value	QN 3	What are the categories of decisions that should be considered when developing an ICT4D intervention, in order to catalyse the delivery of sustained benefit?	Categories that extend across hierarchical levels, and according to sphere of influence (for example, strategic, tactical, and operational)	Section 5.9
	QN 4	What strategies for decision support could be useful to support decisions that influence sustained benefit?	The framework should be technique-independent and flexible; focus on integration and alignment across hierarchies and between decision-makers	Section 5.9
	QN 5	What decision process, or other concept of value creation, should be used for contextualisation of the decision tools or models for sustained benefit?	Any construct of value creation that captures the extent of decision-making in its entirety, and that highlights alignment between decisions. For example, decisions that are mapped along an ICT4D value chain, or an agricultural value chain)	Section 5.9
Project process	QN 6	What are the characteristics of an ICT4D project process, that is conducive to the delivery of sustained benefit, and that can serve as background for the decision framework?	A process that: ➢ Differentiates between readiness of different groups of participants ➢ Is iterative and incremental (e.g., through modularity) ➢ Is flexible in terms of what is delivered	Table 6.5

While the sub-questions were primarily explored to build evidence in support of the main question, they also contributed by identifying key concepts such as a definition of decision-making in ICT4D, and an understanding of the various ways in which sustainability is interpreted.

11.3. CONTRIBUTION

In assessing the *contribution* of any research, the researcher is tasked with interpreting the value of the research, and positioning it relative to the relevant body of knowledge (theory) (Gregor and Hevner, 2013). In addition to contributing to theory, the value may also be at the level of practice, or in the new insights that resulted from a subset of the research. This section considers the knowledge contribution from different perspectives.

Apart from answering the research question and sub-questions, the research process resulted in new insights, each of which can be considered as a contribution to the debate on sustaining value during ICT4D-initiated change. First, the *DSR contribution framework* of Gregor and Hevner (2013) is used to position the knowledge contribution that is made by the research (Section 11.3.1). Thereafter, the specific incremental contributions that resulted from the research process are summarised, as described in the different thesis chapters (Section 11.3.2) – see Table 11.2.

11.3.1. Positioning the knowledge contribution

In Design Science Research, Gregor and Hevner (2013) propose the *DSR contribution framework* as a means of positioning a project's knowledge contribution. They emphasise the contribution to practice, as well as the contribution to theory development. In addition, they differentiate between the contribution of the Design Science research process and the role of the artefact in knowledge creation (Gregor and Hevner, 2013).

Level of contribution

First, Gregor and Hevner (2013) position *the nature of the knowledge contributions* that are made by an artefact:

	Contribution Types	Example Artifacts
More abstract, complete, and mature knowledge	Level 3. Well-developed design theory about embedded phenomena	Design theories (mid-range and grand theories)
↕ ↕ ↕ ↕	Level 2. Nascent design theory—knowledge as operational principles/architecture	Constructs, methods, models, design principles, technological rules.
More specific, limited, and less mature knowledge	Level 1. Situated implementation of artifact	Instantiations (software products or implemented processes)

Figure 11.3 Design Science Research Contribution Types (Gregor and Hevner, 2013:342)

In this representation, knowledge is positioned as being either more specific, or less specific and therefore more generalisable – that is, more or less mature, respectively. The decision framework produced by this research contains the generic elements to be considered when seeking to sustain benefits. It was developed at the concept level, and leaves significant room for the adaptation thereof to specific research environments. In the classification of Figure 11.3, it can be categorised as a Level 2 rather than a Level 1 contribution, in that it represents knowledge as operational principles or architecture.

In Section 10.4.1, the role of the decision framework and the associated practitioners' guide was explained as follows:

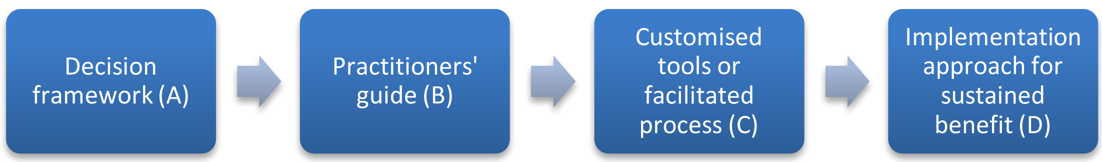


Figure 11.4 Role of practitioners' guide

In this representation, the customised tools or facilitated process (C), that is intended to guide the discussion around decisions for sustained benefit, can be seen as an instantiation of the artefact (A). These tools can therefore be described as a Level 1 knowledge contribution, that is, the situated implementation of the artefact.

The implication of this positioning is that the work forms a foundation upon which fundamental theory to inform the concept of decision-making for sustained benefit in ICT4D can be explored and developed. This research served as an exploration of relevant principles. It positioned decision-making against a continuum from simple to complex to messy (Chapter 6), and defined the characteristics of a decision problem in ICT4D. As the research proceeded to illustrate the role of decision concepts in structuring the complexity of ICT4D problems, it stressed the importance of collective, aligned, decision-making processes in a systemic context. It placed both a process and network perspective on decision-making in virtual system of decision-makers.

Further, this positioning of the work indicates that it contributes to practice more than to theory, in the sense that it is closer to influencing practice (through the practitioners' guide and the instantiations of the artefact) than to theory development. Gregor and Hevner (2013) state that the degree of knowledge contribution could comprise 'incremental artefact construction or only partial theory building', but that 'the size of the knowledge increase could be offset by the practical impact in a knowledge area' (Gregor and Hevner, 2013:343). This positioning therefore also serves to emphasise the importance of exploring ways in which to make the work useful to practitioners in future, so as to realise its knowledge contribution.

Finally, the positioning as a Level 2 contribution points to the level of abstraction and generality of the framework, thereby implying its potential applicability in more than one (unstudied) context. The artefact in essence integrates the concepts of systems, decisions, objectives, and sustained benefit, thus pointing to its possible extension to similar decision problems of a systemic and complex nature.

Role of contribution

Gregor and Hevner (2013) further define the *role of knowledge* in Design Science Research, as depicted in Figure 11.5. In this representation, the knowledge that relates to the problem researched in this thesis has been overlaid on the diagram, in red text.

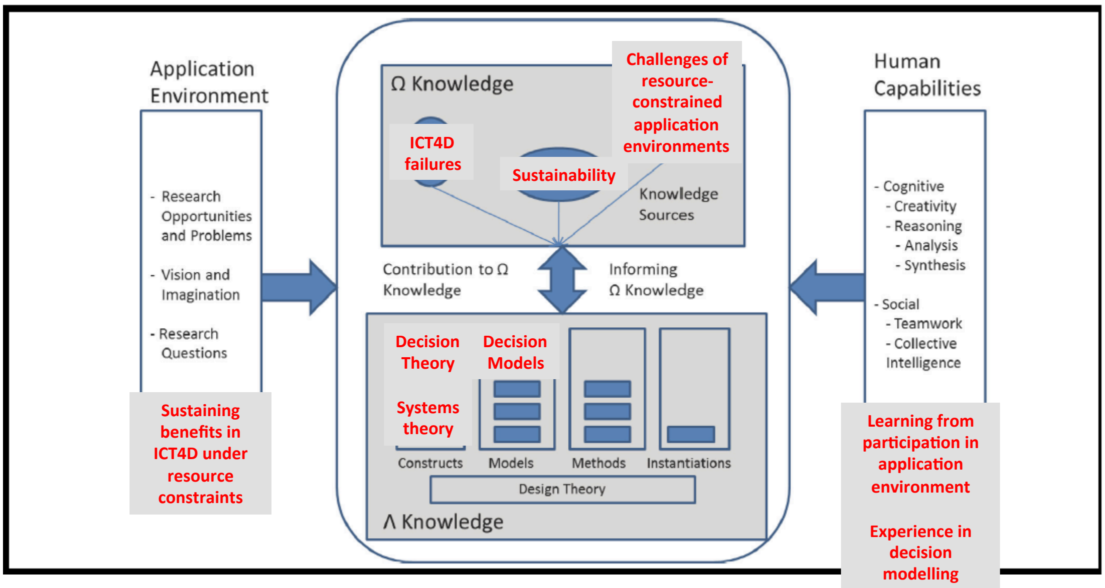


Figure 11.5 The roles of knowledge in Design Science Research, adapted for this work (from Gregor and Hevner, 2013:344)

This representation emphasizes that the knowledge contribution of this work (decision framework) is at the confluence of descriptive (**Ω**) and prescriptive (**Λ**) knowledge bases. It draws on knowledge from diverse fields to contribute an integrative framework for the improvement of practice.

Nature of contribution

Finally, Gregor and Hevner (2013) position the work in terms of a *Knowledge Contribution Framework,* which differentiates the work in terms of the maturity of the application and solution domains, respectively, as outlined in Figure 11.6.

In this representation, this thesis can be positioned as extending known solutions (various approaches to decision modelling and conceptualisation) to new problems (that of sustaining benefits from ICT4D in resource-constrained environments). The work is therefore defined as an *exaptation*, that is, a solution in which the maturity of the application domain is low, while that of the solution domain is high.

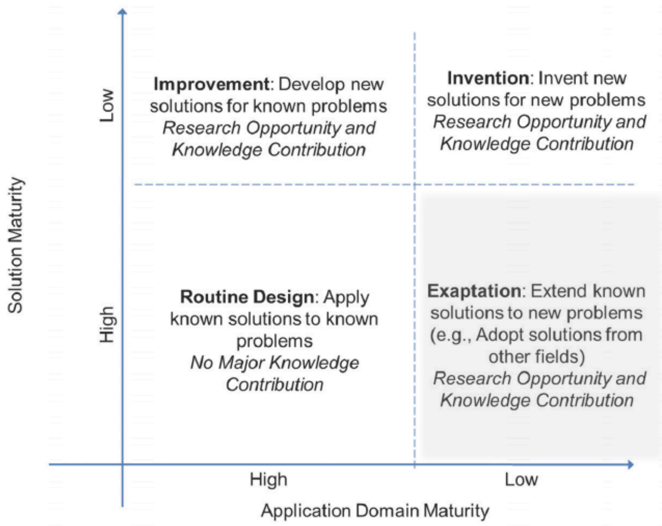


Figure 11.6 DSR Knowledge Contribution Framework (Gregor and Hevner, 2013:345)

According to this framework, artefacts in the exaptation quadrant aim to create better solutions for contexts in which current solutions are sub-optimal (Gregor and Hevner, 2013). In this research, the high failure rate and contended success (Section 1.3.2) of ICT4D interventions are indicative of the need for better solutions.

For research products in this quadrant, the challenge of demonstrating the value of the knowledge contribution lies in demonstrating its effectiveness relative to other solutions in this space (Gregor and Hevner, 2013). In this work, the rationale for this specific approach stems from the notion that decision-making (as an integrative focal point) defines the performance of organisations (in this case, project teams or 'virtual' organisations) (Blenko et al., 2010). Integrative decision frameworks for this problem environment could not be identified in literature (Chapter 5). On this basis, the decision framework was proposed as an artefact that would constitute an improvement on existing approaches to sustaining benefits from ICT4D interventions.

In arguing the above, the researcher is *reasoning* that the framework will be an improvement on existing approaches, thus adopting the approach of Davis (2009), who argues that 'The contribution may be demonstrated by reasoning, proof of concept, proof of value added, or proof of acceptance and use' (Davis, 2009:18). However, note that the framework presented in this thesis has been developed at the concept level, and its potential applicability has been demonstrated retrospectively (in concept, not in practice) and through expert reviews. While the *nature* of the contribution has been defined here, and while its potential as an improved approach has been argued, its *value* remains to be proven through future work.

