A co-creation design framework to support elderly rural women in refining an ICT platform

by

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ABSTRACT

Although elderly women living in rural areas of South Africa and other developing nations is the most disadvantaged segment of the population, very little funding is allocated to their development, and social, economic and political empowerment. Despite their meagre resources, these women are very often responsible for looking after their families while the working age men and women migrate to cities in search of employment. The entire community can benefit when women are uplifted and empowered. There is a worldwide belief that Information and Communications Technology (ICT) can be of benefit if access is provided. However, researchers do not always agree on how ICTs should be introduced. In addition, Information Communication Technology for Development (ICT4D) initiatives are known to have a notoriously high failure rate.

The aim of this research project is to develop a co-creation design framework for Elderly Rural Women (ERW) in Mafarafara (area in Limpopo province of South Africa) that incorporates the implications of the social interplay within the community. The framework will contribute to an understanding of how ERW can be co-creators of an ICT platform deployed as part of an ICT4D initiative (known as the Digital Doorway project of the CSIR, Meraka). It will also be investigated to what extent co-creation is possible in a remote rural community, when the participants are ERW with limited technical knowledge, in a social structure that may limit free participation. During seven site visits to the community, the research team determined the elderly women's needs with respect to various aspects of their lives and their exposure to ICTs. An ICT platform was refined in collaboration with the ERW to better address their needs. The initial design approach (combining participatory design, design thinking and co-creation design frameworks, models and steps) was developed by investigating the extant literature. Results of the data collected during site visits were used to develop the interim framework, which was finalised with inputs from experts in the ICT4D and co-creation disciplines.

The Design Science Research Methodology (DSRM) formulated by Peffers, Tuunanen, Rothenberger and Chatterjee (2007) informed the development of the framework. Structuration theory was used to explicitly outline the social structuration processes that implicitly occurred during the co-creation and refinement of the ICT platform. It was shown how the social processes of signification, domination and legitimation played out

during co-creation, and how the co-creation of the artefact simultaneously affected the social structure. In the ICT4D context, the surfacing of the social dynamics is especially important, since cultural differences are at play, and ICT4D projects often fail for social reasons. The use of the DSRM supported by structuration theory contributed to developing an appropriate ICT co-creation design framework for co-creating and refining an ICT platform with ERW in South Africa.

Key words: ICT4D, design science research methodology, structuration theory, participatory design, co-creation, ERW, ICT4D platform

I declare that this thesis is my own work and that I have referenced all the sources that I have used and that no part was previously submitted to any tertiary institution.

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Ronel Smith

Notes on similarity:

- *Some parts of the thesis have been published in some of the papers listed under Previous Publications, and as a result similarity may be detected between the publications and the content of this study.*

- *Similarity to university portal content may be found, due to submissions of the candidate's own work in progress for similarity checking.*

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CRDP	Comprehensive Rural Development Programme
CSIR	Council for Scientific and Industrial Research
DSR	Design Science Research
DSRM	Design Science Research Methodology
DSRP	Design Science Research Process
DST	Department of Science and Technology
DD	Digital Doorway (ICT platform)
DRDLR	Department of Rural Development and Land Reform
ERW	Elderly Rural Women
GDP	Gross Domestic Product
GTM	Greater Tubatse Municipality
HSRC	Human Sciences Research Council
ICT	Information and Communications Technology
ICT4D	Information and Communications Technology for Development
IDRC	International Development Research Centre
ITU	International Telecommunications Union
JAD	Joint Application Development
LM	Local Municipality
LSF	Labour Force Survey
MDGs	Millennium Development Goals
OECD	Organisation for Economic Co-operation and Development
PD	Participatory Design
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific

Elderly Women	Women older than 64 years of age (Statistics South Africa, 2012)
ICTs	"Information-handling tools – a varied set of goods, applications and services that are used to produce, store, process, distribute and exchange information" (UNDP, 2010)
ICT4D	"complex socio-technical activity in which the social and the technical negotiate and evolve together" (in Dodson, Sterling & Bennett, 2012:4)
Framework	It is a tool that incorporates various components (such as a process or method) that can be applied when ICT is implemented in disadvantaged areas that involves ERW. A framework is the product of theorising, which can ultimately be used to update model development, and direct the generation of further research questions (Hasan, 2014).
Rural women	Women residing in rural and under-serviced areas (Joseph & Andrew, 2007).

CHAPTER 1:   SCOPE OF RESEARCH

1.1 INTRODUCTION AND BACKGROUND

"The one resource that liberates people from poverty and empowers them is knowledge. Possessing knowledge is empowering, while lack of knowledge is debilitating" (Nath, 2001:318).

Despite the strong international focus on the upliftment and social, economic, and political empowerment of people in developing third-world countries, elderly rural women (ERW) remain the most disadvantaged segment of the population. They are mostly illiterate, poorly educated and have access to very limited resources (Lal, Dwivedi, Rana, Frost & Chirara, 2018; ANC Women's League, 2014; ILO, 2012; Jacobs, Namy, Kes, Bob & Moodley, 2011; Ozoemena, 2010; Manuel, 2007). According to the United Nations Development Programme (2011), women account for 6 out of every 10 of the world's poorest inhabitants, and for two thirds of the world's illiterate people. Despite these disadvantages, and due to the absence of men who are working away from home often for months at a time, rural women are usually responsible for looking after large extended families and sometimes whole communities (Jiménez & Zheng, 2018; ANC Women's League, 2014; Aliber & Hart, 2009; Huyer, 2005).

In South Africa, apartheid has created a complex set of challenges for elderly black South Africans in general, and women in particular (Lam, Leibbrandt & Ranchhod, 2004). For most of their lives they have lived under restrictions that limited their access to residency, employment, and education. For today's elderly South Africans, the inequality in education between and amongst races was much greater than what they are for younger South Africans. The literacy levels of elderly women in general, and black women in particular, are therefore significantly lower than that of their younger counterparts, who were educated after the end of apartheid (Statistics South Africa, 2014, 2013; Lam *et al.*, 2004). A survey conducted in 2011 by Statistics South Africa showed that 58.3% of rural women have not received any education, compared to 41.66% of men. Older women are less likely than men to have progressed past primary school (Statistics South Africa, 2018, 2013). Discussing the plight of ERW, Ozoemena (2010:3) uses the term "feminisation of poverty" to describe the failure of the South African Government's poverty alleviation strategies to uplift the country's women in general, and rural women in particular.

Empowerment of women should be a priority of programmes and policies aimed at promoting agricultural development (Oxfam, 2014; Hafkin & Odame, 2002). While the term 'empowerment' is widely used in a range of domains, there is no broad consensus on the meaning, measurement and realisation of the concept (Beeker, Guenther-Grey & Raj, 1998). As used in this study, empowerment means an expansion in the "ability to make strategic life choices … where this ability was previously denied" (Kabeer, 1999:437). Empowerment results in gaining agency and obtaining access to resources in order to build confidence, make decisions and act in one's own interests (Yang, 2018; Malhotra, Schulte, Patel & Petesch, 2009; Giddens, 2001). The World Bank (2008) cites a number of examples to demonstrate the benefits of uplifting rural women. One particularly relevant example for this project is South Africa, where the Bank (2008) established that involving women in the design and testing of new 'technologies' such as different crop varieties, farm tools and small machinery speeds up innovation and its adoption, and increases productivity and income. However, an obstacle to empowerment is an information and skills gap that either constrains the adoption of available technologies and management practices, or reduces their efficiency if adopted (Aker, 2010; World Bank, 2008). The (World Bank, 2009a) is of the opinion that ICT can play a major role in reducing these gaps. In order to achieve this, equal emphasis must be placed on local content generation, education and infrastructure (Khumalo & Pather, 2018).

Improving the economic status of women has multiplier effects that bring about an improved standard of living as measured by improved health and nutrition, access to and levels of family members' education and greater control over fertility (Jiménez & Zheng, 2018; Mehra & Rojas, 2008; World Bank, 2008; Ngqaleni & Makhura, 1995). Empowerment of women can therefore positively influence a whole community. The Beijing Declaration and Platform for Action (BDPFA), especially number 16, indicates the relevance of including women in projects where development and empowerment are concerned:

> *"Eradication of poverty based on sustained economic growth, social development and social justice requires the involvement of women as agents and also beneficiaries …" (in Ozoemena, 2010:2).*

Nath (2001:319) indicates that:

> *"without the progress towards the empowerment of women, any attempt to raise the quality of lives of people in developing countries would be incomplete"*.

The field of ICT4D focuses on the role that ICTs can play in development. Although many authors argue that ICTs have the potential to significantly contribute to alleviating the plight of ERW through socio-economic development (Mthoko & Pade-Khene, 2013; Food and Agriculture Organisation, 2011; World Bank, 2009b), many authors caution that ICT4D interventions are not guaranteed to succeed in this endeavour (Heeks & Ospina, 2018; Dodson *et al.*, 2012; Heeks, 2010). In fact, ICT4D initiatives in rural communities have a notoriously high failure rate, with an estimated 80% ending in absolute, partial or sustainability failure (Heeks & Krishna, 2016; Heeks, 2010; Unwin, 2009a; Heeks, 2008). This high failure rate of development projects, the complex socio-cultural contexts of rural communities in South Africa, corruption of tribal authorities and government officials, and persistent and pervasive inequalities, present researchers and practitioners with significant challenges (Ramadani, Kurnia & Breidbach, 2018; Barjis, Kolfschoten & Maritz, 2013). Rural communities view any project initiated by outsiders with distrust and cynicism, making it difficult to gain entry into a community, or to secure buy-in once entry has been achieved (Ramadani, Kurnia & Breidbach, 2017; Barjis *et al.*, 2013).

This research project ties together the empowerment and upliftment of ERW through ICT4D in a project that aims to develop a co-creation design framework for ERW; the framework was iteratively developed through the co-creation and refinement of an ICT platform with ERW in Mafarafara. The Design Science Research Methodology (DSRM) formulated by Peffers *et al.* (2007) formed the overall framework for this research project. Structuration theory (Joseph, 2006; Giddens, 1984) was applied to the empirical data that were collected throughout the co-creation process. Structuration theory indicates how, within the particular social setting, the social structures of signification, domination and legitimation influence and are influenced by the co-creation process. The social structures refer to the social dynamics of the Mafarafara community, the project team doing research and implementation as well as the interaction between the two groups of people. Structuration theory is used to complement the DSRM by making visible the social nature of the design process. Further, structuration theory provides an analytical means to assess whether and how the women involved in the project were empowered.

A decision was taken by the CSIR to initiate a project focusing on ICTs, women and agriculture (informed by the high priority the South African government affords these focus areas). The ICT platform (also known as the Digital Doorway – see section 4.3; 4.4) was chosen based on its success of application in rural areas, in terms of access to information and advancing skills. The adoption of a co-created ICT platform was aimed at addressing the disconnect in context regarding the use and development of technology, also known as the design-reality gap (Heeks, 2003).

1.2 PROBLEM STATEMENT

ERW are the most disadvantaged population group in South Africa; not only in society as a whole, but usually also in their own families (Smith, 2015b). Their dire situation has its origin in an ecosystem where difficulties caused by their general lack of access to, and control over, resources and basic services are exacerbated by their unequal rights in traditional family structures as well as inequitable access to family resources such as land and livestock (Statistics South Africa, 2018; ANC Women's League, 2014; Diale, 2013; Statistics South Africa, 2013; Lam *et al.*, 2004). Apartheid, persisting discriminatory customary practices, patriarchal authority structures, and a lack of initiatives aimed at their upliftment, leave them without the resources to improve their situations (Jiménez & Zheng, 2018; ANC Women's League, 2014; Diale, 2013; Ozoemena, 2010).

ICTs in its various forms can be instrumental in addressing gender inequalities, and can provide women with a tool through which to empower themselves, both socially and economically (Yang, 2018; Fife & Pereira, 2016; Buskens, 2010; World Bank, 2009b; Hafkin & Taggart, 2001). However, there is a lack of scalable longitudinal research on how this can be achieved, and on the different role that ICTs play in the lives of women and men (Lwoga & Sangeda, 2018; Huyer, 2005). In addition, the majority of research on women's acceptance and use of ICT has been conducted in developed countries and cannot necessarily be applied to rural women in developing countries (Zheng, Hatakka, Sahay & Andersson, 2018; Hilbert, 2011; Moens, Broerse, Gast & Bunders, 2010). In order to ensure that women derive the same benefits from ICT as their male counterparts, it is important that they have the opportunity to contribute equally to the design, development and application of ICT (Jiménez, 2018; Huyer, 2005). Adopting a co-creation approach in ICT4D projects aimed at the upliftment of women is an option to achieve this requirement (Khumalo & Pather, 2018; Byrne & Sahay, 2006).

In the ICT4D domain, the potential contribution of ICTs to the development and transformation of developing countries is the subject of ongoing debate. Cautious voices join Dodson *et al.* (2012:58) in arguing that ICT4D interventions are not "unequivocally effective in improving the lives of community members in developing areas". In fact, the success rate of ICT4D initiatives in developing communities is abysmal. Around 80% percent of projects fail, or only succeed partially (Ramadani *et al.*, 2018; Heeks & Molla, 2009; Krauss, 2009; Tongia & Subrahmanian, 2006). Three main factors contribute to the failure of ICT4D initiatives: ICT solutions are not fit for purpose, and irrelevant to the community context in which they are deployed; ICT4D researchers and practitioners do not understand and appreciate the complex, often invisible socio-political dynamics of traditional rural communities and the erroneous assumption that the appearance of ICTs in a community will automatically leave its people better off. Many authors ascribe these factors firstly to the lack of participation of the local communities and, secondly, to ICT4D projects that are not adequately and sensitively taking the local context into consideration (Lal *et al.*, 2018; Lwoga & Sangeda, 2018; Mthoko & Pade-Khene, 2013; Independent Evaluation Group, 2011; Moens *et al.*, 2010; Heeks & Molla, 2009).

Historically, participatory design research has focused on the workplace context in western countries. Application in the developing world has been limited, specifically with respect to social development, and many researchers and practitioners fail to recognise that the developing world context is fundamentally different to that of the developed world (Khumalo & Pather, 2018; Byrne & Sahay, 2006).

There is a need for a multi-dimensional approach in an ICT4D context to ensure the success of ICT4D initiatives (Singh, Díaz Andrade & Techatassanasoontorn, 2018; Walsham, 2012) that are aimed at empowerment of elderly women in the remote rural communities of South Africa. Towards this end, this research project investigates which co-creation design approach is applicable when ERW become co-creators of an ICT platform deployed as part of an ICT4D initiative.

1.3 MAIN RESEARCH QUESTION AND SUB-QUESTIONS

The aim of this study was to answer the following research question:

Main research question

What components should the co-creation design framework include when refining an ICT platform with Elderly Rural Women (ERW) in South Africa?

To answer the main research question, the following five supporting sub-research questions had to be addressed:

Sub-questions

- **SRQ1:** What is an appropriate design process to follow when refining an ICT platform to support ERW in Mafarafara? (Chapters 2; 3)
- **SRQ2:** What challenges related to ERW and ICT4D initiatives need to be considered in the design process? (Chapters 3; 4)
- **SRQ3:** How does the social interplay amongst the different role players influence the refinement of an appropriate ICT platform? (Chapters 5; 6)
- **SRQ4:** What role does the combination of the social interplay between all role players and the design process have on the ICT platform, as well as on the co-creation design framework? (Chapters 6; 7)

1.4 AIMS AND OBJECTIVES OF THE RESEARCH

The main aim of this research is to develop a co-creation design framework as an artefact. During the development of the framework, an ICT platform was refined and co-created with ERW in Mafarafara. The framework incorporates the implications of the social interplay on the co-creation process. Mafarafara is a small rural community in South Africa's Limpopo Province. The objectives of this research project are to:

1. Investigate an appropriate design process and framework to use when designing and developing an ICT platform with ERW in Mafarafara;

2. Conduct a literature study on the challenges faced by ERW in an ICT4D context in order to inform the appropriate design approach and process. This also involves a focus on the challenges faced by ICT4D initiatives;

3. Investigate the benefits of using co-creation as a means to develop an ICT platform in the context of the challenges faced by ERW and ICT4D initiatives;

4. Apply structuration theory as a lens to analyse the social interplay between the different role players involved in the co-creation design process of refining the ICT platform;

5. Collect and analyse qualitative data from ERW in a deep rural community in South Africa during specific site visits to inform the development of the co-creation design framework. The development of the framework will be taken through the Peffers *et al*. (2007) design science research process in three phases; and

6. Reflect on the implications for a co-creation design framework that recognises the value of co-creation, design thinking and co-design process, as well as the social interplay that occurred during the phases of refining the ICT platform.

1.5 SCOPE AND CONTEXT OF STUDY

The criteria for selection of a community for this research project were the following:

- A potential participant group of ERW;

- An involvement by the ERW in food production activities as part of sustaining themselves in their community;

- A willingness to participate in the study accompanied by permission of the community leaders to conduct the research project in their community;

- Existing links with the CSIR (the project sponsor) to facilitate entry into the community; and

- A geographical location no more than one day's driving distance from Pretoria and reachable in a normal vehicle without the need to engage four-wheel drive.

Based on these criteria, Mafarafara, as a remote rural community in South Africa's Limpopo province, was nominated by a CSIR researcher who described the community as "having nothing" (Veldsman, 2013). She had previously met Mma C, a senior woman who had a leadership role in Mafarafara, while involved in another project nearby. This relationship facilitated entry into the community, and Mma C acted as the champion of the research project. The first step was for the researcher to contact Mma C, present both the ICT4D and research projects, gauge interest, and obtain permission for the research team of CSIR to contact her and arrange for visits.

The majority of the participants in this study were women older than 64 years of age and members of the Bapedi, a local indigenous population group. Women from this age was chosen with the aim of uplifting them, as they are regarded as the most deprived population group in South Africa. Although the majority of women were illiterate and spoke Sepedi only, at least one member of the group could speak and read English fluently. The women were all willing to participate in the study, and were prepared to use the proposed ICT platform (see section 4.4) to provide feedback to improve its design.

1.6   LITERATURE REVIEW

In support of the problem statement, the literature review commenced with an investigation on the plight of rural women, research with ERW, and co-creation processes (*cf.* Chapter 3). This was followed by a study on the challenges faced by ICT4D initiatives, and the factors that contribute to success and failure (*cf.* Chapter 4). The outputs of the literature review will be used to construct the preliminary framework.

1.7   RESEARCH METHODOLOGY AND DESIGN

The aim of this study is to develop, after refining an ICT platform with ERW in Mafarafara, a co-creation design framework that incorporates the implications of the social interplay on the co-creation process.

The research, grounded in a pragmatist research philosophy, was operationalised through DSR as methodology within a longitudinal case study context and conducted iteratively over three phases, as shown in Figure 2-6. The Design Science Research Methodology (DSRM) formulated by Peffers *et al.* (2007) provides the overall framework for this research project. Structuration theory was applied to the qualitative data collected throughout the project (in the form of site visit reports, field notes, transcriptions of

interviews and visual media). Structuration theory was used to indicate how the social dynamics between role-players influenced the design, development, and demonstration activities of the DSRM, and how this co-creation process in turn influenced the social dynamics as the role-players' understanding of the situation changed over time. The use of structuration theory complements the DSRM, as it helps to make explicit the social nature of the design process. The theory of design and action as part of design thinking further influenced this research study (*cf.* section 2.6). This study acknowledges two other theories that affected the development of the co-creation design framework, namely, the theory of diffusion of innovation and the socio-technical systems theory. However, structuration theory will be applied during data analysis as main theory in this study to develop the co-creation design framework. It helps to make visible the often unstated cultural differences between researchers and the community, which need to be understood and managed for a successful project.

Figure 1.1 provides an overview of the DSRM supported by structuration theory, as applied in this research project.
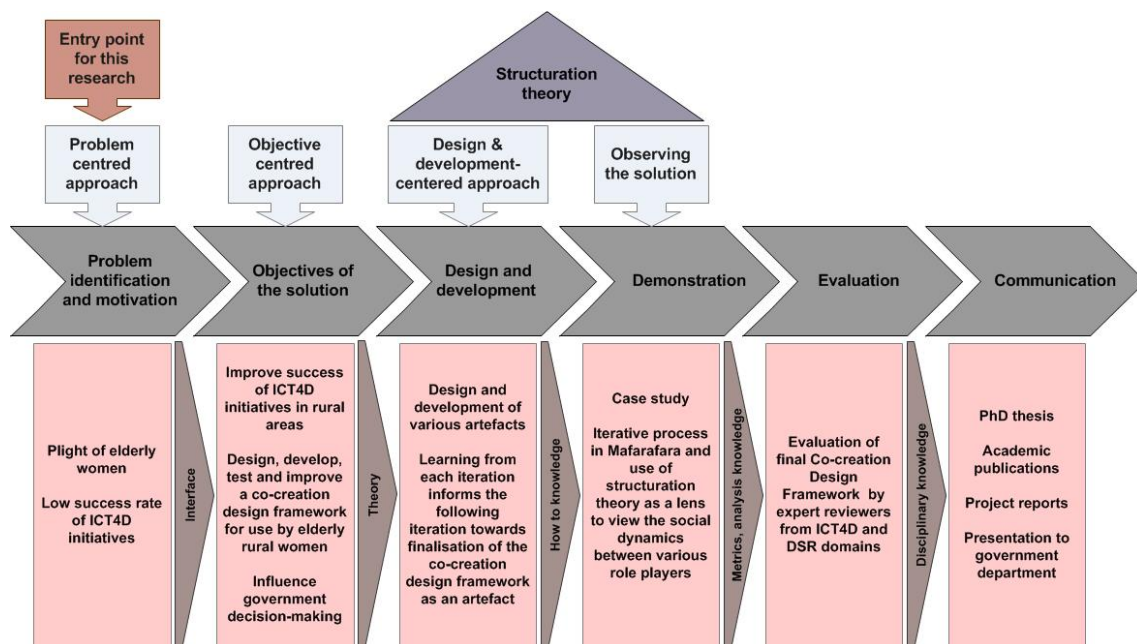
Figure 1-1: The DSRM as applied in this research project (Adapted from Peffers *et al.* (2007) and Herselman and Botha (2014)

The research methodology is discussed in more detail in Chapter 2.

1.8   EXPECTED CONTRIBUTIONS OF THIS STUDY

The primary contribution of this study is the co-creation design framework that was developed after understanding the design process and implications of co-creating an ICT platform with ERW, as part of an ICT4D initiative.

In defining a framework and its constituting elements, it is important to recognise the work of Hassan (2014), in which a different perspective is provided on conceptual, research and theoretical frameworks. For Hassan, a framework is the product of theorising that can ultimately be used to inform model development and guide the generation of further research questions. In this study, a co-creation design framework will be developed to inform the ICT4D context; it can be applied to assist when ERW are involved in the refinement of a specific ICT platform. Bordage (2009) defines a framework as representing the way one thinks about a problem or the way one can visualise how complex problems work. Based on this definition, the co-creation design framework will inform the complex context of working with ERW in rural settings.

The methodological contribution is the DSRM process of Peffers *et al.* (2007) as it is used to design a fit for purpose ICT4D platform (applying design and action theory), while structuration theory is applied to make visible and take into account the complex socio-political dynamics in the community. Other contributions include a tailored made ICT platform adapted to suit the specific requirements of ERW with respect to physical design, content and applications. The use of structuration theory to demonstrate the social nature of the design process in an ICT4D context constitutes a theoretical contribution.

This study contributes to the body of knowledge in a theoretical sense, as it indicates how DSR, used in combination with structuration theory, design and action theory, diffusion of innovation as well as socio-technical systems theory, can support the design approaches of ICT platforms.

1.9   LIMITATIONS AND CHALLENGES OF THE STUDY

The main limitations of the project are as follows:

1. Only one deep rural community in South Africa, in which the role of the elderly women was very evident, was used for this study.

2. Only one particular ICT platform was involved, of which the functionality was influenced by a lack of electricity and internet connectivity.

3. The language of the community was Sepedi, the local language spoken in Mafarafara. Although Sepedi is widely spoken, the language has very distinct localised regional dialects. Transcribing and translating the recordings in an objective way to ensure their validity and reliability presented a challenge.

1.10 ETHICAL CONSIDERATIONS

Researchers are responsible for conducting research in such a way that the "welfare, rights, and dignity of those individuals participating in institutionally sanctioned research" are protected (Brydon-Miller & Greenwood, 2006; Larson, 2005).

The researcher applied the ethical guidelines of the University of Pretoria as well as the Council for Scientific and Industrial Research (CSIR) to adhere to the following principles:

- Privacy, anonymity and confidentiality;
- Informed consent;
- Voluntary participation and right to withdraw;
- Accountability; and
- Good research.

Ethical clearance for the research project was obtained from both the University of Pretoria and CSIR (Appendix A). Authorisation to conduct the research in the community of Mafarafara was obtained from the local tribal chief. More detail on ethical considerations are provided in section 2.7.

1.11 ORGANISATION OF THE THESIS

This thesis consists of eight chapters:

- Chapter 1 provides an introduction to, and overview of, the study.
- Chapter 2 presents the research methodology, and includes the philosophy, the design followed, data collection instruments and the methods used to analyse data.
- Chapter 3 is a literature review focusing on the dire position of ERW, conducting research with ERW, issues pertaining to rural women and ICTs, and co-creation.
- Chapter 4 outlines the ICT4D context of the study. It commences with a literature review addressing the challenges faced by ICT4D initiatives, and the factors that

contribute to success and failure. This is followed by an overview of the specific ICT platform used in this study.

- Chapter 5 introduces the case. It starts with a demographic overview of Mafarafara, followed by a discussion of the Bapedi nation. It concludes with a summary of the empirical work performed in Mafarafara.

- Chapter 6 presents an analysis of the case. Structuration theory is used to analyse the qualitative data collected throughout the project. It is shown how the social dynamics between the various role-players influenced the co-creation process, and how the development process in turn influenced the role-players' understanding of the artefact as well as the social context. The results are used to refine the initial design approach developed after the literature reviews.

- Chapter 7 presents the intermediate and final co-creation design framework and its validation by external experts.

- Chapter 8 presents a summary of the study and a self-reflection. It ends with recommendations for future work.

1.12 SUMMARY

This chapter lays the foundation for the research study. The research problem, questions and objectives were introduced. The scope was defined and the research justified. The research methodology was briefly explained. Expected contributions of the study were outlined and the limitations discussed. The organisation of the thesis was outlined. Chapter 2 will present the detailed research methodology.
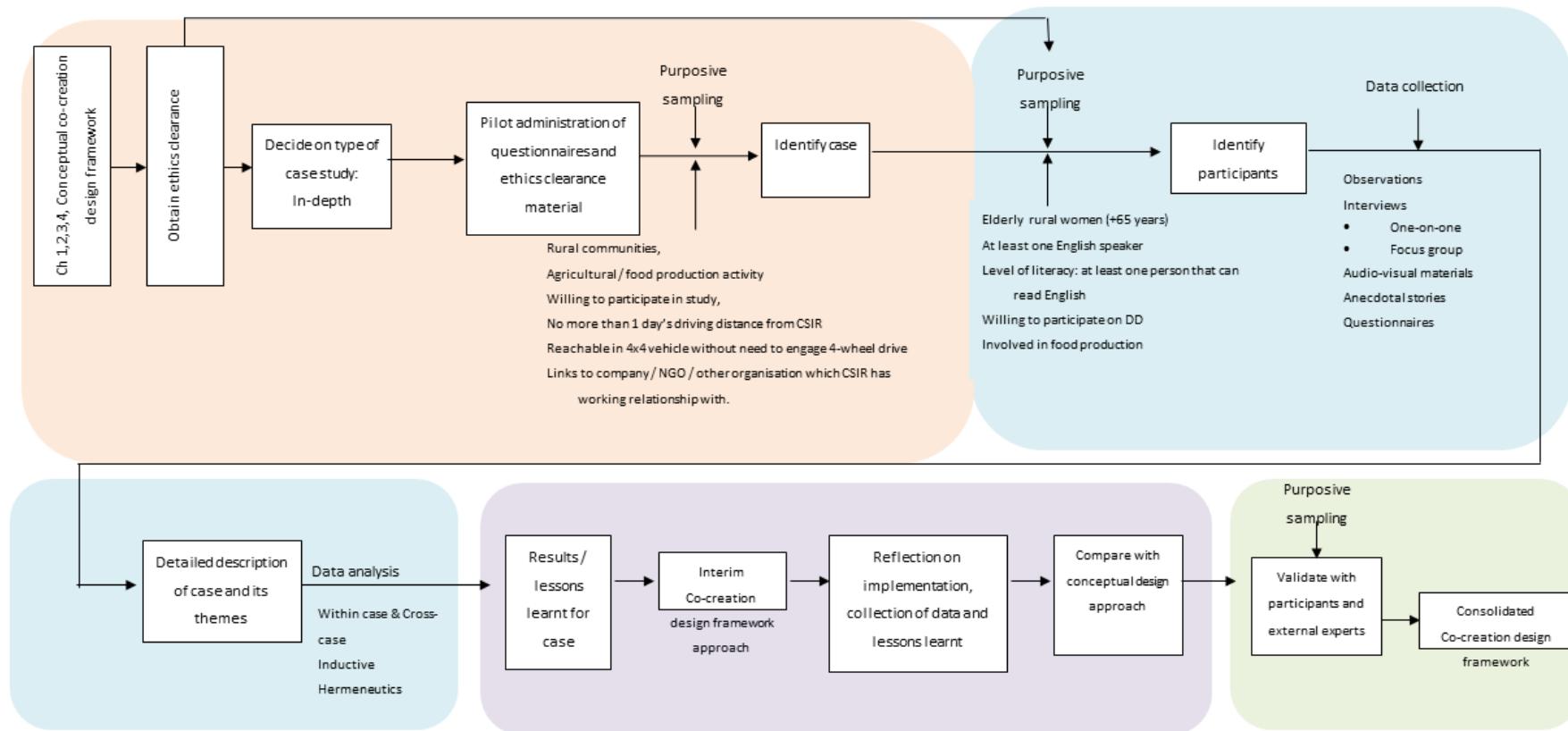
Figure 1-2: The research process

Ch 1, 2, 3, 4, Conceptual co-creation design framework

Obtain ethics clearance

Decide on type of case study: In-depth

Pilot administration of questionnaires and ethics clearance material

Purposive sampling

Identify case

Rural communities,
Agricultural / food production activity
Willing to participate in study,
No more than 1 day's driving distance from CSIR
Reachable in 4x4 vehicle without need to engage 4-wheel drive
Links to company / NGO / other organisation which CSIR has working relationship with.