11.3.2. Summary of contributions

While seeking to develop a decision framework, the research in essence addressed issues of sustainability, value (benefit), and the interactions between the people that engage around an ICT4D intervention in the form of a temporary or 'virtual' organisation. In exploring the research questions outlined in Section 11.2.2, the following contributions were made:

Table 11.2 Summary of research contributions

	Contribution
Theory: Knowledge abstractions to inform future exploration	➢ A summary of the diverse ways in which sustainability is interpreted in literature, and an outline of multiple perspectives on sustainability (Chapter 3). ➢ A summary of the applications of the sustainability concept in ICT4D (Chapter 3). ➢ Conceptualisation of sustained benefit as an extension of the concept of sustainability, when operationalising the long-term value of ICT4D interventions (Chapter 3). ➢ An overview of the themes related to ICT4D failures (Chapter 4). ➢ A summary of how knowledge about ICT4D failure is applied for improvement (Chapter 4). ➢ A summary of the extent to which decision-making is addressed in ICT4D literature (Chapter 5). ➢ A definition of the decision problem and decision-making in ICT4D, based on the characteristics of messy problems (Chapter 5).
Method	➢ A definition of appropriate characteristics for project processes in ICT4D interventions (Chapter 6). ➢ The definition of a framework that would focus decision-making towards sustained benefit (Chapter 10).
Practice	➢ Recommendations for the development of a practitioners' guide for the framework (Chapter 10).

Each of these individual contributions has the potential to play a role in the debate around sustained benefit in ICT4D, even though they may be different from the original intent of the work.

In summary

The knowledge contribution of this research is predominantly at the conceptual level. However, some aspects were explored that could inform the future development of theory. The knowledge contribution resulted from the integration of descriptive and prescriptive knowledge, to create concepts that could be applied at the methodological (prescriptive) level. It stems from the application of existing concepts to new problems (exaptation), as such seeking to develop better ways in which to solve problems.

11.4. CRITICAL REFLECTION

In this section, the researcher reflects on the value and quality of this research project as a means of answering the original intent of the research. It is done by commenting on the research process (Section 11.4.1) and research product (Section 11.4.2), as well as by the researcher reflecting on the learning that resulted from conducting the work (Section 11.4.3). Three sets of criteria are considered in evaluating the work: the seven guidelines for Design Science Research (Hevner et al., 2004), three key questions proposed by Hardy (Wilson, 2002), and the seven principles of interpretive research (Klein and Myers, 1999).

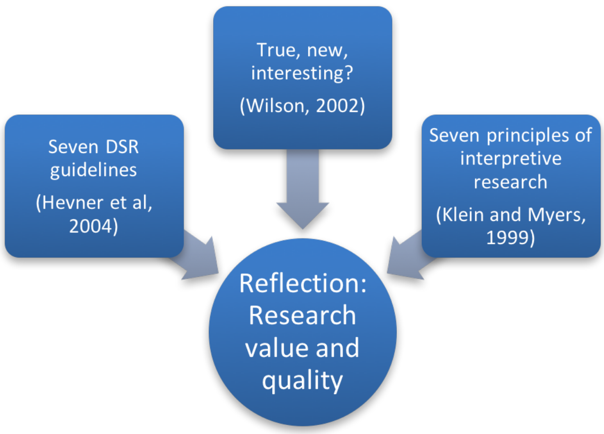


Figure 11.7 Reflections on research value and quality

11.4.1. The research process

This research called for the design of a construct that could aid practitioners in ICT4D to improve the manner in which they deliver value at project level. Given this *design* focus, a Design Science Research approach was followed – which is hailed as being primarily a problem-solving paradigm that seeks to create innovations for the effective implementation of Information Systems (Hevner et al., 2004). Design Science is considered to be useful in this research in the iterative manner in which it enabled to researcher to explore and integrate data from different sources (literature, cases, and experts' experience) into an artefact.

In assessing and reflecting on this work, it is considered that the quality of the research *product* is related to the quality of the *process* by means of which it is produced. This is in line with the underlying principles of Design Science, which iteratively addresses the quality of both the product and process of design (Hevner et al., 2004).

In Chapter 2, seven principles for Design Science research were outlined, and their relevance to this research project was indicated (Section 2.5.2). These are revisited here, to assess whether a rigorous process was followed.

Guideline 1: Design as an artefact

This guideline calls for the production of a viable artefact. In this research, the artefact is represented by a *decision framework*; the path towards creating the instantiation of the artefact was also described (Section 10.4). The viability of the artefact was in concept demonstrated through two case studies and an expert review, which agreed on its potential viability (Section 10.3). However, its viability in practice remains to be proven.

Guideline 2: Problem relevance

A Design Science Research problem should address important and relevant business problems. In the problem of sustainability in ICT4D, importance and relevance are demonstrated by the high failure rate of ICT4D interventions, the spectrum of manners in which failure is realised (Chapter 4), the wide spectrum of approaches that aim to address the problem of sustainability (Chapter 3), and the on-going effort to reach elusive development goals (Section 1.1). Any effort to improve sustainability from ICT4D interventions could therefore be deemed both important and relevant.

Guideline 3: Design evaluation

The utility, quality, and efficacy of a design artefact must be demonstrated rigorously by means of well-executed evaluation methods. In this research, evaluation methods were clearly planned and described (Section 2.6.4), and were rigorously adhered to. While the case studies provided subjective data, the expert review provided a means of scrutinising the initial work in an objective manner. While the reviews were constrained by practical aspects such as the extent of information that could be provided for scrutiny, they did result in useful recommendations that led to the improvement of the framework (Section 10.4).

Guideline 4: Research contribution

This guideline requires that clear and verifiable contributions be provided in the areas of the design artefact, design foundations, and/or design methodologies. In this research, the contribution was made in terms of the design artefact. Contributions were primarily at the method or concept level, with pointers towards future theory development. The contribution was described and positioned relative to a known assessment framework, and the assessment contributed to the understanding of how the contribution could be realised, and where the focus of future contributions should be (Section 11.3).

Guideline 5: Research rigor

Rigorous methods should be applied in both the construction and evaluation of the design artefact. In this work, an iterative process was followed in the development of the artefact. As per Guideline 3, evaluation was also performed in a structured manner. The interplay between theory (through literature review) and practice (through case studies and expert reviews) provided multiple perspectives on the development of the artefact, and should enhance its future applicability and value. The rigor could be improved through the prospective (rather than retrospective) application of the framework in a case study.

Guideline 6: Design as a search process

This guideline states that the search for an effective artefact requires utilisation of available means to reach desired ends, while satisfying the laws in the problem environment. In this research, it is proposed that the iterative process provided a means of exploring the messy problem environment and potential solutions from different perspectives, as outlined in Guideline 5. The artefact was conceptualised through initial work, and amended after each iteration of the process – thus reflecting an ongoing search for its conceptualisation and improvement.

Guideline 7: Communication of research

It is a requirement that Design Science Research must be presented effectively to technology- and management-oriented audiences. This dissertation forms the primary communication of the work under consideration. Elements of the work have been presented at various conferences and through articles during its development. As part of the development of the thesis, the framework was presented to expert reviewers by means of a shortened toolkit. This manner of communication was to some extent considered inadequate and, in response, a number of guidelines for the future development of a practitioners' guide (hence, the communication of the work) were developed.

Summary

The assessment against the seven guidelines for Design Science Research indicates that the development of the framework complied with the required rigour. This implies that a quality process was followed, delivering a quality artefact. The process could be improved by proving its viability in practice (Guidelines 1 and 5), extending the research contribution towards theory (Guideline 4), and developing an appropriate means of communicating the research at the practical level, in the form of a practitioners' guide (Guideline 7).

11.4.2. The research product

The knowledge contribution of this work was positioned and summarised in Section 11.3. Here, it is more broadly considered whether the research achieved what it set out to do, and whether it produced answers that are useful, usable, and valuable.

While the nature of the knowledge contribution was defined, and its potential value was reasoned, it was also indicated that the value of the research would only become evident through future exploration of the knowledge contributions, and through future application of the decision framework in practice. For a more general assessment of the *value* or *noteworthiness* of the research, the three questions proposed by Hardy could be considered (Wilson, 2002). These questions were proposed as a means of assessing whether research contributes to knowledge, and is therefore worthy of publication: (1) is it true; (2) is it new; and (3) is it interesting? For this research, the following responses are relevant:

Is it true?

The researcher interprets this question as referring to whether or not the work can be justified as being valid and viable. Both the nature of the process that was followed, and the assessment of the process against its own guidelines (Section 11.4.1), serves to reflect the *truth* of the work.

Is it new?

The *novelty* of this work could be interpreted as the integration of the concepts of sustainability, failure, and value creation around a focal point of decision-making, and the use of a strong systems perspective in the search for benefit creation. The move from the dimensional view on sustainability (economic, social, environmental, etc.) to a process and systems view adds the possibility of operationalisation, which has been underplayed in earlier work (Section 3.4). A further novel concept is the introduction of the alternative term *sustained benefit* as an interpretation of sustainability at project level. Finally, the concept of the elements of decision problems has been used to define the decision problem in ICT4D (Section 6.3). Evidence could not be found that these interpretations and concepts have been addressed in this manner in literature before.

Is it interesting?

The extent to which this work is interesting depends, indeed, on the perspective of the reader. The specific research contributions listed in Section 11.3.2 comprise elements that could potentially be of interest to researchers. Specifically, the novel aspects listed in the previous paragraph could form the basis for further exploration of the theory of decision-making in ICT4D.

Another manner of interpreting the value of the research is to assess whether it was produced by a consistent and well-justifiable method. The value of the Design Science Research process has already been discussed in Section 11.4.1. Here, a broader reflection on process is taken. The principles for interpretive analysis, proposed by Klein and Myers (1999), were put forward as a basis for this work, and specifically for case study interpretation (Section 2.6.2). These principles are reviewed as a further means of assessing the quality of the underlying approach that led to the research contribution and hence, by implication, as an indication of the quality of the research contribution.

Principle 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' (Klein and Myers, 1999:72). This research was executed through participation of the researcher in project execution, specifically through the development of decision models (a small subset of the problem to be addressed, and then by integrating the learning from this work into a broader decision framework. The latter considers the 'whole' that is formed by organising the interdependent views of different decision-makers and decision perspectives, thus reflecting on the integration of the learning from this work into a broader framework, as such honouring the principle of the hermeneutic circle.

Principle 2 The principle of contextualisation

Two case studies were used to demonstrate the application of the initial decision framework. These served to contextualise the work relative to the environment from which the original decision question arose. The context-specific constraints emerged from the case descriptions, thus illustrating how the resolution of the research question would address the original question that arose from the environment under consideration.

Principle 3 The principle of interaction between the researchers and the subjects

In this principle, it is assumed that 'interpretivism suggests that the facts are produced as part and parcel of the social interaction of the researchers with the participants' (Klein and Myers, 1999:74). The researcher undertook this research in interaction with the project teams that executed the two case studies under consideration. The subjects were therefore the project team members with whom the researcher interacted regularly in the development of decision models. This provided both the environment from which the research questions arose, and the environment that provided the data against which the research product could be tested. In interaction with the project team members, the challenges around sustainability (and especially the multiple interpretations, unspoken assumptions, and manner of application) became clear. It prompted revision of the researcher's original constructs, and led to the definition of the research problems.

Principle 4 The principle of abstraction and generalisation

The authors of the principles state that 'it is important that theoretical abstractions and generalisations should be carefully related to the field study details as they were experienced and/or collected by the researcher' (Klein and Myers, 1999:75).

In this research, the data that were collected through literature review and case studies were used to develop an abstraction of the way in which stakeholders could structure their decision-making towards sustained benefit. Results from literature were organised into themes, and these were used to inform the characteristics of the decision framework. This presented a key manner in which to form abstractions from the available data in a structured manner. Principles that were collected and organised from literature and case studies were integrated and abstracted to form a framework that could be applied in numerous contexts, thus representing the principle of generalisation. Decision theory and the structuring of decision problems played a central role in the manner in which the framework was constructed. The approach of abstraction and generalisation was therefore well structured, and represented an interplay between the data that were collected and the theory within which it was structured.

Principle 5 The principle of dialogical reasoning

According to Klein and Myers 'This principle requires the researcher to confront his or her preconceptions (prejudices) that guided the original research design (i.e., the original lenses) with the data that emerge through the research process' (Klein and Myers, 1999:76). This principle is inherent in the manner in which the Design Science Research process is structured, and therefore played a significant role in the research. The iterative cycles of literature reviews and multiple case studies call for iterative reflection on the research product, as well as iterative refinement thereof. In addition, the selection of a multi-case approach provided the researcher with the opportunity to look beyond the first impressions of a case, by doing a rigorous cross-case analysis (Eisenhardt, 1989), thus confronting any preconceived ideas.