Purposive sampling

Identify participants

Elderly rural women (+65 years)
At least one English speaker
Level of literacy: at least one person that can read English
Willing to participate on DD
Involved in food production

Data collection

Observations
Interviews
• One-on-one
• Focus group
Audio-visual materials
Anecdotal stories
Questionnaires

Detailed description of case and its themes

Data analysis

Within case & Cross-case
Inductive
Hermeneutics

Results / lessons learnt for case

Interim Co-creation design framework approach

Reflection on implementation, collection of data and lessons learnt

Compare with conceptual design approach

Purposive sampling

Validate with participants and external experts

Consolidated Co-creation design framework

CHAPTER 2:   RESEARCH METHODOLOGY

2.1 INTRODUCTION

This chapter presents the research methodology that underpins the study. Roode defines a research methodology as "a strategy of inquiry that extends from the philosophical stance of the researcher to inform the research design and approach" (in Bennett, 2010:73). It refers to the combination of processes, methods and tools as well as the underlying theoretical and philosophical assumptions and their implication for the methods adopted (Creswell & Plano Clark, 2011; Saunders, Lewis & Thornhill, 2009; Nunamaker, Chen & Purdin, 1991). Research methodology defines how the research is done with respect to its design, measurement of research effort and measurement of success. It is often influenced by the subject discipline and is dependent on both the research statement and research questions (Herselman, 2011; Mouton, 2006). This study follows a multi-methodological research strategy by locating a case study within a DSR project. Pragmatism as research philosophy underpins the research as far as artefact building is concerned. A limited interpretive component is included in the case study where the data will be collected and analysed.

Section 2.2 outlines the research purpose. The philosophical perspective underlying this study is presented in section 2.3. This is followed by an explanation of DSR in section 2.4, and of its application in this study in section 2.5. The use of structuration theory to complement the DSRM, by making visible the complex socio-political dynamics between the research/implementation team and the rural community, is discussed in section 2.6. This is followed in section 2.7 by a discussion of the ethical considerations of this study.

2.2 THE RESEARCH PURPOSE AND OBJECTIVES

The aim of this research project is to develop a co-creation design framework that incorporates the implications of social interplay on the co-creation process. During the development of the framework, an ICT platform was refined with ERW in Mafarafara, a small rural community in the Limpopo Province of South Africa. This chapter will address the first sub-research question: What is an appropriate design process to follow when refining an ICT platform to support ERW in Mafarafara?

The specific objectives are to:

1. Investigate an appropriate design process and frameworks to use when refining an ICT platform with ERW in Mafarafara;

2. Conduct a literature study on the challenges faced by ERW in an ICT4D context inform the appropriate design approach and process. This includes a focus on the challenges faced by ICT4D initiatives;

3. Investigate the benefits of using co-creation as a means to refine an ICT platform in the context of the challenges faced by ERW and ICT4D initiatives;

4. Apply structuration theory as a lens to analyse the social interplay between the different role players involved in the co-creation design process of the ICT platform;

5. Collect and analyse qualitative data from ERW in a deep rural community in South Africa during specific site visits to inform the development of the co-creation design framework. The development of the this framework will be taken through the Peffers *et al*. (2007) design science research process in three phases;

6. Reflect on the implications for a co-creation design framework that recognises the value co-creation, design thinking and co-design process as well as the social interplay that occurred during the phases of the refinement of the ICT platform.

The research project commenced with a review and contextualisation of extant literature on ICT4D, rural woman, participatory design, structuration theory and DSR. The second step was the development of an initial framework based on literature. This was followed by the identification of the community in which the case study was undertaken, as well as relevant data collection methods. Data were collected during seven site visits to the Mafarafara community. The subsequent analysis of the data was informed by the initial co-creation design framework, and in particular structuration theory. The findings were used to enhance and refine the initial co-creation design framework. After external experts in the ICT4D and DSR domains validated the framework, a final framework was produced. To address the purpose of this study, the definition of a framework as interpreted by Hassan (2014) will be applied. According to Hassan (2014), a framework acts as the map for the researcher to indicate the

important concepts and constructs, and how these relate to one another. Figure 2.1 provides a graphical outline of the research process.
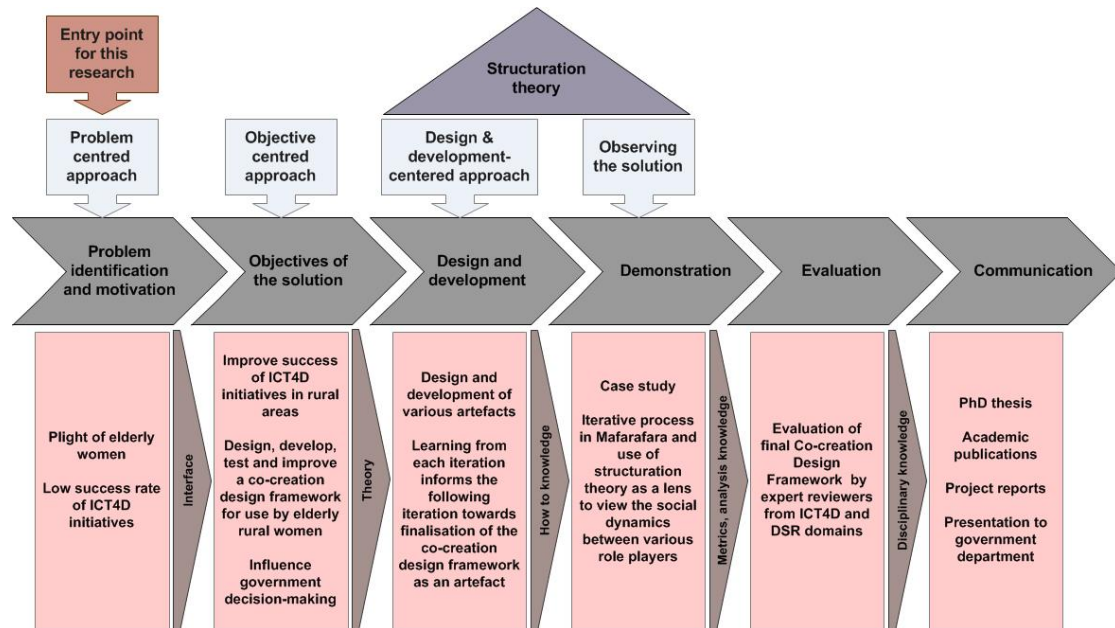
Figure 2-1: The study's research process adapted from Peffers *et al.* (2007)

The details of this process will be explained in this chapter (section 2.5).

2.3 PHILOSOPHICAL PERSPECTIVE

Guba (1990:17) describes the philosophy that underpins a research project as the "the basic set of beliefs that guide action" based on the assumptions regarding the ontology, epistemology and methodology. These beliefs or assumptions influence how the researcher views the world and interacts with it (Creswell, 2013). Given that philosophical beliefs influence the practice of research (Slife & Williams, 1995) it is important for the researcher to familiarise him or herself with the various philosophical world views and make explicit the specific philosophical assumptions underpinning the research project. The 'traditional three' paradigms, namely positivism, interpretivism and critical research (Oates, 2005), have long dominated research in Information Systems and Information Technology. However, the research philosophy of pragmatism is also gaining acceptance (Goldkuhl, 2012; Kelder, Marshall & Andrew, 2005).

2.3.1 The pragmatic research philosophy

This research study is underpinned by a pragmatic research philosophy to develop the co-creation design framework. This section discusses the characteristics of pragmatism as research philosophy, motivates the adoption of a pragmatic worldview for this study, and details how a pragmatic research philosophy influenced the approach to the research project.

The Cambridge Dictionary of Philosophy defines pragmatism as:

> *"A philosophy that stresses the relation of theory to praxis and takes the continuity of experience and nature as revealed through the outcome of directed action as the starting point for reflection" (Audi, 1999:730).*

To this, Dewey (in Goldkuhl, 2008:4) adds that:

> *"Reason has a creative function ... which helps to make the world other than it would have been without it".*

Pragmatism originated in the USA in the late 19th and 20th centuries, and has its origins in the writings of James, Peirce, and Dewey (Creswell, 2013; Wicks & Freeman, 1998). Contemporary authors include Murphy, Patton and Rorty (Levy & Hirschheim, 2012).

Creswell (2013:10) describes pragmatism as a research philosophy that arises "out of actions, situations, and consequences rather than antecedent conditions". The principal concern for pragmatists is the usefulness of something – be it the methodology, information or philosophy. 'Useful' is understood as something being "instrumental in producing desired or anticipated results" (Goles & Hirschheim, 2000:261).

Pragmatists are concerned with solutions that work, and knowledge is viewed as a way to improve the world. Researchers focus on the research problem, placing it above methodology or the underlying paradigm by using all available approaches to understand and find a solution to the problem (Creswell, 2013; Goles & Hirschheim, 2000). According to Levy and Hirschheim (2012), concepts and theories are only deemed useful if they can increase our ability to explain and utilise phenomena. Pragmatism is a school of thought that regards practical consequences or actual effects as essential components of both truth and meaning (Goldkuhl, 2011).

Goldkuhl (2008:4) describes three types of pragmatism, namely, functional, referential and methodological, each with a different view of what knowledge is or can be created:

- Functional pragmatism has as its central tenet that knowledge should be useful and make a practical difference. Knowledge is prescriptive in nature, viewed as a basis for action, and is produced and used to improve action.

- Referential pragmatism holds that knowledge should be about actions. Therefore, the primary objects of research, and the knowledge generated are actions, activities, and practices.

- Methodological pragmatism places the focus on how knowledge should be created. Knowledge is seen as created through both the execution of actions, and the study of actions.

In this study the focus is on functional pragmatism, as the designed co-creation framework has to be useful for ERW in rural settings. Methodological pragmatism is also supported, as it is about learning while doing.

To discover the meaning of an idea, one should ask about its empirical and practical consequences (Peirce and James in Johnson & Onwuegbuzie, 2004; Goles & Hirschheim, 2000). Pragmatism as philosophy holds the view that what is practically relevant and useful must be agreed upon by dialogue and argument; it cannot merely be asserted by claims to experience. Reality is complex and the many different perspectives in the specific cultural and/or social setting where the study is being conducted and decisions are being made, must be accommodated.

The use of knowledge and action are two key concepts in pragmatism (Goldkuhl, 2008). For pragmatists, knowledge is provisional, socially constructed and situated in history and culture. In summary, theory can be regarded as true only if it is useful in the context and for the period of time in which it is agreed to be useful (Levy & Hirschheim, 2012; Kelder *et al.*, 2005).

2.3.1.1 Pragmatism in DSR

An increasing number of authors argue that the rigid boundaries imposed by traditional paradigms are too restrictive for research in the complex, increasingly transdisciplinary IS domain (van Zyl, 2015; McKay & Marshall, 2007). They highlight the need for "more open and nuanced ways to study and analyse IS complexities" (Goldkuhl, 2012:1), and advocate the use of multiple philosophical approaches, theories and methods (Kelder *et al.*, 2005; Orlikowski & Iacono, 2001; Goles & Hirschheim, 2000).

Towards this end, there is growing acceptance of pragmatism as philosophical grounding for research in the IS domain.

Given the emphasis that DSR places on relevance and on making a visible impact, several authors contend that DSR is fundamentally pragmatic in nature (Goldkuhl, 2011; Hevner, 2007; McKay & Marshall, 2007). Pragmatism is an appropriate philosophical basis for research that is aimed at intervening in, and changing the world, rather than merely observing (Goldkuhl, 2012). "Essential in pragmatism and in design research is that the search for a possible and desirable world is not only a question of conjectures. A pragmatist and design researcher is not only guessing or proposing what might be, but he/she also tries to install it through action. It is a process of knowing through making" (Goldkuhl, 2011:88).

Dewey in Goldkuhl (2008) defined the concept of inquiry, which is pivotal to the application of pragmatism in research, and which resonates well with the aim of DSR to change the current situation into a desired one. "This means that an inquiry is an investigation into some part of reality with the purpose of creating knowledge for a controlled change of this part of the reality" (Goldkuhl, 2012:7). Viewing design research in terms of pragmatic inquiry implies the conversion of a problematic situation into a satisfactory one through artefact design (Goldkuhl, 2011).

2.3.1.2 Pragmatism in this research project

A pragmatic philosophy is appropriate for this study for a number of reasons. The emphasis on practical applications, consequences, relevance and usefulness resonates well with the aims of design science research (DSR). Recognising that theory and decisions are only relevant to a specific context and time allows for on-going enquiry and continuous incremental improvement of the artefact whilst evaluating it (Prat, Comyn-Wattiau & Akoka, 2014; Kelder *et al.*, 2005; Johnson & Onwuegbuzie, 2004). The view that dialogue is important supports the co-creation component of the study. Pragmatism supports a pluralistic approach and offers researchers a method to select a mix of methodologies to better answer their questions (Levy & Hirschheim, 2012; Johnson & Onwuegbuzie, 2004). Table 2-1 indicates how the philosophical assumptions of pragmatism position themselves within this DSR project (adapted from Creswell (2007), Herselman (2011), Vaishnavi and Kuechler (2015) and Baskerville, Kaul and Storey (2015)).

Table 2-1: Philosophical assumptions of pragmatism

Pragmatism		This study (DSR)
Basic belief	**Description**	
Ontology The nature of reality What is real? What is derived and what is essential?	Singular and multiple realities exist: the accepted view is that which best answers the research questions and results in the desired or anticipated outcome.	Multiple, contextually situated realities and assumes alternative world-states. The construction of artefacts regarded as being context based and socio-technologically enabled.
Epistemology The nature of knowledge What is the truth, how do we know it, and how can we be certain about what we know?	Knowledge arises from situations, actions, and consequences (real-world practice oriented). Knowledge is a means for action, change and improvement. Practicality: the research problem is more important than the method. Truth is that which works at the time. Knowledge types: explanatory, understanding, prescriptive, normative, and prospective.	Knowledge is gained through making (artefact design). Iterative and incremental circumspection during the development process reveals truth and meaning. The meaning of the artefact is the functionality it facilitates in the system or relevant context (it means what it does).
Axiology What is of value?	Values are important and relevant only to the extent they influence what is studied and how. Solving practical problems in the real world.	Solving problems creatively. Applicable means to accomplish the desired end result. "Creative manipulation and control of the environment."
Methodology Research process / procedure through which knowledge will be created	Use what works: combine pluralistic approaches.	Developmental; measure impact of artefact on the system.
The researcher's role	Involved in changing and solving problems.	Involved in changing and solving problems.

Several characteristics of pragmatic research are particularly important in the development context where this study is conducted. Pragmatism's approach to research is explicitly value-oriented (Johnson & Onwuegbuzie, 2004). It emphasises the importance of making visible and validating the purpose of the research (Kelder *et al.*, 2005). Further, engagement with and evaluation of the ethics of the research process, decisions and actions is also relevant to pragmatism (Kelder *et al.*, 2005). These characteristics are important to ensure that research that is conducted in vulnerable communities, is done for the right reason in the right way and makes a difference.

Interpretivism was only applied during the case study part of the research process depicted in Figure 2.1, under the phases of demonstration and evaluation, when the ERW's feedback were analysed to improve and develop the co-creation design framework; this followed after they have refined the ICT platform that was used to

assist them with their agricultural activities. Myers and Klein (2011) indicate that, when using interpretivism, access is provided through social constructs that can include language, shared meaning or instruments. Here the focus is on the complexity of human sense-making, and phenomena are understood through meanings that people assign to them. Interpretivism uses qualitative studies to investigate research questions, focusing on understanding phenomena that occur in natural settings (Chowdhury, 2014). Consequently, the data collection and analysis is primarily qualitative, and describing the phenomena and interpreting the data are important (Moon & Blackman, 2014). During analysis, the hermeneutic circle and principles have to be considered (Klein & Myers, 1999). Interpretivists consider individual cases to understand phenomena, often adopting a qualitative approach (Moon & Blackman, 2014). The application of interpretavism and results thereof will be provided in Chapter 6.

2.4   DESIGN SCIENCE RESEARCH

Iivari and Venable (2009:4) define DSR as a "research activity that invents or builds new, innovative artefacts for solving problems or achieving improvements … Such new and innovative artefacts create new reality, rather than explaining existing reality or helping to make sense of it".

The position of DSR in IS is an ongoing debate (Hovorka, 2010; McKay & Marshall, 2007). It is variously described as a distinct research paradigm (Hevner & Chatterjee, 2010; Vaishnavi & Kuechler, 2008; Hevner, March & Park, 2004), a type of science (Gregor, 2009; Baskerville, 2008), and a research methodology (Weber, 2010; McKay & Marshall, 2007; Niehaves, 2007; March & Smith, 1995). In this research study, DSR is used as the research methodology.

For the purpose of this study, 'design research' is defined as having as its aim the creation of solutions for specific problems, and therefore entails the *actual* building of artefacts using a rigorous construction and evaluation process (Winter, 2008). 'Design science' has design as the topic of research, reflecting on the artefact creation process, and therefore entails *research into* the building process. 'Design science research' is research with design as research methodology (Vaishnavi & Kuechler, 2015; Winter, 2008).

This section starts by providing a general introduction to DSR and then proceeds to a detailed discussion of DSR as a research methodology within the IS domain.

2.4.1 General introduction to Design Science Research (DSR)

Using DSR as a research methodology, a researcher

"… answers questions relevant to human problems via the creation of innovative artefacts, thereby contributing new knowledge to the body of scientific evidence. The designed artefacts are both useful and fundamental in understanding that problem" (Hevner & Chatterjee, 2010:5)

Definitions of design include "to invent and bring into being" and to "plan and make something for a specific use or purpose" (Merriam-Webster, 2015:45). Design therefore deals with the creation of something new, which does not exist in nature. Simon in his seminal work 'The Sciences of the Artificial' describes design as follows: "everyone designs who devises causes of action aimed at changing existing situations into preferred ones … Design so construed, is the core of all professional training; it is the principal mark that distinguishes the professions from sciences" (Simon, 1996:111).

The design activity is the creation of an artefact, its components, and their organisation in such a way that the artefact interfaces with its context or environment in a desired manner (Vaishnavi & Kuechler, 2008).

The foundation for DSR's legitimacy in academic disciplines, which have design as central focus, including IS, was conceptualised by Herbert Simon when he argued that these disciplines can establish their credibility while achieving their purpose "to the degree that they can discover a science of design, a body of intellectually tough, analytic, partly formalisable, partly empirical, teachable doctrine about the design process" (Venable, 2006:35; Simon, 1996:111). Simon makes a clear distinction between the terms 'natural science' and 'science of the artificial'. The latter, which includes DSR, is a body of knowledge about man-made (artificial) phenomena, which are designed to meet specific desired goals.

As indicated earlier, DSR is essentially research that uses design as research method (Vaishnavi & Kuechler, 2015). It is differentiated from routine design by the production of new and innovative knowledge to solve a specific problem. Through this focus on problem solving, DSR aims to "produce and apply knowledge of tasks or situations in order to create effective artefacts" rather than on the production of general theoretical knowledge (March & Smith, 1995:253). DSR is therefore fundamentally a creative, problem solving methodology that focuses on creation, with the purpose of design being

to change "existing situations into preferred ones" (Herselman & Botha, 2014; Venable, 2006; Simon, 1996:130). For this reason, the theory of design and action is very applicable to DSR (Baskerville, Baiyere, Gregor, Hevner & Rossi, 2018). This will further be explained in relation to structuration theory, as both were applied in this study in section 2.6.

A number of research frameworks for DSR have been formulated since the publication of The Sciences of the Artificial. The main authors include Takeda, Veerkam, Tomiyama and Yoshikawa (1990), Nunamaker *et al.* (1991), March and Smith (1995), Hevner *et al.* (2004), Peffers *et al.* (2007), Peffers, Tuunanen and Niehaves (2018) and Vaishnavi and Kuechler (2008). From these, a general structure with a number of central tenets focusing on ***problem identification-build-evaluate-theorise*** has emerged (Baskerville *et al.*, 2018; Hovorka, 2010). The majority of authors see new knowledge as being created through the ***design*** of innovative, novel and purposeful artefacts to address real-world problems, and the subsequent ***evaluation*** of the artefact to ensure that its characteristics are beneficial and address the identified problem sufficiently (Peffers *et al.*, 2018). ***Analysis*** of the artefact's use and performance along with ***reflection*** and ***abstraction*** further contributes to knowledge creation.

2.4.2 Design Science Research in ICT4D

ICTs have the potential to make a significant positive impact on the socio-economic conditions of people living in developing countries. However, as will be discussed in Chapter 3, many of these initiatives are either a partial or complete failure. The problem is compounded by individual, uncoordinated efforts with no cumulative knowledge building (Walsham, 2013; Heeks, 2006). Heeks and Bailur (2007:256) describe this phenomena as the throwing of stones in a pond instead of building knowledge statues with those stones. "The problem is serious as the development of systemised knowledge (design theory) can mean that lessons learned across projects inform subsequent interventions, and reduce the chance of failure" (Gregor, Imran & Turner, 2014:655). This view is supported by Gregor *et al.* (2014), Patel and Kaufman (1998), Baskerville *et al.* (2018) and Lwoga and Sangeda (2018), who all argue that DSR can add to developing a sound theoretical foundation for ICT4D by building a body of systemised knowledge in terms of design principles and design theory, which can form the basis for design and action. Heeks (2002:103) describes failure in ICT4D initiatives as an

opportunity to learn valuable lessons, but laments the fact that most of the learning is "fortuitous rather than planned".

Addressing the diverse, wide-ranging challenges that development initiatives face require solutions that are innovative, robust, affordable and sustainable over time (Barjis *et al.*, 2013). Misaki, Apiola and Gaiani (2016) and Lwoga and Sangeda (2018) hold that the integration of DSR with ICT4D can add to developing and designing technical solutions that are innovative and that can adapt to identified needs in developing contexts. Barjis *et al.* (2013:223) add that service delivery in developing countries remains a challenge, especially where a large portion of people stay in rural contexts and can "benefit from innovative service models and supporting technology". This view is supported by de la Harpe (2014:20) who uses DSR in a project aimed at "developing a mobile application for home-based healthcare data in a resource restricted community" in South Africa. Because many ICT4D initiatives are initiated by the providing party, such as donors, NGOs, or central government, they are often based on invented needs, instead of actual needs and problems identified in the community (Barjis *et al.*, 2013). This challenge can be resolved by using a DSR approach, which can ensure that the problem that is addressed is real and relevant to the intended users. Inappropriate technologies, or solutions developed for 'invented needs' results in what Heeks (2002) calls a design-reality gap. The bigger the gap, the higher the likelihood of the ICT artefact not functioning in practice as expected. Given the key requirement that DSR produces a valid, innovative artefact that is relevant to the intended users, it can serve as a tool to develop an ICT system that bridges the design-reality gap.

Islam and Gronlund (2011) hold that little has been done in both the IS and ICT4D domains to understand the ICT artefact itself. This is in line with Orlikowski and Iacono (2001), who indicate that the IS domain has not engaged enough with the IT artefact, its core subject. This failure results in the IT artefact itself disappearing from view, being taken for granted, or being assumed to be "unproblematic once it is built and installed" (Orlikowski & Iacono, 2001:122). As will be discussed in Chapter 3, inappropriate technology is one of the main reasons why ICT4D initiatives fail. Sein, Henfridsson, Purao, Rossi and Lindgren (2011) as well as Lwoga and Sangeda (2018) add to the discussion by suggesting that IS, and per implication ICT4D as part of the IS

domain, needs a research method that explicitly recognises technical artefacts that are designed according to the values and assumptions of users and developers.

ICT4D has been described as a "complex socio-technical activity in which the social and the technical negotiate and evolve together", to address "ill-structured and wicked problems" (Dodson *et al.*, 2012:32). Wicked problems result from, inter alia, multi-faceted and poorly defined contexts, relationships that are complex, and a need for teams to work together in delivering effective and applicable solutions (Hevner & Chatterjee, 2010). As argued by Islam and Gronlund (2011), DSR can be particularly powerful as a research methodology in complex situations where the researcher must address many diverse key questions, pertaining to users, the ICT artefact, and development in a relatively short time period and within a coherent research framework. This sentiment is echoed by Rittel and Webber (1984), who hold that DSR is particularly suited to managing wicked problems.

There is general consensus that ICTs can contribute to the improvement of socio-economic conditions in developing countries. However, the question of what technologies, with what feature, and how these should be designed to maximise effective usage is a matter of debate (David, Sabiescu & Cantoni, 2013).

2.4.3 Outputs of Design Science Research

The concept of the artefact is not new in IS. Orlikowski and Iacono (2001:121) introduced the term as "those bundles of material and cultural properties packaged in some socially-recognizable form such as hardware and/or software". The aim of DSR is to create an artefact that produces utility for users in particular communities, in this case the ERW of Mafarafara. Artefacts are not only tangible pieces of equipment and, as described by Gregor and Jones (2007), Peffers *et al.* (2007), March and Smith (1995), Vaishnavi and Kuechler (2015), Baskerville *et al.* (2018) and Rossi and Sein (2003), can include, amongst others, the following:

- *A construct:* A formulation in the language or vocabulary of a specific domain, in order to conceptualise a problem. It is refined throughout the various iterations of the cycles in DSR.
- *A model:* A representation of the relationships between constructs. It can also be a way to represent a problem or a solution.

- *A method:* This is the set of steps that indicates how a task should be executed. Methods can also be regarded as structured plans, which contribute to the realisation of a goal. In DSR, the method that can provide a better way to achieve results is valued highly.

- *Instantiations:* Operationalisation or realisation of design as an artefact within the relevant environment ("situated implementation"). It demonstrates that the artefact is feasible and fit for purpose (Vaishnavi & Kuechler, 2008:13).

- *Better theories/ theory building:* DSR can contribute to improved theory where artificial construction of the artefact is analogous to experimental natural science (Baskerville *et al.*, 2018; Vaishnavi & Kuechler, 2008:14).

In a memorandum on design-oriented research in IS, members of the German-speaking scientific community identified four basic principles with which a DSR artefact must comply and that can be applied in the development of concepts that are innovative (Peffers *et al.*, 2018; Osterle, Becker, Frank, Hess, Karagiannis, Krcmar, Loos, Mertens, Oberweis & Sinz, 2011:9). The first is known as abstracting, where an artefact must be shown to be applicable to a class of problems. The second is originality, which implies that the artefact should contribute to knowledge creation. The third is the justification of the validity of the created artefact. The last is the benefit that your artefact should have for various users.

To address the purpose of this study, the artefact (a co-creation design framework) will be developed by exploring how ERW co-created an ICT platform that was placed in their contexts, and that was improved through their co-design and feedback. The framework is an instantiation, as it was produced and evaluated based on the ICT platform that was placed within the Mafarafara context, and had to be utilised. The final framework was also evaluated for utility and its fit for purpose for the ERW.

2.4.4 Models describing artefacts

Various authors have developed models to classify artefacts produced by DSR. These are used to position the artefacts produced in this research project.