Principle 6 The principle of multiple interpretations

The decision framework was reviewed against multiple case studies, thus forcing interpretation of the framework in multiple environments. In addition, experts were selected from diverse technical backgrounds and fields of experience to interpret and comment on the decision framework. All of these interactions informed revisions to the framework, thus reflecting to accommodation of multiple interpretations by the researcher.

Principle 7 The principle of suspicion

Klein and Myers (1999) indicate that the application of this principle in IS research is the least developed, and may be ignored by researchers. In this work, the principle was best applied in the critical review of the data collected through literature. The data informed the initial decision framework, and hence represented a substantial voice towards the development of the artefact. The positioning of literature, and specifically claims to address the concept of sustainability, was critically reviewed and interpreted. In addition, the responses by expert reviewers played a significant role in shaping the final artefact. These responses were similarly interpreted against the background of the context within which the review took place, and the limited data that were available to the reviewers. The principle of suspicion was therefore applied through the extent to which different views were allowed to influence the final artefact.

Summary

In this section, it was assumed that the demonstration of a rigorous research process points (at least partially) to the development of a research product of good quality. To this end, two frameworks were used. First, it was argued that the research product could be considered true, new, and interesting (Wilson, 2002) and, second, it was argued that the research was aligned with Klein and Myers' (1999) seven principles for interpretive field research.

11.4.3. Learning

This research stemmed from the aspiration to enhance the ability of ICT4D interventions to result in something of lasting value. It originated from the researcher's participation in two ICT4D case studies, in which the complexities of engagement between stakeholders at different levels of governmental hierarchies, and from different perspectives, presented obstacles to sustaining value in practice. While significant resources are spent, in financial terms as well as in terms of effort, energy, and commitment of stakeholders, results often do not last. Organisational systems do not necessarily have the capacity or resources to carry the benefits forward, and these fall by the wayside in the face of the challenges of day-to-day business.

Against this background, the research project was scoped from a practitioners' perspective, with the aim of developing a unifying framework within which stakeholders could work towards sustaining the benefits from their work. The researcher's personal interest in Decision Science led to the selection of decision-making as a focal point of the work.

The integration of the diverse concepts of sustainability, failure, and decision-making was made possible by the application of a Design Science Research Process. The latter provided a useful means of iterating through different sources of knowledge, and of improving the framework with each iteration. In addition, it could be demonstrated that a knowledge contribution could be made at the methodological and practical level, with a number of pointers towards the future development of theory.

From a process perspective, the Design Science Research approach provided the researcher with the opportunity to develop the capacity to explore research questions with the required amount of rigour within a structured environment, and to learn how to integrate and abstract across different sources of information.

The expert review of the work indicated that experts agreed on the potential usefulness of the framework, and that they could identify specific aspects of value within the framework. However, a number of experts indicated that facilitators would need to be experienced to use the framework as part of an intervention, and that further work is required to enhance its applicability in practice.

This left the researcher with the dilemma of answering questions at a theoretical level, while at the same time providing answers that are usable in practice – as was the original intent of the research. The researcher attempted to bridge this dissonance by defining guidelines for the development of a practitioners' guide, as a means of facilitating practical implementation of the framework.

11.5. LIMITATIONS AND FUTURE RESEARCH

The limitations of this research, and hence the opportunities for future research, are explored in terms of (A) limitations of the research approach, (B) limitations of the framework, and (C) limitations of the envisaged application of the framework.

A. Limitations of the research approach

The Design Science Research approach has already been highlighted as a well-structured manner of arriving at a usable artefact. In essence, the approach in itself did not present significant limitations. However, the *application* of the research approach points to room for improvement. First, the analysis of case studies was done retrospectively. While it provided useful input in terms of improvement of the work, the validity of the framework remains to be tested in practice.

Second, only two case studies were selected to test the initial framework. Both of the case studies represented ICT4D interventions that were developed on behalf of the South African government (as key funder, and as client) by an implementation agent (CSIR) in rural South Africa. This very specific set of conditions could have biased the nature of modifications made to the framework as a result of the case study analyses. Further, the definition of the research, and hence the selection of cases, was limited to resource-constrained environments — where resources were mostly defined in terms of technology and funding. While this perspective was chosen to represent the characteristics (and challenges) of many ICT4D implementations in rural South Africa, it constrains the generalisation of results to other messy environments. While case study analyses were not the only data that influenced the framework, it would be advisable to validate the generalisability of the framework through future application in different environments.

Third, case studies are seen as a means of developing theory: 'the intimate connection with empirical reality… permits the development of a testable, relevant, and valid theory (Eisenhard, 1989:532). This research explored the nature and context of decision-making in ICT4D, and identified pointers to future theory development. The development of theory per se is left as a topic of future work (Section 11.3).

Fourth, the framework was primarily developed for the audience of project team members and the facilitators that are responsible for the development of appropriate project methods. This research was therefore primarily developed through interaction of the researcher with the environment of the implementation team (at the intervention planning level). In practice, an ICT4D intervention comprises a broader set of stakeholders, including community members, custodians of the intervention (e.g., Department of Education), and others. By implication, the success of such a framework relies significantly on the extent to which all stakeholders are able to engage with the instantiation of the framework. The prospective testing of the framework in an environment where all stakeholders engage with the planning process is therefore essential.

Future work (based on research approach):

- Exploration of the validity of the framework through application in more case studies on different environments, as well as through the prospective application of the framework in interventions where all stakeholders engage with the planning process through facilitated interaction with the framework; and

- Use of the pointers to theory that were identified in this research, to further develop theory pertaining to decision-making in ICT4D.

B. Limitations of the framework content

In Chapter 6, the perspective of Chigona (2008:58) on the benefits of a *theoretical* framework were listed:

1. Ability to make predictions.
2. Ability to proceed systematically, to observe or measure selected things.
3. Explain what is happening, in terms of the theory.
4. Put the theory under stress in order to improve it.

While this framework is positioned at the methodological rather than the theoretical level, these benefits provide pointers for the future improvement thereof.

The framework is presented as the integration of a number of factors, which would allow the project team to 'enhance and influence the capacity to sustain benefits' (Figure 11.2). However, the ability to measure the capacity to sustain benefits and decision-making (point 2 above), or the prediction of the potential for improvement (point 1 above), has not been considered. That is, in a complex environment such as this, there is no indication of how good current practice is. This observation is in line with that of Chianca (2008) who, in considering the five OECD/DAC criteria for international development evaluations, states 'In considering the five DAC criteria, impact, efficiency and sustainability criteria should have minimum acceptable levels of performance (bars) associated with them'.

Since the ability to sustain benefits or make decisions is difficult to assess, it would be difficult for project teams to know the extent to which a specific application could be improved towards sustaining benefits. Here, network perspectives on the evaluation of aid interventions, as advocated by Davies (2003), could be explored to assess aspects such as the capacity for decision-making, for example. Since this is an aspect that would be difficult to quantify in practice, it is expected to remain a theoretical consideration for the foreseeable future. However, it is well worth considering when interventions are required to 'tick the boxes' on the multiple dimensions of sustainability.

With respect to the capacity of the framework to explain what is happening, in terms of theory (point 3), the framework succeeds in doing so, based on the assumptions that are made. However, multiple alternatives exist for explaining decision-making in complex systems, and these could be employed to the same end. For example, alternative perspectives such as agile value chains or value grids could be considered to enhance the perspectives on value creation that were adopted in Chapter 6.

Future work (based on framework content):

- Exploration of measures to assess the quality of current practice and the potential for improvement within a specific ICT4D intervention.
- Exploration of alternative perspectives on specific elements of the framework, such as the constructs of value creation.

C. Limitations of application

The framework is presented at a conceptual level, as a means within which operationalisation of the sustained benefit could take place. The expert review highlighted the need for facilitators to be experienced in the use of the framework as a concern. For uptake and on-going use of the framework, further work is required to guide the operationalisation thereof.

This concern is also related to the development of an appropriate schema for communication of the framework. It is in line with Gregor and Hevner (2013), who calls for an appropriate strategy for communication of the work, so as to enhance its uptake and value.

Future work (based on framework application):

Development of a practitioners' guide for useful and consistent implementation of the framework, and an appropriate schema within which to communicate the work.

11.6. SUMMARY

This research set out to explore a means of operationalising the concept of sustainability. It chose decision-making as the focal point for the integration of the multiple perspectives and forces that influence the outcome of an ICT4D intervention, and as the focal point for value creation. As such, it engaged with the capacity of stakeholders to understand the benefits that they intend to deliver, and to structure themselves in a manner that would enable them to make decisions that will ensure that benefits are created and maintained. It considered coordination of decision-making towards value creation as the purpose of the framework.

The research proposed the concept of *sustained benefit* as a means of capturing the specific intent of sustainability at the project level. The study used an iterative approach, guided by the Design Science Research process, to develop the decision framework, and succeeded in demonstrating the potential usability of decision-making as a focal point when seeking to sustain benefits.

The knowledge contribution of this research is primarily at the conceptual and methodological level. It answered the primary research question of defining the elements of a proposed decision framework, and of integrating them through the overall goal of sustained benefit. In the process of framework development, the research explored both theory (through literature) and practice (through case studies).

In earlier business and social contexts, decision-making was often the privilege and right of individuals at specific levels of a hierarchical structure. This resulted in well-structured and seemingly simplistic decision problems, for which optimal answers could be sought. However, as complexity increased, the number of decision makers that influence change accordingly increased. Within this collective of decision-makers and their less structured nature of interaction, decisions problems are more complex and less easy to solve, and optimality is as a rule not achievable. This complexity is further exacerbated under resource constraints, where decision-makers tend to seek local optimums such as least-cost solutions to the detriment of overall progress.

This research examined decision-making for sustained benefit from the perspective of a virtual network of decision-makers, and refocused decision-making from a search for optimality towards milestones along a path of value creation. It challenges decision-makers to understand their role and contribution within a wider network, and to reflect and agree on what ‘change for the better’ means within their context. This *network* and *value* focus establishes a basis from which a theory for decision-making in the messy context of ICT4D implementations could be developed.

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APPENDIX A. Analysis of literature: sustainability

Authors	Title	Year
M S Akter, J Rajasekera, ...	Serving the poor by marketing information: developing a sustainable village phone model in Bangladesh	2010
Maryam Ali, Savita Bailur	the Challenge of " Sustainability " in Ict4D – Is Bricolage the Answer ?	2007
J Antin	Cultural assessment for sustainable kiosk projects	2006
K Appolis, B Alexander	Sustainable m-Governance strategies for communities in tension: exploring the role of the grassroots champion	
A D Ayoung, B Sigweni, P Abbott	Case-based reasoning system for predicting the sustainability of a telecentre	2015
Arlene Bailey	Issues affecting the social sustainability of telecentres in developing contexts: A field study of sixteen telecentres in Jamaica	2009
Joseph Barjis, Gwendolyn Kolfschoten, Johan Maritz	A sustainable and affordable support system for rural healthcare delivery	2013
S.Batchelor, P. Norrish	sustainable ICT case histories	2003
S. Batchelor, P. Norrish	Framework for the assessment of ICT pilot projects	2005
Michael L. Best, Rajendra Kumar	Sustainability Failures of Rural Telecenters: Challenges from the Sustainable Access in Rural India (SARI) Project	2008
Adam Blake, Margarita Quiros Garzon	Boundary objects to guide sustainable technology-supported participatory development for poverty alleviation in the context of digital divides	2012
Anna Bon, Jaap Gordijn, Hans Akkermans	A Structured Model-Based Approach To Preview Sustainability in ICT4D	
J Breytenbach, C De Villiers, ...	Communities in control of their own integrated technology development processes	2013
M J Casany, M Alier, M Barcelo	Integration of M-learning and LMS: A sustainability approach	2012
W S Cheah, A B Masli, E Mit	Sustainability Modelling of e-Commerce for Rural Community: A Case from Long Lamai e-Commerce Initiative	2013
Thomaz Chianca	OECD/DAC criteria for international development: An Assessment and Ideas for improvement	2008
A Ciaghi, A Villafiorita, L Dalvit	Understanding Best Practices for ICTD Projects: towards a Maturity Model	
A P da Silva, W D Fern	Sustainability of ICTD Projects and Its Influencing Factors: A Comprehensive Literature Review	2016
S Easter, R Ewins	Funding for E-learning in Africa: A Question of Sustainability	
D A Egbe, M B Mutanga	Technical sustainability in rural ICT deployments in South Africa	2016
J GÅRDSTEDT, N O A JULIN, J TÖRNQVIST	A study of the preconditions for a sustainable implementation of a digital health system in Uganda	2013
Marije Geldof, David J Grimshaw, Dorothea Kleine,	What are the key lessons of ICT4D partnerships for poverty reduction?	2011