Purao (2002) classifies the multiple outputs of DSR by level of abstraction. The artefacts produced in this study can be classified as a situated implementation (ICT platform), and knowledge as operational principles (ICT4D framework). This is visually represented in Figure 2.2.
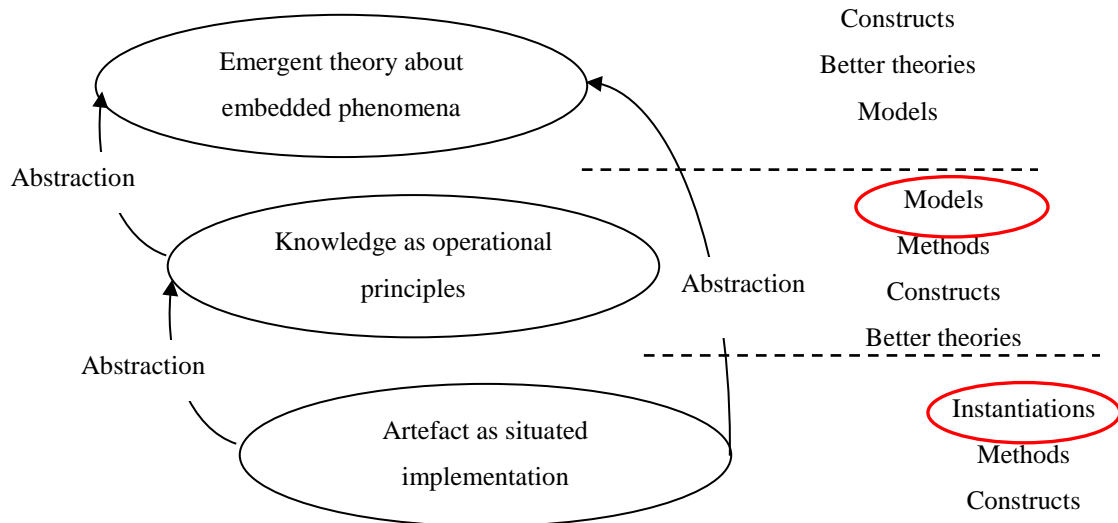
Figure 2-2: Outputs of DSR by level of abstraction. Source: Purao (2002)

March and Smith (1995) developed a two-dimensional framework that focuses on outputs and activities in research, as shown in Table 2-2.

Table 2-2: Research outputs and activities in DSR

		Build	Evaluate	Theorise	Justify
Research outputs	**Construct**				
	Model	√	√		
	Method				
	Instantiation	√	√		

Gregor and Hevner (2011:6) developed a framework positioning a DSR artefact on three levels, progressing from less abstract and specific to more abstract and general. This study delivered both a Level 1 and Level 2 type of artefact, as shown in Table 2-3.

Table 2-3: The classification of an artefact according to Gregor and Hevner (2011)

	Contribution type	General examples	This research project
More abstract and more general	Level 3: Emergent design theory about embedded phenomena	Theories	
↑	Level 2: Design principles – knowledge as operational principles / architecture	Constructs, methods, models, partial theory	Co-created modified ICT platform
Less abstract and more specific	Level 1: Artefact or situated implementation	Instantiations (products or processes)	The co-creation design framework aimed at improving the adoption of an ICT platform by ERW

The co-creation design framework is therefore an example of a Level1 contribution, and the co-created ICT platform can be regarded as a Level 2 contribution, as its design was adapted to fulfil the needs of the ERW. Through the value and utility of this ICT platform, the artefact could be informed and improved.

2.4.5 Rules to apply when conducting design science research

Although many authors have done significant work in DSR, Hevner *et al.* (2004) is recognised to have set the de facto benchmark for DSR with respect to criteria, standards and expectations (Venable 2010). They proposed seven guidelines or practice rules for design science in IS research. These are summarised in Table 2.4.

Table 2-4: Practice rules for DSR and this research study Adapted from (Dreschler & Hevner, 2016a)

Guidelines	Description	Consideration for this study
Guideline 1: Design as an artefact	An innovative, purposeful and viable artefact must be produced.	A research related artefact (framework) was developed based on the refinement of an ICT platform in a rural community South Africa's Limpopo province with ERW.
Guideline 2: Problem relevance	The artefact must address a significant and relevant problem.	A framework was based on the refinement of the ICT platform to support the deployment of ICT4D initiatives in such a way that it increases the likelihood of adoption of the technology (ICT platform) by ERW. The ICT platform was also based on the needs of the ERW.
Guideline 3: Design evaluation	The artefact must be thoroughly tested and evaluated to ensure utility, efficacy and that its characteristics are beneficial.	Specialists in the ICT4D and DSR domains evaluated the artefact (framework).
Guideline 4: Research contribution	Research contributions include the design artefacts and any new evaluation methodologies, models, methods, constructs and instantiations. Contributions must be verifiable.	Theoretical, methodological and practical contributions (*cf.* section 1.8).
Guideline 5: Research rigor	The methodology used in the design and evaluation of the artefact must be sound and rigorously applied.	Applied through the four-cycle process (*cf.* Figure 2.3), where the focus is on impact, relevance, design and rigour. The framework was also evaluated and validated by expert reviews.
Guideline 6: Design as a search process	The design of an artefact is an iterative problem solving process during which solutions are tested and evaluated to ensure that the identified problem is addressed in full. In the process, it is important to take cognisance of other approaches.	In this study the framework was developed by searching for the best-suited design, co-creation and co-design processes and models (*cf.* section 3.6.5).

Guidelines	Description	Consideration for this study
Guideline 7: Communication of research	The research process, results and lessons learnt must be communicated in such a way that it addresses the needs of a variety of audiences including, academic, technical and managerial.	The research process, results and lessons learnt was communicated through academic articles, this thesis, and project reports.

In order for DSR to contribute to the refinement of an ICT platform suitable for ERW, the researcher must relate the proposed practice rules to the utility of the design artefact for the intended users within their socio-cultural context.

2.4.6 Processes in design science research methodology

A number of different methodologies, strategies and processes have been proposed for DSRM researchers. Authors include March and Smith (1995), Rossi and Sein (2003), Nunamaker *et al.* (1991), and (Hevner, 2007). Two DSR approaches dominate recent IS research, namely the four cycle framework developed by Drechsler and Hevner (2016) and the DSR process model by Peffers *et al.* (2007). A brief overview of these methodologies is provided in section 2.4.6.1.

2.4.6.1 The four cycle framework

In their seminal paper, Hevner *et al.* (2004) published the well-known three-cycle framework for DSR. Acknowledging the dynamic nature of the IS artefact designed for messy, complex environments, Drechsler and Hevner (2016) extended the model by adding a fourth cycle which they labelled the "change and impact" (CI) cycle. They argue that the CI cycle allows DSR to "cope with dynamic application contexts as well as artefact-induced organisational change and the resulting need for follow-up design efforts" (Drechsler & Hevner, 2016:1).
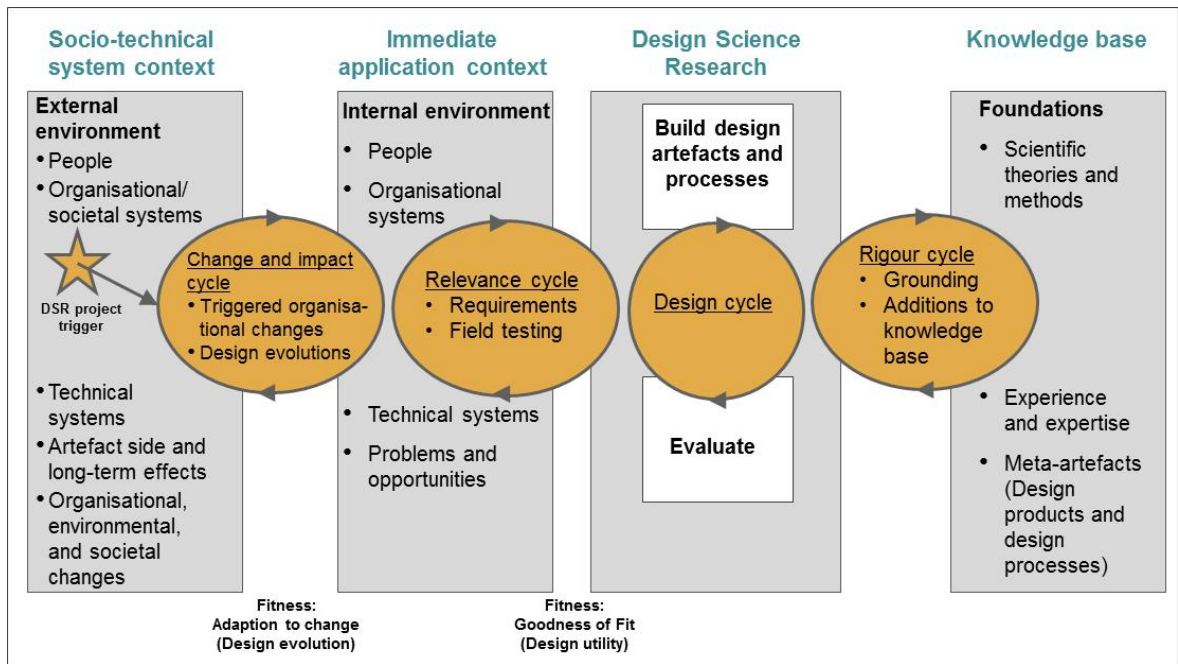
Figure 2-3: Four cycle view of DSR (Dreschler & Hevner, 2016a)

- The change and impact cycle captures an artefact's second-order impacts on the wider context in which it is deployed. To this end, (Drechsler & Hevner, 2016) distinguishes between the immediate context in which an artefact is introduced, and the wider socio-technical system of which the immediate application context is a subsystem. The authors describe the change and impact cycle as the "driving axel of the other three cycles and, thus, the entire DSR process" (Drechsler & Hevner, 2016:8) (ERW vs. community of Mafarafara as a whole).

- A DSR project starts with the relevance cycle, which describes the research problem or opportunity, details artefact requirements, and defines the acceptance criteria, which will be used for evaluation of the results in order to demonstrate acceptable utility in the field. This will be discussed under the evaluation of the artefact (section 2.5.3).

- The design cycle relates to the actual artefact creation, and subsequent evaluation. It is an iterative process consisting of design, construction, evaluation, feedback, and refinement of the artefact. The design cycle activities are informed by existing scientific theories and research methods, as well as existing experience and expertise. The co-creation design framework was developed through three phases, as depicted in Figure 2.6.

- The rigor cycle addresses how the artefact is grounded in existing knowledge. This cycle also serves to ensure that the artefact constitutes a research contribution, and not routine design. The rigor cycle further describes how the DSR process and evaluation of the created artefact will contribute to the existing knowledge base. This is addressed in the literature chapters that follow.

2.4.6.2 The process in DRSM

Peffers *et al.* (2007) argued that, despite significant previous work, DSR in IS still lacked a cohesive methodology, which they defined as a commonly accepted framework for doing research, as well as a way to evaluate and present research outputs. In response, they developed the DSRM for Information Systems research, the stated objectives of which are three-fold: it should be consistent with extant DSR theory, practice, and research; it should provide a guideline for the conduct of effective DSR in IS; and it should provide a model to characterise DSR outputs. Peffers *et al.* (2007) view DSR as an iterative problem solving process with six steps, as illustrated in Figure 2.4:

- *Problem identification and motivation:* Identify the specific research problem and motivate why it is worth solving, stating the value of the solution;

- *Definition of the objectives for a solution*: Infer the objectives of the solution from the problem statement;

- *Design and development*: Create the artefact. This activity is guided by the definition of the problem and objectives. It includes specification of functionality and architecture;

- *Demonstration*: Demonstrate that the artefact solves the identified problem. It can take different forms, for example reference implementation, experiment, simulation or case study;

- *Evaluation:* Observe and measure how well the partially or fully developed artefact addresses the problem and meets the defined objectives; and

- *Communication:* Communicate the results and lessons learnt from the previous activities in various relevant forums with due consideration to the requirements of the various audiences.

The idea is to suggest, develop and evaluate frequently until arriving at an artefact that meets the requirements. Peffers *et al.* (2007) describe the process as being nominally sequential in order, but state that researchers can start at almost any step depending on the focus of their research.
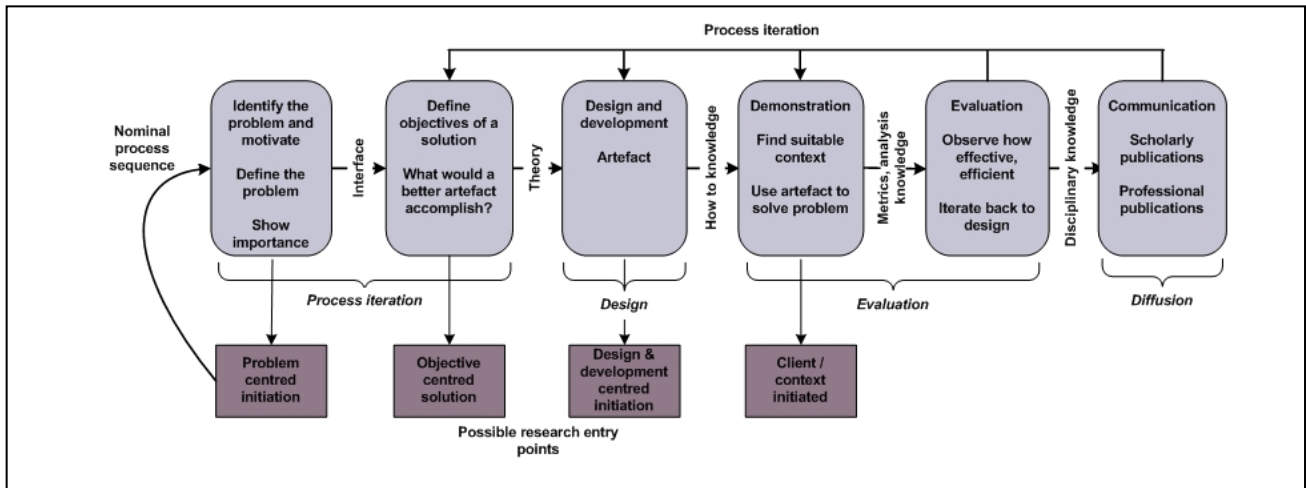
Figure 2-4: DSRM Adapted from Peffers *et al.* (2007)

The DSRM developed by Peffers *et al.* (2007) was adapted for this study as discussed in section 2.5.

2.5 RESEARCH STRATEGY: APPLICATION OF DESIGN SCIENCE RESEARCH IN THIS THESIS

Figure 2.5 was developed to illustrate how the Peffers *et al*. (2007) DSR process was adapted based on the purpose of this study. Each of the seven process steps indicates how this study will address these steps. This is followed by a more in-depth description of how the specific phases 1-3 under the process steps of *Design and develop, Demonstrate* and *Evaluate* will result in the outcome of the different phases of development of the framework (from initial to intermediate to final).
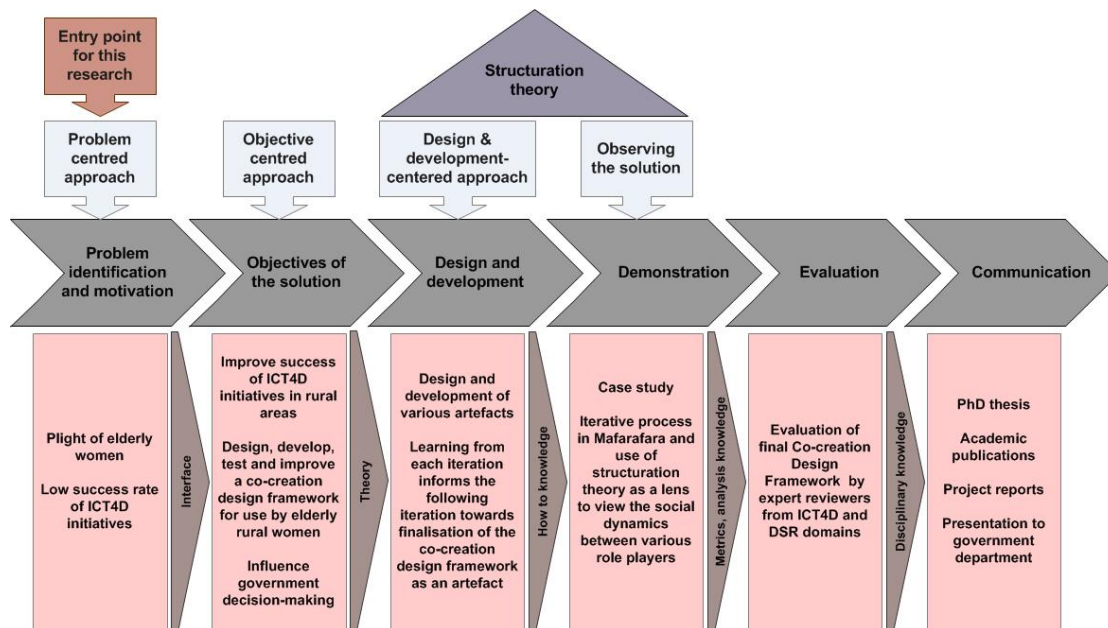
Figure 2-5: Design Science Research Methodology as applied in this research study (Adapted from Peffers *et al.* (2007) and Herselman and Botha (2014)

In this study, the DSR process consisted of three phases as depicted in Figure 2.6. The outputs of each phase served as inputs to the next. The ICT platform and the artefact (framework) were improved, refined and informed by means of a case study. The results informed the refinement and improvement of the ICT artefact and the framework. DSR regards the construction of artefacts as being context based and socially constructed. This study therefore follows an iterative process of constructing and evaluating the artefact in the rural community with the active participation of elderly women (Hevner *et al.*, 2004; Vaishnavi & Kuechler, 2004). In this study, the framework was validated with the women as well as a number of external experts.

Iivari (2015) defines two design science strategies in IS. The first strategy involves construction of a meta-artefact by a researcher, as a general concept solution to address a class of problems. The meta-artefact could be instantiated into a specific solution, or a concrete artefact, which can be adopted and applied in a specific context. In the second strategy, the researcher attempts to address a specific problem, in a specific context, by constructing a concrete artefact. Prescriptive knowledge can be distilled from the experience and then packaged as a general solution to address a class of problem. The process of Peffers *et al.* (2007) was adapted to indicate how it was applied in this study. Three phases were involved, each producing an improved co-creation design framework.
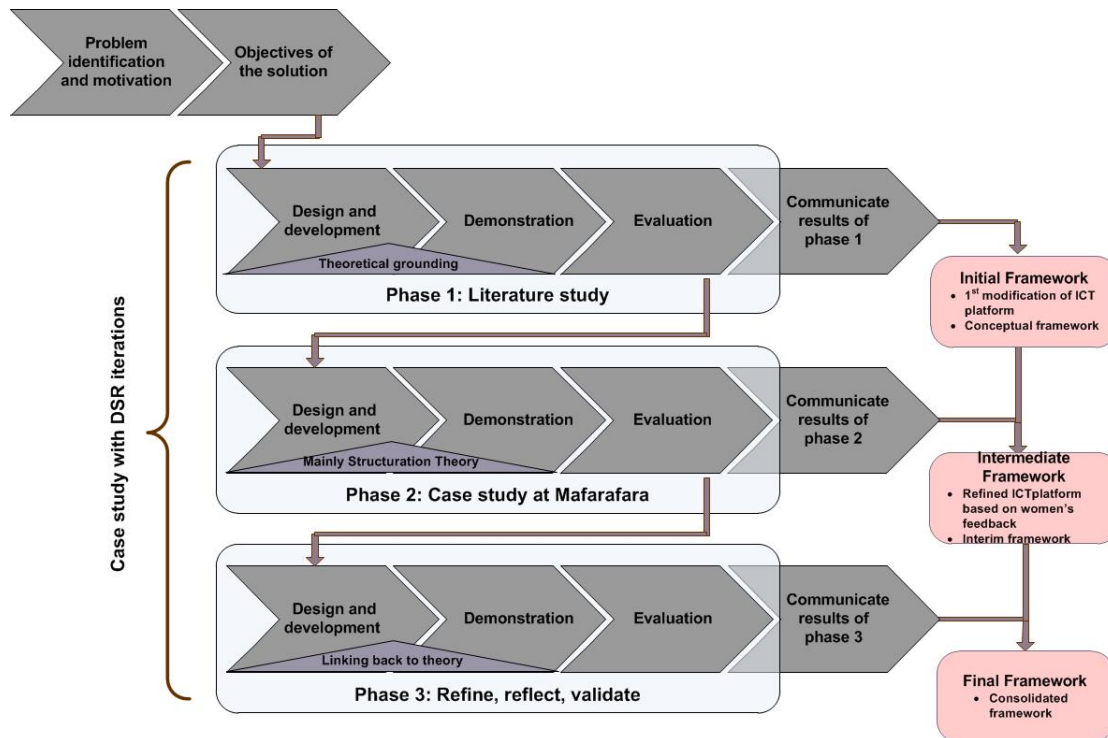
Figure 2-6:Applying the process of Peffers *et al.* (2007) in this study.

As is evident from Figure 2.6, the artefact was developed through three phases.

2.5.1 Phase 1: Literature review

A literature review was undertaken during this phase of the study; such a review assists in synthesising and summarising past knowledge on a topic, or domain of interest. Since it entails interpretation of existing knowledge, it can assist in identifying important knowledge gaps and insightful research propositions (Rowe, 2014).

Literature reviews "examine and critically assess existing knowledge in a particular problem domain, forming a foundation for identifying weaknesses and poorly understood phenomena, or enabling problems relating to assumptions and theoretical claims in the existing body of knowledge" (Boell & Cecez-Kecmanovic, 2014:258). Literature reviews reveal the research landscape and theory development, and provide a foundation for research (Schryen, 2015). The scale and scope of literature reviews are affected by technological developments. Rapid technological developments have increased the importance of literature reviews. It can be more challenging to do IS literature reviews, since the inter-disciplinary nature of IS requires authors to draw on theories from a variety of disciplines (Schryen, 2015). In this study, two literature review chapters are included, namely Chapters 3 and 4.

2.5.2 *Phase 2: Case study*

Case study research has long gained acceptance in ICT4D as a method for exploratory research as well as artefact evaluation, making a valuable contribution to both IS theory and practice, particularly in the context of interpretive research (Baskerville *et al.*, 2018; Yin, 2009; Walsham, 1995; Lee, 1989). Case study research as a qualitative approach is a natural fit for a study that explores the nature of rural women's experience of their interaction with an ICT platform. It allows for exploration of a bounded system (a rural community) in a specific context over a period of time; in-depth data collection; and use of multiple data-collection tools and sources of information such as observations, interviews, audio-visual material, anecdotes and documents (Creswell & Plano Clark, 2011; Walsham, 1995). All the collected information is collated with the aim of building a useful framework or insightful picture that is beneficial to the researcher and participants alike.

The case study was undertaken during phase 2 of the DSRM process model, as indicated in Figure 2.6. Interpretivism was used as research philosophy during the case study only, as discussed in section 2.3.1.2, to interpret its qualitative data.

2.5.2.1 Community selection

The selection criteria for a community for this research project included: the presence of a potential participant group of ERW who were involved in food production activities as part of sustaining themselves, a willingness of ERW and community leaders to participate in the study, existing links with the CSIR, as well as a geographical location within one day's driving distance from Pretoria and reachable with a normal drive vehicle (see also section 1.5). In the case of Mafarafara, a researcher from CSIR met Mma C, a senior woman in the community, while involved in a project in a nearby community, and this researcher made the introductions. This relationship facilitated entry into the community, and Mma C acted as the local leader of the research project in Mafarafara (Limpopo Province of South Africa). This community had a strong presence of ERW who were also involved in agricultural activities. Mafarafara is located about 339 km Northeast of Pretoria and accessible with a normal drive vehicle.

2.5.2.2 Selection of the participants

During the first meeting with Mafarafara residents the intended project was explained, the context for participation was communicated and the ERW who were willing to participate were included in the study. The community leaders as well as the target group were informed that their participation was voluntary. The women who participated in the study were all older than 64 years of age and members of the Bapedi, a local indigenous population group (for more detail *cf.* section 5.3, Chapter 5). Although the majority of women were illiterate and spoke Sepedi only, at least one of them could speak and read English fluently. The women were all willing to participate in the study and were prepared to use the ICT platform to provide feedback to improve its design.

Non-probability purposive sampling was the applicable sampling technique for the selection of all the participants, as well as for the community (Oates, 2006).

The following participants were involved in this study (Table 2.5):

Table 2-5: Participants of the study

Participant group	Number
ERW from Mafarafara	N=25 at first until site visit 3; the number stabilized to become n=11 until site visit 7
Trained local ICT champions assisting with the use of the ICT platform	N=2
Experts from the ICT4D field, academia specialising in DSRM, an ethnographer and a person from industry working with rural communities	N=5

Technological support for the ICT platform was done by two trained local champions (young male adults trained by the CSIR). They were involved from site visit 2 onwards. (*cf.* section 5.5.6). They were interviewed, but not as regularly as the ERW, since the focus of the study was on the ERW user group. The local chief of Mafarafara was consulted to obtain his blessing for the study, but he was not interviewed.

The purpose of using expert reviewers, as a participation group, has been to validate the intermediate framework after Phase 2 of the research process (*cf.* Figure 2.1).

Expert reviews are often used by researchers as a means to review the result/product of their project(s) (Jansen & Hak, 2005). Expert reviews are primarily used to reveal potential problems with a given product that is the subject of the evaluation process

(Holbrook, Krosnick, Moore & Tourangeau, 2007). Nielsen (2003) suggests that three to five experts are appropriate in the evaluation of projects where humans interact with computers. For experts to be able to provide a credible assessment, it is important that they are conversant with the subject matter of the product being evaluated; in other words, the experts' background and characteristics should be relevant to the subject matter (Holbrook *et al.*, 2007). In this study, the experts were carefully chosen to include only those who were from the ICT4D research field. The experts were academics specialising in DSRM, an ethnographer and a person from industry working with implementation projects in rural communities. Four experts from the mentioned domains were included in the evaluation of the intermediate framework (*cf.* Chapter 6, Phase 3).

2.5.2.3 Site visit process

A team consisting of junior researchers from the CSIR Meraka Institute conducted the site visits, two or three at a time. Prior to this research project, the same researchers were part of a large monitoring and evaluation project on the Digital Doorway (known in this study as the ICT platform, more information on the ICT platform is provided in Chapter 4, section 4.4). This monitoring and evaluation was done in 2012 at the request of the Department of Science and Technology (DST). The researchers, although relatively young, were well versed in building relationships with rural communities and with the various data collection techniques used in this study. All the researchers in the Mafarafara team were fluent in Sepedi, the local language. The interviews and other interactions with the community were done in Sepedi, while the site visit reports were submitted in English. The author could not accompany the research team on the site visits due to medical reasons. However, she briefed the research team thoroughly about the purpose of the research. Before each site visit, a briefing session was conducted to ensure that the research team understood the expectations of that site visit. Following each visit, a debriefing session was held.

The research site visits started with an initial visit to Mafarafara, during which the purpose of this research study was explained to the community and their agreement was obtained to continue with the study.

During this first visit, time was spent to get to know the participants and to determine their current situation with respect to ICT usage and food production. Feedback from

the participants was used to inform the content of the ICT platform so that it could meet the information needs expressed during the interviews. A further six visits took place; these are further explained in Chapter 5 (*cf.* section 5.5.6).

2.5.2.4 Data collection instruments

According to Oates (2006), researchers produce data either through a qualitative study where images and words are applied, or through a quantitative study that applies numeric data.

Data collection techniques allow for the systematic collection of information about the objects of study (computer systems, people, objects, phenomena) and about the settings in which they occur. The main data collection methods include questionnaires, individual interviews, focus group interviews, observation, documents, critical incidents and portfolios (Oates, 2006). The collected data are unique to the research study. The data collection methods that were applied in this study were document analysis, interviews and questionnaires as described in the following sections.

2.5.2.4.1 Interviews

Lazar, Feng and Hochheiser (2017) explain that one should ensure that all relevant groups or affected parties are included when planning and conducting interviews.

Focus groups are a form of group interviews that are anchored in active communication between research participants in order to generate data about the phenomenon being investigated (Morgan, 2006). Although group interviews are often used as a quick and convenient way to collect data from several people simultaneously, with focus groups, the interaction between participants is part of the inherent benefits of the method. Information sharing, even dissent of opinions which happens in focus groups, all serve to impact the depth of information collected for each activity (Acocella, 2012). The method is particularly useful for exploring people's knowledge and experiences, and can be used to examine how the current phenomenon is perceived.

In this study, individual interviews as well as focus group discussions were held with the participating ERW during site visits. Individual interviews were also conducted with the two local ICT Champions who were assisting the ERW. The interviews were audiotaped on digital recorders; the focus group discussions were recorded in the field notes of the participating researchers.

2.5.2.4.2 Observations

During observations, the researcher scrutinises the phenomenon without directly involving the respondent (Marshall & Rossman, 2014). Observation involves the act of keeping track of certain events and taking notes of what is observed. Marshall and Rossman (2014) note that this approach allows the researcher to have an insider view on what is happening and enables data to be collected at the point of occurrence.

In this study, each member of the research team observed events within the Mafarafara community while the ERW used the ICT platform. This was done to gain further understanding and clarity on research issues, as well as the context surrounding/ the study participants said and did. Through observation, the researchers were able to study situations that had been described by participants and check for possible discrepancies. Furthermore, anecdotal records were made through observation; these provided additional information to support the interview data.

2.5.2.4.3 Document Analysis

Policy documents and reports are used in document analysis to supplement other data sources, such as interviews. Document analysis is a systematic procedure for reviewing or evaluating documents (Bowen, 2009). The goal of document analysis is to understand the document by exploring and examining its elements (Mabila, 2017). Document analysis, as a qualitative research method, has advantages as well as limitations that stem from the nature and forms of documents being analysed. A major advantage of document analysis is that the materials could already be in the public domain, either published on paper or on the web (Bowen, 2009). Major considerations in document analysis are how to initially discover, source and record the material.

In this study government documents – especially reports on the Digital Doorway project (known as the ICT platform in this study) as well as policies of the DST and CSIR regarding rural community development – were analysed.

This concludes the section on data collection methods that were applied in the case study. Table 2.6 provides a summary of the research questions, the objectives as well as the data collection instruments that apply to each of these. Table 2.6 outlines the data collection of the entire study.