Authors	Title	Year
Tim Unwin		
Sibukele Gumbo, Hannah Thinyane, Mamello Thinyane, Alfredo Terzoli, Susan Hansen	Living Lab Methodology as an Approach to Innovation in ICT4D : The Siyakhula Living Lab Experience	2012
V. Harris, RW., Kumar, A., and Balaji	Sustainable Telecentres? Two Cases from India Harris, RW., Kumar, A., and Balaji, V.	
Richard Heeks	ICT4D 2.0: The next phase of applying ICT for international development	2008
Richard Heeks	ICT4D 2016: New Priorities for ICT4D	2016
Richard Heeks, Alemayehua Molla	Impact Assessment of ICT-for-Development Projects: A Compendium of Approaches	2009
L Hosman	Making the transition from pilot to scale: examining sustainability and scalability issues in a public–private telecenter partnership in Sri Lanka	2011
I Howard	Unbounded Possibilities: Observations on sustaining rural information and communication technology (ICT) in Africa	2008
F Hussain, R Tongia	Community radio for development in South Asia: A sustainability study	2007
A Iluyemi	Ensuring sustainable internet access for development in Africa: Insights from mHealth innovations	2008
S J Jacobs, Marlien E Herselman	An ICT-Hub model for rural communities	2005
N R Jere, M Thinyane, A Terzoli	Development of an ICT road map for eservices in rural areas	2011
P Joubert	Using a socio-technical maturity model to assist in the sustainability of ICT4D projects	2008
Jecinta Kamau, Andrew Reberio-Hargrave, Hiroaki Saito, ..., Emran Abdullah, Hiroshi Okajima, Ashir Ahmed	Social services on wheels: A sustainable model to improve access in unreached communities	2014
L Kendall	Opportunities, constraints and challenges to the introduction of ICT services for sustainable agricultural development in West Bengal, India	2015
M S Khalid, T Nyvang	From change agent to sustainable scaffolding?	2014
K Khovanova-Rubicondo, W Kyewalyanga	Kasambya Computer Center—From community initiative to self-sustainable enterprise	2010
W S Kisan, A S Dadabhau, K Singh	Factors affecting the sustainability of ICT intervention for agricultural development-A review	2013
Dorothea Kleine, Tim Unwin	Technological Revolution, Evolution and New Dependencies: what's new about ict4d?	2009
D Kumar	Why Institutional Partnerships Matter: A Regional Innovation Systems Approach to Making the Ict4d Projects More Successful and Sustainable	2010
Rajendra Kumar, Michael L. Best	Impact and Sustainability of E-Government Services in Developing Countries: Lessons Learned from Tamil Nadu, India	2006
Richa Kumar	eChoupals: A Study on the Financial Sustainability of Village Internet Centers in Rural Madhya Pradesh	2004
Hannu Larsson, Åke Grönlund	Future-oriented eGovernance: The sustainability concept in eGov research, and ways forward	2014
Natalie Leon, Helen Schneider, Emmanuelle Daviaud	Applying a framework for assessing the health system challenges to scaling up mHealth in South	2012

Authors	Title	Year
	Africa.	
Chun Liu	Sustainability of rural informatization programs in developing countries: A case study of China's Sichuan province	2016
Shirin Madon, Nicolau Reinhard, Dewald Roode, Geoff Walsham	Digital Inclusion Projects in Developing Countries: Processes of Institutionalisation	2007
C Mahonge	Factors behind sustainability of activities in the post-project period in Matengo highlands in Tanzania	2015
M S N Mamba, N Isabirye	A framework to guide development through ICTs in rural areas in South Africa	2015
H T Manara	Factors Affecting Sustainability of ICT4D: A Case Study of Mobile-Cinemas in Rural South Africa	2015
M A Marais	Thinking about Sustainable Development : Engaging with societal and ecological concepts	2010
Mario Marais	Analysis of the factors affecting the sustainability of ICT4D initiatives	2011
Mario A Marais	ICT4D and Sustainability	2015
Silvia Masiero	Financial vs Social sSustainability of telecentres: mutual exclusion or mutual reinforcement?	2010
Stuart Mathison	Increasing the Outreach And Sustainability of Microfinance through ICT Innovation	2007
T Mawela, N M Ochara, N O Muganda, T Mawela	Sustainability of e-participation through mobile technologies	2013
M Meddie, M Mayanja	Rethinking telecentre sustainability approaches	2006
J P T Moore, R Younger,	A sustainable information kiosk driven by sound	2015
J Mwenda, M Turpin	A comparative analysis of approaches to apply the sustainable livelihoods framework to do impact assessment in ICT4D	2016
G Naik, K P Basavarajappa, S Joshi	Financial sustainability of E-governance Embedded rural telecentres (EGERT) in India	2011
H S A Nawi, N S A Shukor, Suzana Basaruddin, Siti Fatimah Omar, ..., Haslinda Sutan, Ahmad Nawi, Nur Syufiza, Ahmad Shukor, Suzana Basaruddin, Siti Fatimah Omar, Azizah Abdul, Rohaya Abu Hassan, Mohammad Ashri, Abu Hassan	Sustainability Criteria Model: A Field Study of ICT4D Project	2013
J Nayak	Sustainability of Government initiated (ICT) Information and Communication Technology projects for development: A Comparative study on Malaysia and India	2013
MJ Nissilä	Promises and pitfalls of open source software business in fostering sustainability	
C Pade-Khene, B Mallinson,	Sustainable rural ICT project management practice for developing countries: investigating the Dwesa and RUMEP projects	2011
Caroline Ileje Pade	An investigation of ICT project management techniques for sustainable ICT projects in rural development	2006
Caroline Ileje Pade, Brenda Mallinson, Dave Sewry	An exploration of hte critical success factors for the sustainability of rural ICT projects - the Dwesa case study	2009

Authors	Title	Year
R Palmer	ICT4D and the Siyakhula Living Lab: an anthropological contribution to digital development	2010
S Pouezevara, S W Mekhael,	Planning and Evaluating ICT in Education Programs Using the Four Dimensions of Sustainability: A Program Evaluation from Egypt	2014
M Pscheidt, T van der Weide	Sustainability of collaborative information system development projects K a North-South case study	2010
GianLuca Quaglio, Claudio Dario, Theodoros Karapiperis, Laura Delponte, Sarah Mccormack, Göran Tomson, Giorgio Micheletti, Laurent Bonnardot, Giovanni Putoto, Paolo Zanaboni	Information and communications technologies in low and middle-income countries: Survey results on economic development and health	
R Ramírez	Participatory monitoring and evaluation of ICTs for development	2010
C R Ranjini	Challenges of Sustaining Health Information Systems: A Case of E-Governance Partnership in the Public Health Sector	2014
I Rega	What do local people think about telecentres? A key issue for sustainability	2010
J R Van Rensburg, B Cronje, U Du Buisson	Infopreneurs in service of rural enterprise and economic development: Addressing the critical challenges of scalability and sustainability in support of service …	2010
J Van Rensburg, U Du Buisson, B Cronje, M Marais, .	Beyond 'Technology for Development'and 'Sustainability'towards systemic and holistic rural innovation: Success factors from the Southern African experience over 20 …	2014
C Rey-Moreno, A G SABIESCU,	Chapter seven: towards self-sustaining community networks in rural areas of developing countries: understanding local …	2014
Patricio Rodríguez, Miguel Nussbaum, Lioubov Dombrovskaia	ICT for education : a conceptual framework for the sustainable adoption of technology-enhanced learning environments in schools	2015
Kobus Roux, Mario Marais	Design for sustainability: Rural connectivity with village operators	2011
C Royal, G S S Windsor	Microfinance, crowdfunding, and sustainability: A case study of telecenters in a South Asian developing country	2014
T A Sanner, J I Sæbø	Paying per diems for ICT4D project participation: A sustainability challenge	2014
Maung K. Sein, Irtishad Ahmad, G. Harindranath	Sustaining ICT for development projects: The case of Grameenphone CIC	2008
Sekhar	Evaluation of sustainability in e-governance initiatives	2015
S Sharma	Rethinking Financial Sustainability in the Context of Telecentre as a Social Enterprise	2011
A Da Silva, W D Fernandez	Beyond Free Lunch: Building Sustainable ICT4D.	2013
Surmaya Talyarkhan	Connecting the first mile : a framework for best practice in ICT projects for knowledge sharing in development	2004
Maureen Tanner, Andries du Toit	The influence of higher education institutions on the sustainability of ICT4D initaitives in underserved communities	2015
K Toyama	ICT4D Research and Potential Sustainability	2009

Authors	Title	Year
K Toyoma	The Challenge of Sustainability: the Difficulty of Operating Rural PC Kiosks	2005
Tim Unwin	ICT4D Implementation: policies and partnerships	2009
Donna Vaughan	The importance of capabilities in the sustainability of information and communications technology programs: The case of remote Indigenous Australian communities	2011
A Veldsman, D D van Greunen	ICT interventions for socio-economic development??? A practitioner's view	2015
Matthew Walton, Richard Heeks	Development Informatics Improve ICT4D Project	2011
S S Windsor, C Royal	Different telecentre models in ICT for development and their impact on organizational sustainability	2014
Z Zaremohzzabieh, B A Samah,	Youth’s sustainable livelihood with information and communication technologies: toward an ICT for development quality model	2014
I Zlotnikova, T van der Weide	Community outreach projects as a sustainable way of introducing information technology in developing countries	2015
M R De Zoysa, N Letch	ICT4D Project Sustainability: An ANT-based Analysis	2013
Coburn, Cynthia	Rethinking Scale:Moving Beyond Numbers to Deep and lasting change	2003
Kanungo	On the sustainability of rural information systems: analysis of preliminary experimental evidence	2001

APPENDIX B DRDLR ICT Hub project: Achievements against the Theory of Action

Source: CSIR Meraka Institute and Benita Williams Evaluation Consultants (2016)

The following table indicates the achievement of the project against the theory of action (ToA) as per the specific proposal titled: “The design and deployment of new container Digital Doorways, upgrading of existing 15 container Digital Doorways, and upgrading of connectivity in the 18 schools running the iSchoolAfrica Programme.” It does not reflect on the activities carried out outside of this specific proposal, or longer term, larger scale results that the DRDLR intends to achieve with this project.

Legend:

Green	Achieved
Orange	Partly achieved (or achieved form some sites)
~~Black and strikethrough~~	~~Not in scope of project~~
Purple	Long-term outcomes (three to five years). Cannot be assessed yet.

Table A.1: Revised Theory of Action of the DD Project

Inputs	Activities	Outputs	Short-Term Outcomes	Long-term Outcomes
DIGITAL DOORWAYS (DD) **Upgrading of the existing 9 container Digital Doorways and the 11 still to be deployed as part of the DST project**				
• Digital Doorway container and equipment (safe, tablets, printers, projector, sound system, Wi-Fi router, solar panels). • CSIR DD implementation team. • Service Providers and Suppliers.	• Assess the specific site requirements. • Prepare and deliver the 11 DD containers as part of the DST project. • Upgrade the 9 existing DD. (Upgrade DD Hardware and Software to improve functionality and performance).	• Report with requirements of each site. • List of communities where 11 DD are deployed. • List of communities where the 9 existing DDs were upgraded. • List of champions & their contact details.	• Communities have improved access to technology.	
SATELLITE CONNECTIVITY **Provision of satellite internet connectivity to all 58 sites (9 Container DDs + 11 DDs + 16 iSchool DDs and 22 new container DDs + Muxeye & Riemvasmaak eRap Centres and Goedgedacht).**				
• Funding and resources from DRDLR. • Service Providers (e.g. Liquid Telecom). • Satellite dish, modem, cables and other equipment.	• Contract a service provider for three years (recommended bandwidth of 1MBps). • Provide 16 iSchools with satellite connectivity for three years. • Provide 20 DDs with satellite connectivity for three years. • Provide 22 new DDs with satellite connectivity for three years. • Provide Muxeye, Riemvasmaak eRap Centers and Goedgedacht Centre with satellite connectivity for three years.	• Service provider contract for all sites. (Contract duration = three years) • List of iSchools where satellites are installed (16). • List of DDs where satellites are installed (20). • List of new DDs where satellites are installed (22). • Monitor report listing sites with connectivity. (Pandora monitoring system report).	• The project team are able to monitor the devices in the DD (uptime, usage etc.). • Community members have internet access. • Community members within 50m of DD are able to access and download content using their own devices without visiting the DD.	• Rural Communities have access to fully functional and well managed Digital Doorways. • Rural communities have access to online resources, information and services.