Research question	Objective	Data collection method(s)
Main research question: What components should the co-creation design framework include when refining an ICT platform with ERW (ERW) in South Africa?	All the objectives will together inform the answer to the main research question.	Literature review, In-depth interviews, Anecdotal stories Observations, Audio-visual material (photographs, voice recordings, video clips) Expert and participant reviews
Sub-question 1: What is an appropriate design process to follow when refining an ICT platform to support ERW in Mafarafara?	To investigate an appropriate design process and frameworks to use when refining an ICT platform with ERW in Mafarafara. Conduct a literature study on the challenges faced by ERW in an ICT4D context in order to inform the appropriate design approach and process. This also involves a focus on the challenges faced by ICT4D initiatives.	Literature review
Sub-question 2: What challenges related to the ERW when they co-create and ICT4D initiatives need to be considered in the development of the framework?	Investigate the benefits of using co-creation as a means to develop an ICT platform in the context of the challenges faced by ERW and ICT4D initiatives;	Literature review, In-depth interviews Anecdotal stories, Observations, Audio-visual material (photographs, voice recordings, video clips)
Sub-question 3: How does the social interplay amongst the different role players influence the refinement of an appropriate ICT platform?	Apply structuration theory as a lens to analyse the social interplay between the different role players involved in the refinement of the ICT platform; Collect and analyse qualitative data from ERW in a deep rural community in South Africa during specific site visits that informed the development of the co-creation design framework. The development of this framework will be taken through the Peffers *et al.* (2007) design science research process in three phases. Indicate how the theory of design and action , diffusion of innovation and socio-technical theory influenced the development of the framework.	Literature review, In-depth interviews, Anecdotal stories, Observations, Audio-visual material (photographs, voice recordings, video clips)
Sub-question 4: What role does the combination of the social interplay between all the role players and the design process have on the ICT platform and the co-creation design framework?	Reflect on the implications for a co-creation design framework that recognises the value co-creation, design thinking and co-design process as well as the social interplay that occurred during the phases when refining the ICT platform.	Literature review, Focus group interviews, Anecdotal stories, Observations, Audio-visual material (photographs, voice recordings, video clips)

Table 2-6: Data collection methods used

2.5.2.5 Data verification

To ensure accuracy of data and to corroborate the findings and enhance their validity various types of triangulation were used (Herselman, 2011; Oates, 2006). These included:

- Data triangulation, which involved the use of a variety of data sources in a study. For this study the sources were the participants (ERW, ICT Champions and the chief in Mafarafara), existing documentation relevant to the study and external experts in the ICT4D, DSR and industry domains.

- Method triangulation entailed the use of multiple data-generation methods, namely observations, interviews, photographs, video clips and anecdotal stories.

Data triangulation was further enhanced by the fact that at least two different researchers took field notes and submitted site visit reports for every site visit. Hence the researchers' observations could be compared.

2.5.2.6 Data analysis process

A qualitative data analysis process commences with organising and preparing the collected data (Nieuwenhuis, 2016; Creswell, 2013). Voice recorded data need to be transcribed. Visual data such as photos need to labelled and organised along with verbal data. Once a systematic means of organising has been applied, the researcher needs to get to know and become familiar with the data by reading through it, preferably more than once (Nieuwenhuis, 2016; Creswell, 2013). This is followed by a process of coding, which could be either emergent (open coding) or a priori (where constructs of a theory is applied). The coding process will lead to the identification of themes in the data. The manner in which coding and thematic analysis is done will further depend on the kind of analysis performed, whether it is content analysis, discourse analysis or another kind. The identified themes need to be synthesised in a manner such that the findings can be coherently communicated – often in the form of a narrative (Nieuwenhuis, 2016; Creswell, 2013).

Case study data already has an implicit structure: the story of the case. Data analysis for a case study involves describing the case and its setting in detail. If events occur chronologically, it is important to present evidence for each phase in the evolution of the case (Creswell, 2013).

In this study, data analysis occurred as follows – taking into account that in a qualitative study data collection and analysis are intertwined (Nieuwenhuis, 2016):

During site visits, each research team member took their own field notes during the day, and expanded their notes in the evenings with information they could remember but did not have time to write down. Individual interviews with ERW were mostly done by the same researcher, for the sake of continuity and also to build on relationships that were developed. Focus group discussions were attended by the whole research team. Informal discussions and observations were individually noted as part of field notes. Interviews and focus group discussions were recorded as indicated earlier in the chapter.

Following each site visit, a debriefing session was held by the researcher to get verbal feedback from the field team members. During debriefing, the researcher made her own notes to supplement the site visit reports that were submitted by each field team member. The debriefing meeting was an avenue for reflecting on experiences during site visits, and learning gained, as well as to define next steps to improve the ICT platform.

As the site visits progressed, the researcher developed a filing system to chronologically order and file site visit reports, visual media and audio recorded data.

The recorded data were in Sepedi and had to be transcribed in English. It therefore required a person who was familiar with the local Sepedi dialect and culture, to sufficiently capture the meaning of the recorded data. Finding an appropriate person to perform the transcriptions was one of the challenges that took the researcher some time to resolve.

Following the last site visit (visit 7), the reports and transcriptions were read again and used to compile a consolidated case study report. This report formed the basis of the summary of the case study that is presented in section 5.5.

Data coding was done using a coding scheme that was informed by the literature components from Chapters 3 and 4 as well as the initial co-creation framework, while also identifying mergent themes. For the data analysis presented in Chapter 6, structuration theory (being part of the initial co-creation framework) was explicitly used to interpret the data presented in section 6.2. The design activities that formed part of the initial co-creation framework were used for the analysis presented in section 6.3.

2.5.3 *Phase 3: Evaluating the artefact*

The objective of DSR is to "create knowledge through meaningful solutions that survive rigorous validations through proof of concept, proof of use, and proof of value" (Pries-Heje, Baskerville & Venable, 2007:112). It is argued that the main focus in DSR should be on the artefact and whether the stated problem is addressed and solved by this artefact (Hevner *et al.*, 2004). The broader question of why the artefact works, which requires a focus on its components interactions, is seldom considered (Vaishnavi & Kuechler, 2015).

Hevner *et al.* (2004:82, 85) state that evaluation is "crucial to DSR and requires researchers to rigorously demonstrate the utility, quality, and efficacy of a design artefact using well-executed evaluation methods". Vaishnavi and Kuechler (2008:819) believe that an artefact should be evaluated in terms of its use and performance and for how it influences a system or an organisation. Venable, Pries-Heje and Baskerville (2016) succinctly state that artefact evaluation serves as a feedback mechanism for further development, and contributes to the rigour of the research process.

With the increased acceptance of DSR in the IS domain, several scholars have addressed artefact evaluation. Examples include March and Smith (1995); Winter (2008); various papers by Pries-Heje, Baskerville and Venable (Venable *et al.*, 2016; Venable, Pries-Heje & Baskerville, 2012; Pries-Heje, Baskerville & Venable, 2008); Sonnenberg and Vom Brocke (2012); and Prat *et al.* (2014).

In design science research, a finished artefact can be evaluated by applying various methods, namely observational, analytical, experimental testing as well as by describing it (Hevner et al., 2004).

The co-creation design framework (artefact) was evaluated by using the observational (case study in Mafarafara on refining the ICT platform) as well as descriptive (demonstrate utility through expert reviews) methods.

2.5.3.1 Evaluation criteria

Central to the evaluation process is the question: What should be evaluated? Hovorka (2010:11) distinguishes between two approaches, namely "the artefact based on criteria determined by the designers" and "the artefact based on how actors actually interact with built artefacts". During the actual usage of the ICT platform, users' perceived

value and the factors that determined these perceptions were important components of the evaluation process. The following checklist was applied to evaluate the DSRM research study as a whole (Hevner and Chatterjee, 2010). The results of this evaluation are provided in Chapter 8 (*cf.* section 8.5).

Table 2-7: DSR checklist (Hevner & Chatterjee, 2010)

Questions	Answers
What is the research question?	
What is the artefact? How is the artefact represented?	
What design processes will be used to build the artefact?	
How are the artefact and the design processes ground by the knowledge base? What, if any, theories support the artefact design and the design process?	
What evaluations are performed during the internal design cycles? What design improvements are identified during each design cycle?	
How is the artefact introduced into the application environment and how is the field tested? What metrics are used to demonstrate artefact utility and improvement over previous artefacts?	
What new knowledge is added to the knowledge base and in what form (e.g., peer-reviewed literature, meta-artefacts, new theory, new method)?	
Has the research question been satisfactorily addressed?	

Gregor and Hevner (2013) state that Davis 2005 (p.18) "presents some general concepts that define a contribution in a PhD thesis". One of these is to determine if the artefact is improving the design of a conceptual or physical artefact. In this study, the artefact is improved through a demonstration and an evaluation phase (case study in Mafarafara and expert reviews). The four criteria of Hevner (2013) will be applied to ensure that the artefact (framework) is evaluated and validated for its validity, utility, quality and efficiency (*cf.* section 7.3.3).

Gregor and Hevner (2013:324) indicate that a DSR artefact should make a contribution to knowledge. This study presents an ***exaptation***, as the co-creation design framework extends a previously known solution (the Digital Doorway) to a new problem namely the ERW refining and co-creating an ICT platform. The framework can contribute knowledge to the ICT4D field regarding co-creation with ERW.
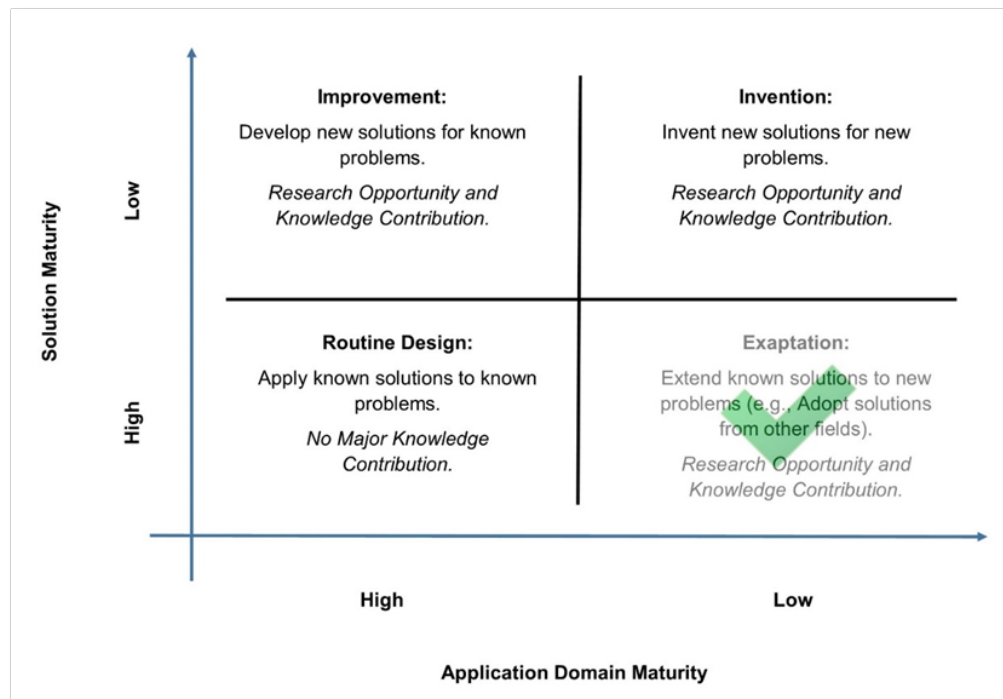
Figure 2-7: Application and solution domain maturity Gregor and Hevner (2013:324)

2.6 THEORETICAL INFLUENCES SUPPORTING THE DEVELOPMENT OF THE FRAMEWORK

The co-creation design framework that was developed as part of the DSRM process was conceptually informed by a theory of design and action (design thinking), the theory of diffusion of innovation and the socio-technical systems theory. While these theories influenced the development of the framework, structuration theory was the main theory that influenced the data analysis in order to inform the framework. The discussion that follows gives an overview of structuration theory, its previous application in ICT4D, and its use as part of a DSR process. In Chapter 6, structuration theory is used to analyse the qualitative data collected during the DSR case study. The following section will also address how a theory of design and action, the theory of diffusion of innovation as well as socio-technical systems theory were recognised in the development of the co-creation design framework.

2.6.1 Structuration theory: origins

Structuration theory is a social theory developed by Anthony Giddens. While Giddens has published widely on the matter, his book *The Constitution of Society* (Giddens, 1984) will be used as a basis for introducing and applying the theory. In addition,

Mendelsohn and Gelderblom (2004) – a text for sociology majors – was used as a guide to better understand Giddens.

Structuration theory was developed to overcome the schism that existed by the 1960s between two opposing schools of social theory. On the one side, there was the objectivist school of thinking, of which Parsons' functionalism is a prime example (Mendelsohn & Gelderblom, 2004; Giddens, 1984). The objectivists over-emphasised the determining influence of societal rules and structures that 'programme' people's behaviour, and did not allow much scope for free individual will. In reaction against the objectivist theories, a range of subjectivist or interpretive social theories arose, such as phenomenology, ethnomethodology and the critical thinking of the Frankfurt School (Mendelsohn & Gelderblom, 2004). These theories placed their emphasis on individual agency and neglected to recognise the influence of social structure. The two schools of thinking were believed to be irreconcilable and social theorists at the time had to choose sides between the two opposing camps. Furthermore, while some of the subjectivist theories contained promising ideas, the subjectivist camp was in disarray as its work was not integrated (Mendelsohn & Gelderblom, 2004).

Giddens proposed structuration theory as a means to synthesise the two opposing schools, presenting agency and structure as a duality (two sides of the same coin) rather than a dualism. Giddens' way of working was to perform a thorough investigation and critique of the range of social theories of his time. He then proceeded to select concepts from a number of theories (preferring the interpretive ones) from which structuration theory was developed (Mendelsohn & Gelderblom, 2004).

2.6.1.1   The basic principles of structuration theory

Simply put, structuration theory states that structure and agency are mutually constituted. The place where agency and structure come together is during the enactment of social activities:

"In and through their activities agents reproduce the conditions that make these activities possible" (Giddens, 1984).

"Human agents draw on social structures in their actions, and at the same time these actions serve to produce and reproduce social structure" (Jones & Karsten, 2003:129).

When participating in a social activity, such as when greeting a colleague, a person subconsciously draws on prior knowledge about how this act or ritual is performed. This prior knowledge is called 'structure'. The structure guides our behaviour but does not determine it. We can choose not to follow the social rule of greeting a colleague. According to Giddens, we act out social rules similar to the way we apply the rules of language (Giddens, 1984). We are inherently competent in applying social rules in our everyday environment without having to think about them. However, we can articulate them when asked about it. When we encounter a person from a different culture, we may realise that we are not inherently knowledgeable about their way of greeting, or of their other social rituals, and then we become conscious of the new ritual until we have internalised it through social practice.