Appendix B

Inputs	Activities	Outputs	Short-Term Outcomes	Long-term Outcomes
NEW CONTAINER DD **The deployment of 22 new specification container Digital Doorways (8 under the old spec and 14 under the new spec).**				
• CSIR Meraka technical team. • DRDLR. • Container manufacturer • Contract?	• CSIR develops new container DD (prototype). • DRDLR approves new DD containers. • CSIR costs DD container. • CSIR deploys new DD container.	• Plans and specifications of new DD container. • New DD costing. • List of 22 sites where new DD containers are deployed.	• DRDLR and CSIR have access to specifications and costings for an upgraded DD. • Rural community members have access to improved facilities at the DD.	
TRAIN DD CHAMPIONS				
• NARYSEC youth. • CSIR Trainer / Training Service Provider. • Training Material (Developed by CSIR).	• Update training material. • Develop additional modules. • Train two DD champions per DD (9 + 11 + 22 = 42 DDs) X 2 champions = 84 champions over a 10 day training programme.	• Training schedule. • Attendance list of participants of training sessions. • Training material. • Training evaluation forms.	• DD Champions have technical knowledge. • DD Champions fully understand their roles and responsibilities. • Communities have access to clean and functional equipment at the DD.	• NARYSEC Youth (DD Champions) are employed. • NARYSEC youth (DD Champions has enhanced skills set.
OPERATION OF THE DD				
• DD champions. • Community Members. • Meraka technical team (Call Centre) • Company providing higher level support.	• DD Champions ensure DD is open during operating hours. • DD Champions provide technical support for users. • DD Champions provide first level IT support to ensure equipment is in a working condition. • DD Champions ensures the Digital Doorway equipment is secure. • DD Champions inform the community about the use of and benefits of the DD.	• Deployment instructions to each Champion from DRDLR. • DD Doorway operating hours. • Call center incident reports logged by DD Champion. • Equipment is in a working order. • Call center logs of technical problems logged using monitoring tools. • List of issues that arise at sites reported to technical team at weekly meetings (Ad-hoc process) • Daily SMS monitoring data collected from each champion.	• DD Champions assist community members at DD. • Community members have improved access to technology. • Community members have access to devices, Wi-Fi. • Community members can connect to the internet using their own devices. • Community members are able to access their emails and download content.	• Communities are able to access, utilise and share information and knowledge

Inputs	Activities	Outputs	Short-Term Outcomes	Long-term Outcomes
		• On-site Monitoring data from champions. (One site only)	• Community members are aware of the benefits and services available at the DD. • Rural communities are introduced to various technologies.	
• Funding. • DRDLR.	• ~~Pay stipend to DD Champions (NARYSEC Youth).~~	• ~~Pay slips.~~ • ~~Financial reports.~~ • ~~DD champion contract with NARYSEC and DRDLR is in place.~~	• ~~DD Champions receive a monthly stipend.~~	• DD Champions are supported by a technical team at the Call Centre. • Rural communities have access to a fully functional DD or e-Centers managed by a trained DD champion.
• CSIR • Outsourced ICT Operating System	• Set up Call Centre Protocol. • Resource the Call Centre. • Manage Call Centre. • Monitor technical status of all DD operations. • Deploy a Mobile Device Management (MDM) system	• Call Centre procedures documented. • Call Centre provide technical support to local DD champions. • Fault report (Call Centre and from DD Champion). • MDM System deployed. • Usage statistics: • Online/ connectivity statistics.	• Problems at Digital Doorways are addressed efficiently. • Problems are identified timeously and solutions are implemented. • Project team has information on technical status and use of DD to inform decision making.	
M&E AND SUSTAINABILITY MODELS **Conducting of an M&E process and development of a sustainability plan for the 42 (existing 9 container DDs + 11 still to be deployed as part of DST project + 22 to be deployed as part of this project) container Digital Doorways.**				
• CSIR DD Project team. • DRDLR Project team. • CSIR M&E team • Consultants	• Develop models and frameworks to enable replication of programme. • Monitoring programme implementation. • Evaluate the programme • Report on Monitoring and Evaluation	• Financial Model. • An operational plan with details on the processes and infrastructure needed to operate and manage a DD, internet connectivity and a wireless network was proposed to DRDLR. • M&E Framework. • Initial Implementation Evaluation Report • Quarterly reports • Integrated report (Dec 2015)	• Project outputs and outcomes are measured and this enhances decision making. • The project team and DRDLR can review progress, identify problems in planning and make adjustments in time. • Project is evaluated and recommendations are disseminated to stakeholders.	• DRDLR have models to enable replication of the project in other rural communities. • Project team and DRDLR adapts the project implementations (if required) and replicated to more rural sites. • A sustainable DRDLR DD network exists.

APPENDIX C DRDLR ICT Hub case: project-level decision map

PROJECT DECISION AREA	WHAT IS DECIDED?	DECISION MADE BY WHOM?	BASED ON WHAT INFO?	IMPLICATION	LINK TO SUSTAINABILITY / SUSTAINABILITY ELEMENT	COMMENT
INFRA-STRUCTURE	Internet /BB connectivity - bandwidth allocation to schools - satellite vs SANREN WiFi – scope Content server (with or without)	Component manager Contract manager Project manager	Research re user requirements & technology Cost-effectiveness as inputs to RFP Supplier responses to RFP Industry benchmarks Internal research know-how	Cost (TCO) vs effectiveness Maintenance & support model - standardisation vs diversity of equipment Quality of service	Financial Operations Supply chain (supplier ecology) Social (long-term buy-in of users and owners)	No detailed national guidelines regarding infrastructure, except national broad policy No inputs from schools or provinces re user requirements
TECHNOLOGY (DD)	Connectivity (wi-fi, satellite) Printers Safe and tablet charging stations Tablets Container Software (O/S; network monitoring) Environmental monitoring systems Solar equipment	Contract manager Technical team Operations consultant	Existing DD technology knowledge (historic decisions) *Requirements* - Client requirements - Design requirements *Suppliers* - availability - ability to deliver in time - supplier responses to RFPs (best quality and performance rated higher than cost) Support and maintenance contract for equipment Customised platform (the DD) TCO	Cost (TCO) Longevity (durability) User experience (tablet, printer) Fit for purpose Maintenance, warranty & support model	Financial Operations Social (long-term buy-in of users and owners) Technical - unique products (keep stock) Operations Supply chain (supplier ecology)	

PROJECT DECISION AREA	WHAT IS DECIDED?	DECISION MADE BY WHOM?	BASED ON WHAT INFO?	IMPLICATION	LINK TO SUSTAINABILITY / SUSTAINABILITY ELEMENT	COMMENT
TECHNOLOGY (UPGRADES)	**As above PLUS:** **-** replace ageing equipment - increased energy demand due to client requirements (refurbishment & upgrades; replacement) - move DD's	Client Contract manager Technical team	Cost effectiveness Client requirements Technical feasibility TCO Learning re. prior experience (battery lifetime).	Cost (TCO) Durability Diversity of technology supported	Financial Operations Supplier ecology Technical - unique products (keep stock)	
TECHNOLOGY (SCHOOLS)	Connectivity (wi-fi, sat) DD content server Server cabinet with equipment Wi-fi coverage area in school (one location or whole school & outside school)	Client Contract manager Technical team Operations consultant.	Client requirements Technical feasibility TCO.	Effective use of tablets supported by Wi-Fi enabled access to Internet.	Financial Operations Effective use of existing equipment (tablets). NARYSEC youth technical support. Update of content of tablets via Internet.	Did not take school requirements into account, Proposal written, then client changes requirement, built in 10% contingency fund) Need to choose how to use contingency fund. Delay in time to rewrite wi-fi technical spec for the RFP process

Appendix C

PROJECT DECISION AREA	WHAT IS DECIDED?	DECISION MADE BY WHOM?	BASED ON WHAT INFO?	IMPLICATION	LINK TO SUSTAINABILITY / SUSTAINABILITY ELEMENT	COMMENT
TECHNOLOGY (E-RAP &GGD)						
DD CHAMPION DEVELOPMENT	Selection of NARYSEC youth Content and type of training Content and nature of induction programme How to introduce to community Nature of champion support (mentoring) Ongoing training Performance assessment	DRDLR DD manager Meraka contract manager NARYSEC liaison Provincial DRDLR	DD operational requirements Service support requirements Service delivery requirements DRDLR portfolio of services	Appropriateness of DD champion User satisfaction Job satisfaction Turnover of DD champions Level of service delivery Scope and richness of services that can be delivered NARYSEC sustainability - human capital development	Financial Operations Social - use and uptake Social - skills development	Community requirements & existing E-rap centre & container DD experiences considered?
CHANGE MANAGEMENT	Community ownership model Role of provincial DRDLR	DRDLR DD manager	E-rap centre experience	Community ownership	Uptake Use	Approach to change management unclear
OPERATIONAL MODEL	Technology support model (local, central) (local, central) SLA – perf. parameters Exit strategy / transfer	DRDLR DD manager Meraka contract manager	BB4ALL experience with ops model	Cost Continued operations Performance Availability for use	Operations Uptake Cost / affordability Organisational (management)	
STAKEHOLDER MANAGEMENT	Which stakeholders to involve to ensure sustainability (govt and private sector)	National DRDLR		Engagement Support	Uptake Use Financial Operations	
SUPPLIER MANAGEMENT	Supplier management model Criteria for procurement of service providers	National DRDLR Meraka contract manager	ICT4RED , BB4ALL and E-rap centre experience	Service delivery	Financial Operations Social (uptake & use)	

PROJECT DECISION AREA	WHAT IS DECIDED?	DECISION MADE BY WHOM?	BASED ON WHAT INFO?	IMPLICATION	LINK TO SUSTAINABILITY / SUSTAINABILITY ELEMENT	COMMENT
RESOURCE ALLOCATION	Nr of DDs per area Bandwidth Equipment Management capacity Technical support (scope)	National DRDLR Meraka contract manager	DRDLR demographic information (households)? Project objectives Service portfolio	Service delivery (scope & SLA) Financial Operations	Financial Operations Social (uptake & use)	
COMMUNITY ENGAGEMENT	Community ownership model					Approach still to be decided
SITE SELECTION	List of DD sites,	DRDLR national and provincial	Distressed Districts and additional locations, certain municipalities prioritised? DRDLR says they choose areas as to where they should be active? Political interference?	Cost increases. Project delays due to top down decision, people on the ground not ready to accept DD or want DD. Uncoordinated deployment (divide DDs equally per province in each round of deployment).		Saturation of an area - loss of reach and hence loss of impact. Late deployment decisions due to political influence. Rivalry between provinces (they all want DDs at the same time!).

APPENDIX D Comparison of case studies

	ICT4RED		DRDLR ICT Hubs	
Framework element	*New perspectives generated*	*Omissions or learning*	*New perspectives generated*	*Omissions or learning*
I. Network of decision makers	Decision makers at different spheres of influence were identified A sequence in decisions as well as potential conflicts could be identified	The completeness of information would depend on the experience and insight of the project team. This may require repeated application of the framework. The prioritization of decisions relative to sustained benefit may be required.	Decision makers at different spheres of influence were identified, *and omissions to include specific decision makers were identified* A sequence in decisions as well as potential conflicts could be identified *Decisions were plot relative to value creation, as such highlighting shortcomings in the scope of decision-making.* *The influence of decision-making on different project process areas were identified*	The completeness of information would depend on the experience and insight of the project team. This may require repeated application of the framework. The prioritization of decisions relative to sustained benefit may be required. *The value contributed by the Strategic/ Tactical/ Operational perspectives is not clear.*
II. Value and sustained benefit	Multiple values and benefits were identified, emphasizing the need for communication and prioritization.	Multiple values and benefits require that value and benefit be prioritised, and require clarity about specific disablers and enablers of value creation.	*A relatively limited (short term) view on benefits was identified, highlighting the need for a broader perspective, and for mechanisms that transcends the current project towards longer-term benefit.*	*A link is required between value creation and the way in which the project process can support value creation*
III. Theory and construct of value creation	As above	As above A generic construct of value creation proved to be useful in reflecting the role of decision makers (rather than the stated theories of change and research frameworks as defined by the project).	As above	As above A generic construct of value creation proved to be useful in reflecting the role of decision makers.
IV. Project process	The modularity of the ICT4RED implementation could be linked to its contribution to sustain benefits	While modularity can enable sustained benefit, it can also frustrate it if modularity creates silo thinking within the project team, and if the team is not aligned in terms of benefits and constraints. This implies that a tight coupling between project process and other framework elements is required.	*A project process could be defined that would address disablers of change, and facilitate enablers*	*Project process changes are linked to the view that is taken on value creation.* As before, this implies that a tight coupling between project process and other framework elements is required.

	ICT4RED		• **DRDLR UCT HUBS** •	
Conceptual perspective	This perspective created new insights that made value creation and its mechanisms visible	The experience and skill of the analyst, and knowledge about the project environment, could influence the quality of the analysis. This analysis should be repeated more than once during the project process.	*This perspective aided in highlighting the omissions in value creation, and the gap in translating short-term to long-term value creation*	As before: the experience and skill of the analyst, and knowledge about the project environment, could influence the quality of the analysis. This analysis should be repeated more than once during the project process.
Analytical perspective	This perspective generated new insights with respect to the structuring of decision-making	The practical implications of this perspective are not necessarily immediately clear. Some additional mechanisms may be required in the framework to address this.	This perspective generated new insights with respect to the structuring of decision-making *and its influence on value creation*.	Some of the practical implications of this perspective are that conflicts and omissions in decision-making are highlighted. *However, more detail may be required to translate this into useful information for practitioners.*

APPENDIX E EXPERT REVIEW QUESTIONNAIRE

The SurveyMonkey® questionnaire displayed the following screens:

Evaluation of a Decision Framework for Sustained Benefit in ICT4D

A framework for decision support has been developed to assist stakeholders in an ICT4D intervention to sustain the benefits that they create, in response to the following research question:

What are the elements of a framework that support strategic decision-making for sustained benefit in the design and implementation of ICT4D projects in resource-constrained environments?

The audience for the framework is all decision makers that influence the outcome of the ICT4D intervention. Decision makers include *any stakeholders* in the intervention that affect decision making. Ideally, *all stakeholders* should be involved. Decision makers are drawn from multiple organizations, thus forming a "virtual organization" of decision makers that collaborate around the intervention under consideration.

It is foreseen that intervention coordinators would use the decision framework as a means of eliciting new perspectives on the intervention, by exploring each of the five framework elements in collaboration with all stakeholders. Intervention coordinators could (for example) be a project team of an implementing organization that roll out a funded intervention, or a structure within the community that get together to facilitate change through an ICT4D intrevention.

Ideally, the use of the framework would lead to adaptations of the intervention to better facilitate sustained benefit.

This survey seeks your (first impression) views on how well the framework contributes towards answering the above research question. Some background is provided first, followed by the survey questions.

Next

FRAMEWORK OVERVIEW

The framework comprises the elements outlined below. The intent is that the coordinators of an ICT4D intervention would brainstorm the five elements with all the stakeholders involved in the intervention.

Click on the relevant links for a summary overview of the framework elements, or a brief description of each individual element. The latter includes examples of how the framework can be discussed and how results of the discussion can be represented or analysed. Howeverm, these are not prescriptive. Coordinators can implement and discuss elements in a manner that is appropriate to their environment.

The pages that follow will lead you through an evaluation of five different aspects of the framework (goal achievement, appropriateness to the ICT4D environment, structure, usefulness, and adaptability).

Follow the hyperlinks below before proceeding to the survey.

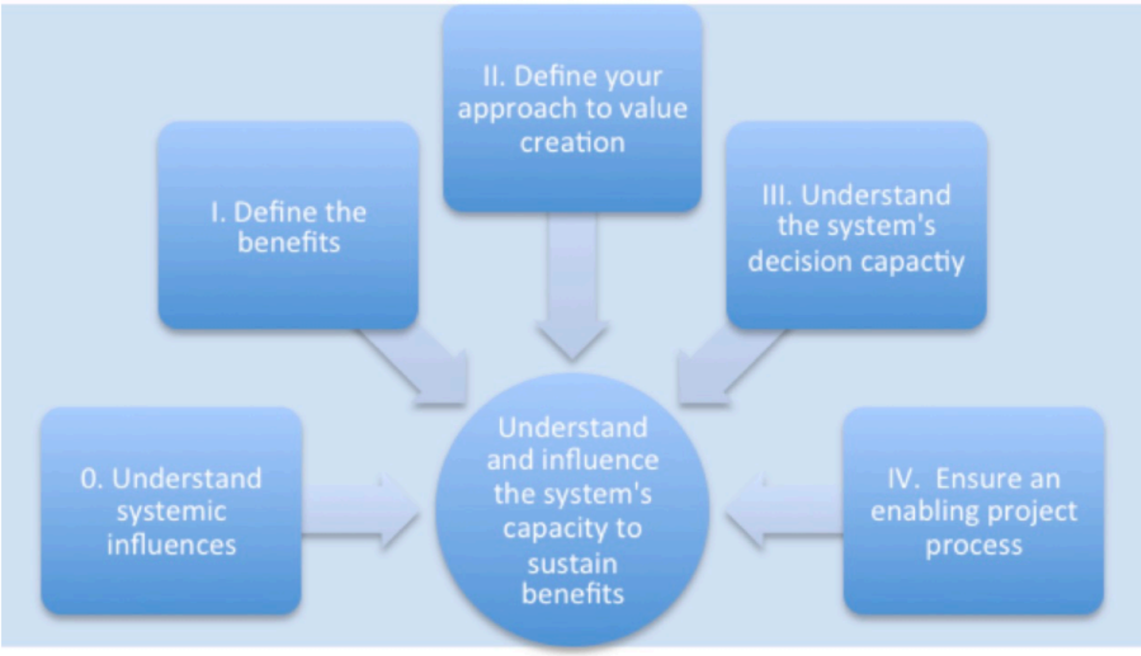
LINKS TO FRAMEWORK DESCRIPTION

Quick overview: summary table

More detail

0. Understand systemic influences   1. Define the benefits   2. Define your approach to value creation
3. Understand the system's decision capacity   4. Ensure an enabling project process

FRAMEWORK OVERVIEW



Prev   Next

Note: *The hyperlinks in the survey guided the user to a description of each element. The descriptions are included at the end of this appendix.*

Q1. GOAL

Rate the extent to which the decision framework will enable practitioners to:

	Not at all	Somewhat	Undecided	Good	Excellent
Understand the influence of the various stakeholders on decision making	○	○	○	○	○
Make each stakeholder's perception of benefits visible	○	○	○	○	○
Develop agreement on the benefits to be sustained	○	○	○	○	○
Adjust project planning towards sustained benefit	○	○	○	○	○
Enhance the ability to sustain benefits from the ICT4D implementation	○	○	○	○	○

Comments

Prev Next

Q2. APPROPRIATENESS FOR THE ICT4D PROBLEM ENVIRONMENT

Rate the extent to which the framework is relevant to the following aspects of ICT4D problems

	Not at all	Somewhat, but not sufficiently	Undecided	Relevant	Very relevant
People: The community of decision makers that affect the ability to sustain benefits	○	○	○	○	○
Process: The spectrum of processes and organizational structures that affect the ability to sustain benefits	○	○	○	○	○
Technology: The spectrum of technologies that could be applied in ICT4D problems	○	○	○	○	○

Comments

Prev Next

Q3-1 FRAMEWORK STRUCTURE

How relevant is each of the following framework elements to the goal of guiding decision making towards sustained benefit?

	Not relevant at all	Somewhat relevant	Neutral	Relevant	Very relevant
0. Understand systemic influences	◯	◯	◯	◯	◯
1. Define the benefits	◯	◯	◯	◯	◯
2. Define the approach to value creation	◯	◯	◯	◯	◯
3. Understand the system's decision capacity	◯	◯	◯	◯	◯
4. Ensure an enabling project process	◯	◯	◯	◯	◯

Prev Next

Q3-2 FRAMEWORK STRUCTURE

How important is each of the following framework elements to the goal of guiding decision making towards sustained benefit?

	Not important at all	Somewhat unimportant	Neither important nor unimportant	Somewhat important	Very important
0. Understand systemic influences	◯	◯	◯	◯	◯
1. Define the benefits	◯	◯	◯	◯	◯
2. Define the approach to value creation	◯	◯	◯	◯	◯
3. Understand the system's decision capacity	◯	◯	◯	◯	◯
4. Ensure an enabling project process	◯	◯	◯	◯	◯

Comments

Prev Next

Q3-3 FRAMEWORK STRUCTURE

Have any critical elements been omitted from the framework?

- ◯ Yes
- ◯ No
- ◯ Unsure

If yes, please describe the elements that you would want to have included in the framework

Prev Next

Q4 USEFULNESS

Do you expect the framework to deliver a useful result?

- ◯ No, not at all
- ◯ It could be somewhat useful
- ◯ Unclear
- ◯ Yes, it will be useful
- ◯ It will be very useful

Comments

Prev Next

Q5 ADAPTABILITY

The framework leaves the way in which the various elements is implemented open to the practitioner. As such, it allows for learning and change between different iterations of use of the framework.

Rate the adequacy of this mechanism in enabling evolution of the framework

	Not adequate at all	Somewhat adequate	Neutral	Adequate	Completely adequate
How adequate?	◯	◯	◯	◯	◯

Comments and suggestions

Prev Next

End of Survey

Thank you for your participation!

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Prev Done

The links on the survey led the user to the following element descriptions:

ELEMENT 0

Understand systemic influences

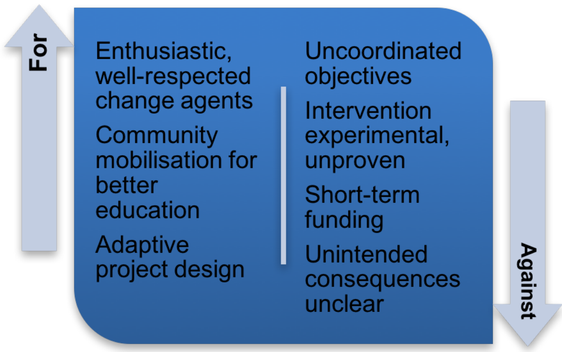
Background

This element focuses decision makers' attention on the alignment between their intended benefits and the forces in the underlying socio-technical system that may counter their realization. It differentiates between drivers that are inherent in the nature of the beneficiary system, and drivers that are inherent in the nature of the development intervention. It is presented in the form of a number of questions to be debated around each of the two levels.

Purpose

Ensure that the intervention is aligned with the dynamics of the beneficiary system that will facilitate or disable sustained benefit, and that these are influenced appropriately

Example discussion outcomes



Reflection

- Are drivers against sustainability understood, or is more work required?
- Is an understanding of drivers shared among shareholders?
- Are mechanisms in place to counter such drivers and manage risks?
- Are mechanisms in place to manage possible unintended consequences?

Example: questions to debate

Change drivers in the beneficiary system	***Alignment of the development intervention***
Who initiates change in the beneficiary system? Is the intervention aligned with change drivers in the beneficiary system? ***What level and type of change is possible?*** Disruptive or incremental? ***Is current change understood?*** Who are the change agents? ***Is the intended change appropriate?*** Is the relevance of the intervention on the	***Strategic intent and funding*** • Is the intent of the funding aligned with the needs of the beneficiaries? • Do multiple funding sources (if relevant) have conflicting objectives? • Is the intent of the implementing agency aligned with the need of the beneficiaries? • Will all benefits be delivered within the time span of the available funding? • Is all funding available to cover the objectives, or is it required to source more funding during the current span of funding? ***Adaptive project design*** • Is the design differentiated for different levels of readiness? • Is the design flexible and adaptable to different implementation environments? ***Familiarity with environment*** • Are the conditions under which technology will be

underlying reality proven? ***Is the proposed change aligned with the readiness of the system for change?*** • Literacy • Management capacity • Capacity • Etc. ***What are the possible unintended consequences of the intervention?***	rolled out understood? • Has the management capacity for taking over the project been assessed? • Is the capacity for uptake of technology understood? ***Resource-hungry solutions in resource-poor environments*** • Have the resource demands of the solution been assessed? • Is the availability of critical resources and capacity known?

ELEMENT 1

Define the benefits to be sustained

Background

This element is concerned with defining the intended benefits of the intervention, that is, the benefits that need to be sustained within the beneficiary system. To attain common ground and goal clarity around benefits, the following questions are proposed for consideration by decision makers:

- *Which benefits need to be sustained?*
- *By whom?*
- *For whom?*
- *For how long?*
- *What are the relative priorities of these benefits?*

Stakeholders are further expected to define how a particular benefit influences the underlying beneficiary system, and to consider the potential unintended consequences thereof. In addition, they are prompted to consider whether a view is taken on sustained benefit that balances multiple perspectives in an appropriate manner.

Purpose

Obtain clarity, visibility, and agreement among stakeholders of the benefits that need to be sustained, in sufficient detail to inform appropriate intervention design

Reflection

- Are all benefits defined in sufficient detail?
- Are all beneficiaries identified and participating in design?
- Is the point of realization, and duration, of the intended benefits accounted for by project design?
- Are adequate mechanisms in place to transfer the realization of benefits between parties (by whom')?
- Are systemic influences understood and risks mitigated as far as possible?
- Is the balance in focus between dimensions of sustainability adequate, or should the project design be adapted?

Example discussions

1. Define the intended benefits, intended influence, and unintended consequences for the underlying system; and
2. Explore the extent to which there is balance in the exploration of the various dimensions of sustainability.

BENEFITS					SYSTEMIC EFFECT	
What?	**For whom?**	**By whom?**	**For how long?**	**Starting when?**	**What is the systemic influence/ disruption?**	**What are the possible unintended consequences?**
Technology access	Community members Entrepreneurs Students	Project funders	Until the selected technology is out-dated	On roll-out	On-going low-cost access to information and communication capacity	Access to inappropriate content by youth Theft Corruption
Economic activity	Community	Financially sustainable community ownership of Hub	7 years after completion of the project	After adoption of technology	Income generated from local activity instead of external influx (grants, remittances)	Business development without adequate local market and external market access

ELEMENT 2

Define your approach to value

Background

This element is based on the assumption that decision-making should be guided by the manner in which value is created through the ICT4D intervention, and that alignment of decision making along a path towards value creation would improve the ability to create value. Decisions are seen as milestones on a path towards value creation, and choices between options are guided by the extent to which they contribute to, or detract from, long-term value creation.

It requires decision makers to define the premise upon which they intend to create value. Numerous constructs of value creation could be used, but this work is not prescriptive in terms of the manner in which value creation should be expressed. However, the essence of value creation should be captured, that is, an indication should be given of the various steps that are employed to change something through the ICT4D intervention, and how the steps are organized to create value.

Purpose

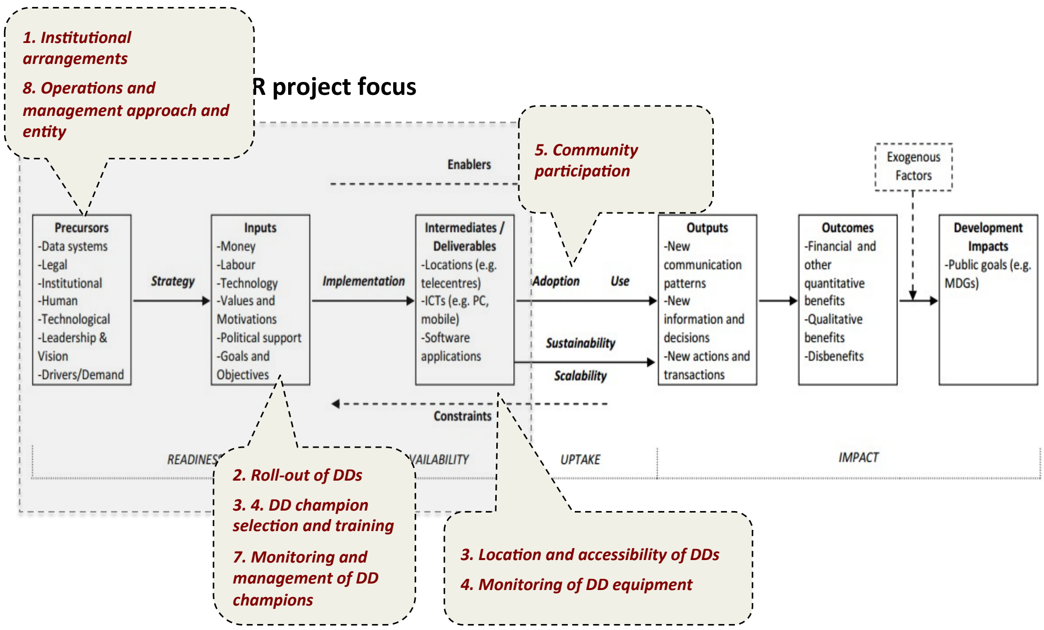
Obtain clarity, visibility, and agreement among stakeholders of the manner in which value will be created by the intervention, in such a way that a critical path towards value becomes clear

Reflection

- Is the process of value creation clear and shared with all stakeholders?
- Is the scope of the project covering all intended benefits?
- If not, are mechanisms in place to bridge project activities to ensure future benefits?
- Are risks and disablers known and managed?

Example analyses

1. Describe your path towards value creation: that is, on what premise are you creating value; what needs to happen and in which order (if any)? What value is created at each step?
2. Where is the focus of the project, as per its current definition? Does the scope of the project focus align with the scope of value to be created?
3. Where along the process are critical risks or disablers to sustained benefit, as the project is currently defined?



Example: construct of value creation (ICT4D value chain; Heeks (2014)), project focus (compare with intended value creation), and risks and enablers

ELEMENT 3

Understand the system's decision

Background

The key assumption of this element is that the combination of decisions that are made has a significant influence on the outcome of the ICT4D intervention. It considers decision making in the context of a network, and the element is intended to capture this networked nature and the influences on decision-making.

Purpose

Understand the influences of the multiple role players on decision-making and value creation, and mitigate the influences that oppose value creation

Reflection

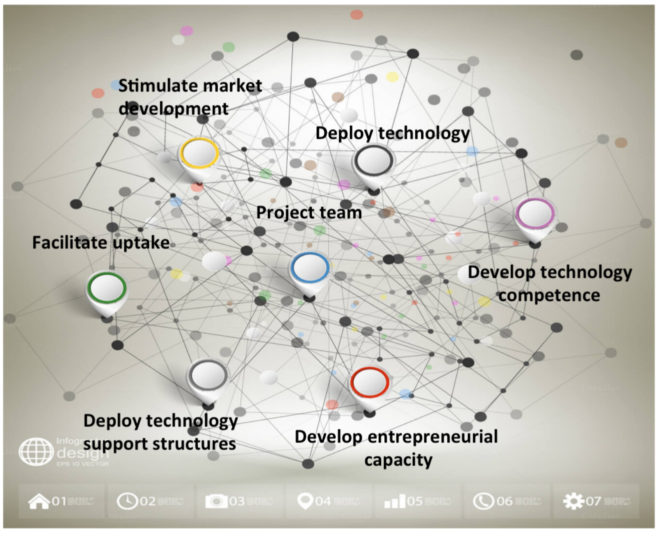
- Are all stakeholders and their influences on each other known?
- Are their involvement and influence in individual (value-affecting) decisions understood?
- Are all (relevant) stakeholders engaged when specific decisions are taken?
- Are plans in place to address the decisions that are not currently addressed?
- Are plans in place to mitigate decisions and influences that distract from value creation?
- Are decision support tools or mechanisms defined and used to add value, where appropriate?

Example analyses

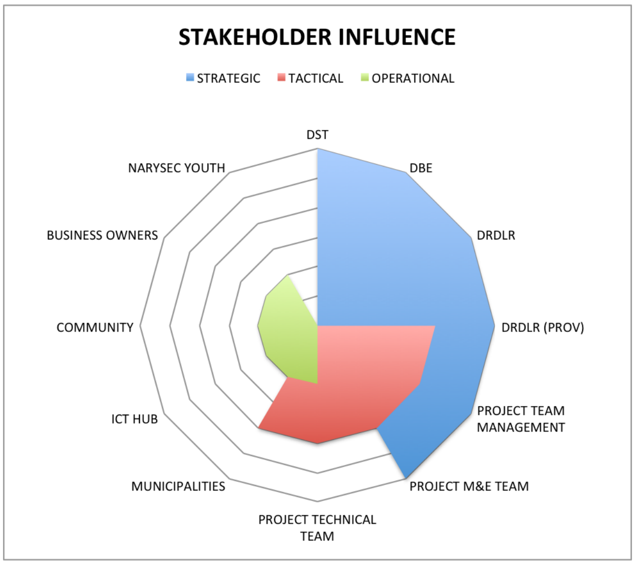
1. Who are the role players and what is their sphere of influence?
2. What decisions are made (and what gaps are there) in support of value creation?
3. What decision support tools could be useful to support value creation?

Some visual representations of answers to these questions are as follows:

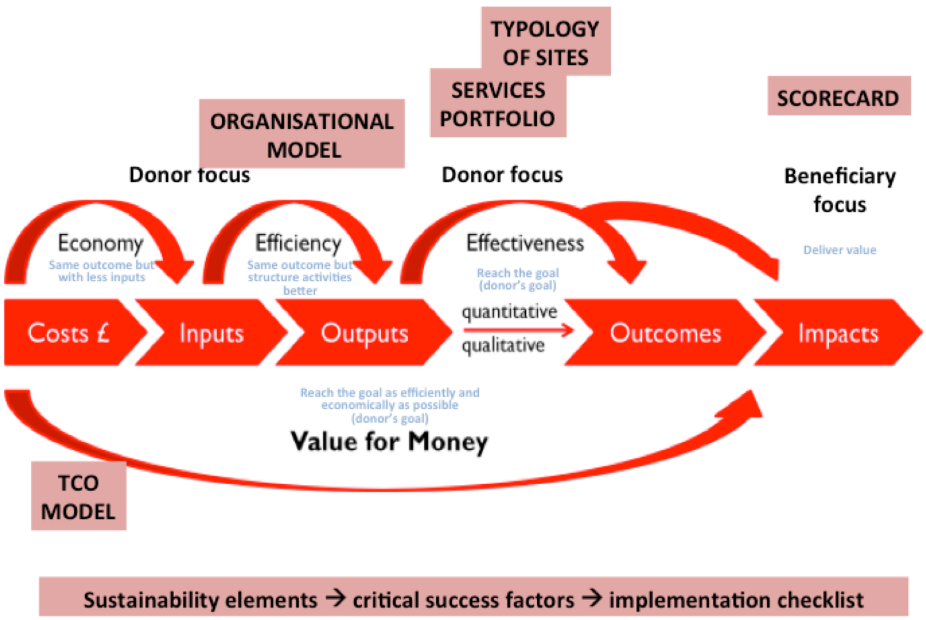
Decision makers in relation to activities that create value



Decision makers (small nodes) in relationship to



Different spheres of stakeholder influence and how they overlap (who influences at what level?)



Background

ELEMENT 4

Ensure an enabling project process

The project process is seen as an important enabler or disabler of value creation. Specifically, it is assumed to have the potential to facilitate or frustrate coordination between relevant decision makers at appropriate points in time. In addition, its structure may or may not support the inherent nature of the development process, which is not necessarily linear.

This framework element assumes that the project process should accommodate non-linearity, be flexible and adaptable to differences in the readiness of implementation environments, and facilitate a shared and common goal. Two questions are explored in the analyses (see *example analyses* below).

Purpose

Ensure that the project process allows rather than frustrates decision-making towards value creation

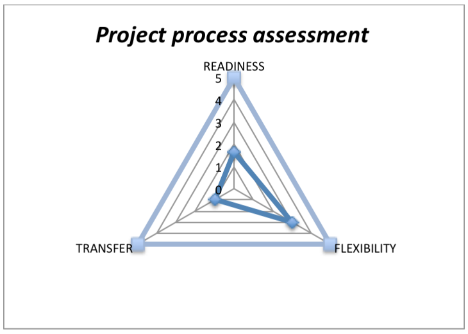
Points for discussion

- Do the characteristics of the project process facilitate benefits to be sustained?
- Is the influence of all relevant stakeholders on the project process understood?
- Are all relevant stakeholders engaged in each step of the project process?
- Are mechanisms in place to strengthen the capacity of decision makers relative to the project?
- Are critical decision makers and their (positive or negative) influence on the process recognized and managed
- Are the gaps or negative consequences of decision-making clear to all stakeholders?
- Are these gaps mitigated and/or managed?

Example analyses

1. Is the project process enabling benefits to be sustained?

It is proposed that the project process be evaluated against a number of characteristics. The extent to which the various characteristics are addressed could be assessed in the following checklist, and results represented graphically:



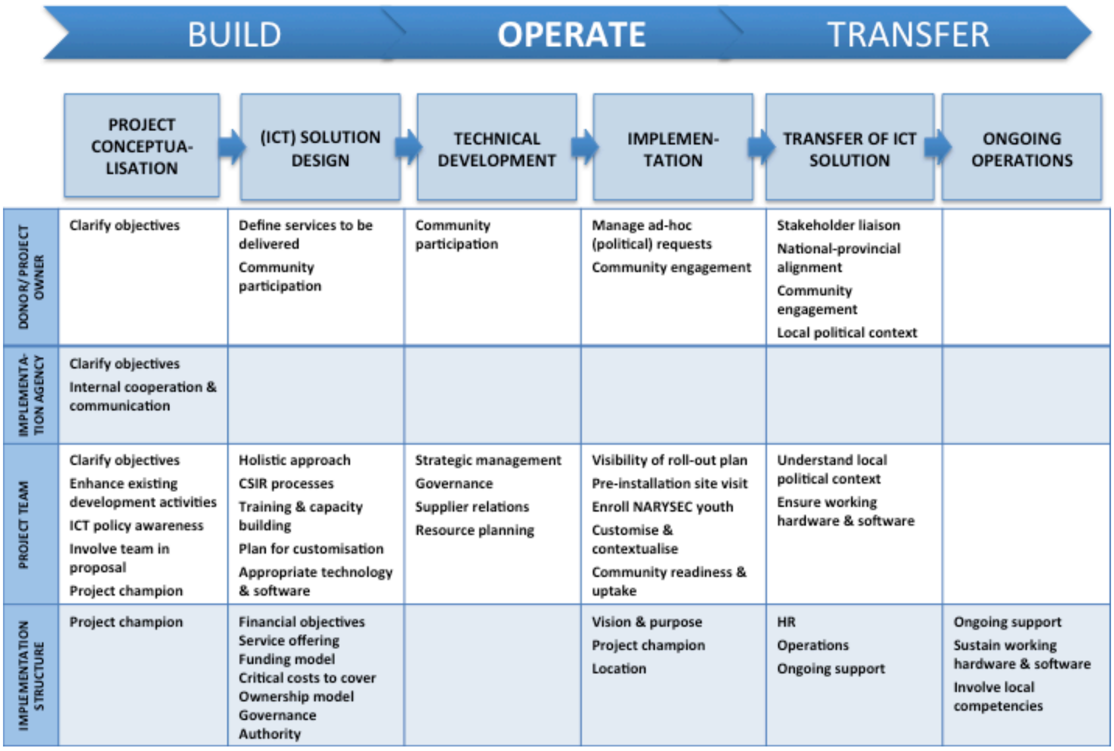
Ensuring an enabling project process	1	3	5
Readiness			
Process allows for readiness assessment		x	
Project design allows for different levels of readiness	x		
Project design allows for appropriate sequence of tasks; for example, technology access should not be available without appropriate preparation, etc.	x		
Average	1.67		
Flexibility			
Project process has a modular nature		x	
Project design allows for learning and adaptation			x

Monitoring and evaluation pro-actively informs decision-making at all levels	x		
Average		3	
Transfer			
Project design allows for structures to transfer project	x		
Project design allows for timeous transfer	x		
Project design addresses the appropriate scope of the ICT4D value chain	x		
Average		1	

1.

2. *Is decision-making enabling or disabling the project process?*

This question aims to highlight potential conflicts in decision-making (relative to the project process) that will affect the ability to sustain benefits. The intent is to represent the influence of different decision makers on the project process. Various representations can be employed, for example:



Influence of decision makers on the project process

This assessment is similar to that of the influence of decision makers on value creation (Framework element 3, discussed above). It seeks to higlight gaps in the involvement of relevant decision makers on the project process. In addition, it seeks to identify decision makers that are critical to specific project elements. In this example, a linear project process is assumed. However, similar analyses should be done for non-linear processes.

APPENDIX F. GUIDE TO FRAMEWORK ELEMENTS

This research concluded that future work should include the development of a practitioners' guide, so as to facilitate the practical application of the framework. As an interim measure, this section provides a brief summary of the framework elements, and an indication of where relevant questions and examples of application can be found in the text. It is intended to provide a guide through the text, rather than to repeat.

The following is summarised for each element:

- Purpose
- Key questions to answer
- Example analyses
- Example application in case studies
- Questions to guide interpretation of analysis

Framework detail can be found in Chapter 9 and Appendix E, and is not repeated here.

Purpose	*Key questions*	*Example analyses*	*Application in case studies*
Element 0: Understand systemic influences			
Ensure that the intervention is aligned with the dynamics of the beneficiary system that will facilitate or disable sustained benefit, and that these are influenced appropriately	***Change drivers*** 1. Who initiates change? 2. What level and type of change is possible? 3. Is current change understood? 4. Is the intended change appropriate? 5. Is the proposed change aligned with the readiness of the system for change? 6. What are the possible unintended consequences? ***Alignment*** 1. Is intent and funding aligned? 2. Is the project design adaptive? 3. Is the team familiar with the environment? 4. Is the solution too resource-hungry for a resource-poor environment?	Identify and visually represent drivers for and against change (Fig. 9.6) Rate the relative importance of drivers (Fig 9.6)	These perspectives were generated retrospectively as an omission of the project approach, and were not applied during the case studies
Questions to guide interpretation of analyses Are drivers against sustainability understood, or is more work required? Is an understanding of drivers shared among shareholders? Are mechanisms in place to counter such drivers and manage risks? Are mechanisms in place to manage possible unintended consequences?			

Purpose	*Key questions*	*Example analyses*	*Application in case studies*
Element 1: Define the benefits to be sustained			
Obtain clarity, visibility, and agreement among stakeholders of the benefits that need to be sustained, in sufficient detail to inform appropriate intervention design	1. Define the intended benefits, intended influence, and possible unintended consequences for the underlying system a. Which benefits need to be sustained? b. By whom? c. For whom? d. For how long? e. What are the relative priorities of these benefits? *2.* Explore the extent to which there is balance in the exploration of the various dimensions of sustainability.	Identify benefits and their intended influences (Table 9.9) Assess balance of effort in sustaining benefits (Fig. 9.7)	Value creation and sustained benefit (ICT4RED Table 7.10; DRDLR Table 8.13)
Questions to guide interpretation of analyses Are all benefits defined in sufficient detail? Are all beneficiaries identified and participating in design? Is the point of realisation, and duration, of the intended benefits accounted for by intervention design? Are adequate mechanisms in place to transfer the realisation of benefits between parties (by whom')? Are systemic influences understood and risks mitigated as far as possible? Is the balance in focus between dimensions of sustainability adequate, or should the intervention design be adapted?			

Purpose	*Key questions*	*Example analyses*	*Application in case studies*
Element 2: Define your approach to value creation			
Obtain clarity, visibility, and agreement among stakeholders of the manner in which value will be created by the intervention, in such a way that a critical path towards value becomes clear	1. Describe your path towards value creation: that is, on what premise are you creating value; what needs to happen and in which order (if any)? What value is created at each step?	Value chain analysis, value network analysis, decision network analysis (Fig. 9.8; 9.9)	Multiple perspectives on value creation (ICT4RED Table 7.9; DRDLR Table 8.12)
	2. Where is the focus of the intervention, as per its current definition? Does the scope of the intervention align with the scope of value to be created?	Visual analysis of the scope of intervention relative to the construct of value creation (Fig. 9.10)	Project scope against value chain (DRDLR Fig. 8.5)
	3. Where along the process are critical risks or disablers to sustained benefit, as the intervention is currently defined?	Risk analysis, visualised against the construct of value creation (Fig. 9.11)	M&E recommendations against project scope and value chain (DRDLR Fig. 8.6) Subjective assessment of sustainability of benefits (DRDLR Table 8.6)
Questions to guide interpretation of analyses Is the process of value creation clear and shared with all stakeholders? Is the scope of the intervention covering all intended benefits? If not, are mechanisms in place to bridge intervention activities to ensure future benefits? Are risks and disablers known and managed?			

Purpose	Key questions	Example analyses	Application in case studies
Element 3: Understand the system's decision capacity			
Understand the influences of the multiple role players on decision-making and value creation, and mitigate the influences that oppose value creation	1. Who are the role players and what is their sphere of influence?	Network map of decision makers (Fig 9.12) Rating of stakeholder influence (Fig 9.13)	Decision network, role players, and influence (ICT4RED Fig. 7.5; DRDLR Fig. 8.8) Decision makers and their influence on sustained benefit (ICT4RED Table 7.7; DRDLR Table 8.7)
	2. What decisions are made (and what gaps are there) in support of value creation?	Network map of decision-makers relative to value creation activities (Fig. 9.14; 9.15)	Decisions and influence on value creation (value chain) (ICT4RED Fig 7.6; DRDLR Fig. 8.9)
	3. What decision support tools could be useful to support value creation?	Critical decisions against the construct of value creation (Fig. 9.16; 9.17)	Decision models against value chain (ICT4RED Fig 7.7; DRDLR Fig. 8.10) Decision models to support value creation (DRDLR Table 8.8; 8.9)

Questions to guide interpretation of analyses

Are all stakeholders and their influences on each other known?

Are their involvement and influence in individual (value-affecting) decisions understood?

Are all (relevant) stakeholders engaged when specific decisions are taken?

Are plans in place to address the decisions that are not currently addressed?

Are plans in place to mitigate decisions and influences that distract from value creation?

Are decision support tools or mechanisms defined and used to add value, where appropriate?

Purpose	Key questions	Example analyses	Application in case studies
Element 4: Ensure an enabling project process			
Ensure that the project process allows rather than frustrates decision-making towards value creation	1. Is the project process enabling benefits to be sustained? 2. Is decision-making enabling or disabling the project process?	Subjective rating of process for readiness, flexibility and transfer (Fig. 9.18; Table 9.10) Map of influence of decision makers on project process (Fig. 9.19)	Modular implementation as indication of flexibility (ICT4RED Fig. 7.13) Decisions and their influence on project elements (DRDLR Table 8.10) Project-level disablers of sustained benefit (DRDLR Table 8.14) Decision matrix, showing role players against project process (ICT4RED Fig. 7.8) Decision makers of the ICT Hub project (DRDLR Fig. 9.19)
Questions to guide interpretation of analyses Do the characteristics of the project process facilitate benefits to be sustained? Is the influence of all relevant stakeholders on the project process understood? Are all relevant stakeholders engaged in each step of the project process? Are mechanisms in place to strengthen the capacity of decision-makers relative to the project? Are critical decision-makers and their (positive or negative) influence on the process recognised and managed Are the gaps or negative consequences of decision-making clear to all stakeholders? Are these gaps mitigated and/or managed?			