The notion of 'agency' refers to our continuous stream of daily actions, rather than discrete events (Mendelsohn & Gelderblom, 2004:58). Agency is about our ability to intervene in the world, while we could have done otherwise (Giddens, 1984). Agency, also referred to as action, refers to the capability to make a difference, and hence to exercise power. Action is always accompanied by a reflective monitoring of the action that is mostly not on a conscious level. However, when asked about it, we are made conscious of our actions and will be able to explain them, as in the greeting example above.

'Structure', according to Giddens, consists of rules as well as resources. Rules can be sense-making or normative in nature (how to do things, or how we are expected to do things) (Giddens, 1984). For example, there is a general social expectation that we will greet a colleague upon encounter, hence this is a normative rule. Resources is what gives us social power, and can take the form of authoritative or allocative resources. Authoritative resources refer to the capability of having command over people – whether because of one's position or because of leadership traits. Allocative resources refer to the capability to draw upon material things in order to have command over our environment and hence social power. The resource is not about the 'thing' itself, but about our ability to use it in a certain way. As will be seen in the Mafarafara case, having a plot of land is not an allocative resource unless the land can be cultivated (*cf.* Chapter 6).

The diagram that best summarises Giddens' structuration theory is that of the dimensions of the duality of structure, presented in the figure below. This diagram draws from (Giddens, 1984) as well as Mendelsohn and Gelderblom (2004:93):

Structuration process	SIGNIFICATION	DOMINATION	LEGITIMATION
Structure element	Interpretive rules	Resources (authoritative and allocative)	Normative rules
	↕	↕	↕
Modality	Interpretive scheme	Facility	Norm
	↕	↕	↕
Interaction	Communication	Power	Sanction

Figure 2-8: Dimensions of the duality of structure

The 'modalities' between interaction and structure are the ways in which agency and structure are mediated. In particular, interpretive schemes enable actors to understand each other and hence to communicate, facilities give actors the means to control others, and norms "allow actors to be sanctioned for their conformity or nonconformity" (Mendelsohn & Gelderblom, 2004:93).

The dimensions of the duality of structure is the analytical framework that is most often used by researchers as a basis for applying structuration theory (Rose & Scheepers, 2001), and it will be used in this study as well.

2.6.1.2 Previous application of structuration theory in IS and ICT4D

Interestingly, Giddens did not intend for structuration theory to be empirically applied (Giddens, 1984). Despite this, he has become one of the world's most cited sociologists (Jones & Karsten, 2008). In the field of IS, his work had a very high uptake despite the fact that structuration theory pays very little attention to the IT artefact. Jones and Karsten (2008) ascribe the attraction of structuration theory to IS researchers, to its ability to reconcile objectivist and subjectivist thinking, to its non-deterministic treatment of structure and agency, and to the dynamic conception of structure that allows for studying changes over time. Further, its broad conceptualisation allows for application in multiple contexts.

In the field of ICT4D, structuration theory was adopted as a theoretical framework as early as 1990 (Walsham & Han, 1990). Since then, it has become one of the frequently

used theories in ICT4D (Zheng, 2015). The use of thereof in ICT4D remains current, as can be seen in the applications by Bernardi (2017) and Turpin (2017).

2.6.1.3 The application of structuration theory in this DSRM study

In this study, DSRM is concerned with the iterative process of design and implementation of an ICT platform for the benefit of ERW in Mafarafara. DSRM concerns itself with the invention and building of a new and innovative artefact, in such a manner that the implemented artefact interfaces with its context or environment in a desired manner (Vaishnavi & Kuechler, 2008). While DSRM stresses that the artefact should be relevant to its intended users, its primary concern is the artefact. Admittedly, it does acknowledge the interaction of a social system (the ERW) and a technical system (the ICT platform) (Smith & Turpin, 2017; Drechsler & Hevner, 2016; Iivari, 2007). Further, as can be seen from the DSR guidelines presented earlier in Chapter 2 (Figure 2.4), 'relevance' and 'utility' are central to the process (as part of the design and action theory as explained in section 2.6.3). However, DSR does not give the researcher guidance to manage the user engagement process and deal with the social context, beyond what is already found in systems engineering, software engineering or IS user requirement elicitation processes. For a person designing an artefact in a context similar to their own setting or organisation, such guidelines might be adequate. However, in an ICT4D context, where projects are notorious for failing due to a "mismatch between IS designs and local user actuality", and where designers are known to make preconceived assumptions about the contextual reality of a community – because they do not have an appropriate understanding of the expectations, culture, skills, and objectives of the intended recipients (Lwoga & Sangeda, 2018:10) – additional emphasis on understanding the social context is required. Hence, because the primary concern of DRSM is not the social context, and because ICT4D requires special focus on the social context, DSRM needs to be supplemented with a means to explicitly recognise and engage with the social context.

It is for this reason that structuration theory is added to the study as the main theoretical lens – to give recognition to the social context of the design process. Structuration theory provides a means to describe the social structuration processes that occur over a period of time within a particular setting, in terms of the social actors' sense-making, enacting of norms and culture, as well as the power dynamics. It does not explicitly

recognise a material artefact (the ICT platform that was designed) but it can be used to study the influences of the artefact on the social setting and vice versa.

2.6.2 Theory for design and action

The co-creation design framework is also informed by theory for *design and action*. According to Gregor (2006), this type of theory says *how to do or design the artefact*, which is in accordance with the intent of this research problem. 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, as this theory indicates how the artefact can be designed, implemented and evaluated (Baskerville *et al.*, 2018). This type of theory is about the "principles of form and function, methods, and justificatory theoretical knowledge that are used in the development of IS" (Gregor, 2006:628). In this study, design and action theory will play a role during the design and development process (Phase 1) of the artefact where the principles of design thinking will influence the development of the framework (*cf.* Figure 4.13, also section 3.6.4). Design thinking draws upon "ideas, logic, imagination, intuition, empathy and reasoning", to pair the needs of users to what will work in real life with what technology can provide Kesavan (2017). The principles of design thinking that will be applied in this study include: Empathize, Define, Ideate, Prototype, Test (De Koning *et al.*, 2016, Kijima *et al.*, 2012, Putro, 2016, Novani *et al.*, 2015).

2.6.3 Theory of diffusion of innovation

Rogers (2003) first documented the Theory of Diffusion of Innovation as he focused on how innovations can spread. It is a popular theory when implementing innovations (Estabrooks, Derksen, Winther, Lavis, Scott, Wallin & Profetto-McGrath, 2008). The theory′s notion of innovation attributes include concepts such as relative advantage, compatibility, complexity, trialability and observability (Rogers, 2003), This theory emphasises the crucial role played by "intermediary actors (opinion leaders, change agents and gatekeepers) for successful adoption and implementation" (Rogers, 2003:57).

As a social process, diffusion takes places between people as they learn about the innovation and as they co-create or co-design. It has to do with adoption and can change a society as the knowledge grows among users and stakeholders, organizations and

places of implementation. If stakeholders support the innovation then there is sustained use of it (Dearing, 2018).

As the motivation and needs of people differ, so too does the degree of the innovation. Rogers (2003) indicates that those who adopt innovation first do this based on their excitement as it is novel and they do not allow their social norms to influence their excitement. Those who adopt next do this only when the advantages of the innovation outweigh the disadvantages. Later adopters adopt the innovations mainly as they are pressurised by their peers to adopt the innovation.

This theory is applicable in this study mainly as part of how the ERW in Mafarafara adopt the innovation in Phase 2 (Chapter 6), and also to indicate what type of adopters they were at site visit 1 compared to site visit 7.

2.6.4 Socio-technical systems theory

Socio-technical systems theory was first documented by Trist (Trist, 1981). It involves two systems that are open and where there is a constant interplay depicted between them: a social system (people, group processes, shared work norms, etc.) and a technical system incorporating the physical infrastructure and tools for accomplishing the organization's tasks. According to socio-technical systems theory, the technical and social systems interact and are interdependent and are reciprocally influential (Mumford, 1987). Therefore, if something changes in the social side it affects the technical side. That is, changes in the technology can result in changes to the social system.

Socio-technical systems theory has continually acted as a conceptual framework to understand how ICTs are implemented in organisations and society (Karam, Straus, Byers, Kase & Cefalu, 2018; Bourquard, Le Gall & Cousin, 2015). Both the social and the technical entities in the system has to be investigated as they influence each other and adapt differently to change in their contexts. Amir and Kant (2018) refer to them as 'hybrids' and 'social constructs' that can affect how the system functions. As human's knowledge change, their activity in their contexts as well as their decision-making are affected. Therefore, the structures in society should be flexible to handle change (Amir & Kant, 2018).

This theory will influence the way in which the ERW in Mafarafara will interact with the ICT platform (Phase 2). If they change their attitude towards using the ICT platform,

then it can have consequences for future use. A systems approach is important here as both the ERW and the ICT platform can affect the development of the co-creation design framework.

While recognising the influence of all the above mentioned theories, structuration theory will be used as the main theory when developing the co-creation design framework. It will be used to bring to the fore the social processes that accompanied the refinement of the ICT platform.

2.7 ETHICAL CONSIDERATIONS

Ethics are the "norms and standards of behaviour that guide moral choices about our behaviour and our relationships with others" (Cooper and Schindler in Saunders *et al.*, 2009:67). What is regarded as acceptable, moral or ethical depends on the particular community involved (Pimple, 2008; Brydon-Miller & Greenwood, 2006; Babbie, 2005; Zimbardo, 1973). It is important for IS researchers to be aware "of the general agreements shared by researchers about what is proper and improper in the conduct of scientific inquiry" in the IS and social science domains (University of Pretoria, undated; Babbie, 2005:26).

The following excerpt from the South African Constitution (South Africa, 1996:1248) highlights individual rights that are adopted in this study as the foundation of research that involves people:

> *"Everyone has inherent dignity and the right to have their dignity respected and protected".*
>
> *"Everyone has the right to bodily and psychological integrity, which includes the right to security in and control over their body; and not to be subjected to medical or scientific experiments without their informed consent".*
>
> *"Everyone has the right to privacy".*

The aim of ethical standards in research is to provide guidance for the decision-making process and actions related to research to ensure that researchers "protect the welfare, rights, and dignity of those individuals participating in institutionally sanctioned research" (Brydon-Miller & Greenwood, 2006:120; Larson, 2005).

This research followed the ethical guidelines laid down by the University of Pretoria and the Council for Scientific and Industrial Research in order to a) protect the rights of all participants and b) to ensure that good research is conducted in a just and fair manner. The welfare and interest of the participants and their communities were at all times considered as of utmost importance. The researcher adopted the following principles at the outset of the study:

- Privacy, anonymity and confidentiality: Participants remain anonymous and their rights, interests and privacy are protected. Visual material is used with discretion. Confidential information shared with the researcher is not shared without the participant's permission. The leader in Mafarafara of the ERW is referred to as Mma C.

- Informed consent: Three elements are important to ensure that valid informed consent is obtained, namely information, understanding and voluntary participation. The participants are provided with information that describes the role of the researcher, the objectives of the research, the research procedures, what will be expected of them if they consent to participate, as well as the risks and expected benefits. All questions with respect to the research would be answered before written consent is obtained.

- Voluntary participation and right to withdraw: All participants would be advised of their right to withdraw from the research at any time without prejudice as participation is voluntary. It would be made clear to the community and the individual participants that they would not be paid to participate in the study. It would be communicated to the community leaders that the women may not be coerced or forced to participate if they chose not to.

- Accountability: The location of the study in an impoverished rural community placed an additional burden on the researcher to conduct the research with integrity and accountability. These communities often have one overriding goal: to ensure their survival on a day-to-day basis. It was therefore very possible that they would regard the researcher as somebody in a position to contribute to their wellbeing and survival, and agree to participate in order to benefit in some (any) way. Traditional rural communities often have a strong patriarchal-hierarchical structure in which the chief's or traditional leaders' authority supersedes individual autonomy. This could influence voluntary participation and the ability

to withdraw from the study. Both these issues were addressed by working with a liaison person ('fixer') in the community who understands the culture and has the respect of other community members.

- Good research principles, comprising of the following:
  - Researcher bias: The beliefs, value system and limitations of the researcher are acknowledged and declared;
  - Analysis and reporting: The researcher strives to report observations and data accurately and discloses the methods and techniques used. Neutrality and integrity are the core values of the research. Shortcomings are acknowledged; and
  - The collected data would be securely stored at the CSIR for two years. Access to the data would be limited to the researchers participating in the study.

Ethics documentation (Appendix B) contain the consent form and information to be provided to participants.

To ensure the integrity of the ethics process, it was piloted at an NGO in Mabopane with a group of women of similar profile to the intended research participants. They were taken through the whole process of being provided with the background information and worked through the informed consent document. The intention was to assess comprehensibility of the information and the consent form, whether the Sepedi was correct, whether the process worked and whether any other issues arose which the researcher did not consider. Improvements and changes were made to the documentation before being administered to the actual research participants.

2.7.1 Conflict of interest declared

This study was conducted in parallel with a project at the CSIR Meraka Institute. There was no conflict of interest and the researcher did not benefit financially from this study.

2.8 TRUSTWORTHINESS

Trustworthiness is a means to ensure and to test the quality of the research design (Creswell, 2013). Guba and Lincoln (1994) state that, in order to ensure trustworthiness, the findings should be credible, transferable, dependable and confirmable. As the research team of the CSIR was the main instrument of data collection, it was important

to adapt to, and be reactive in, changing circumstances. The research team was sensitive and holistic while maintaining a distance (Guba & Lincoln, 1994). Strategies used to attain trustworthiness (Leedy & Ormrod, 2010) were *participant validation*, in which the findings were related back to the participants (ERW and expert reviews) to determine whether the findings of the ICT platform and the framework were accurate; and *triangulation*, where the field research entailed multiple researchers as well as multiple means of data collection. The researcher, who collated the site visit reports and verbal feedback reports, could use these multiple reports on the same events to confirm the trustworthiness of the data.

2.9 SUMMARY

In this chapter, an overview was provided on the research philosophy, strategy and methodology. DSR as a methodology was explained, and its relevance and applicability to the study was indicated. The specific theories (structuration theory and theory for design and action) were discussed and their relevance to this study was motivated. The use of a case study, the data collection instruments and the data analysis methods were provided. The artefact's (framework) development through three phases by means of the specific DSRM process were indicated. Ethical considerations were also discussed. An outline will be provided on the ERW, their plight and the use of technology to develop and empower themselves through co-creation in Chapter 3.

CHAPTER 3: RURAL WOMEN, DEVELOPMENT AND CO-CREATION

3.1 INTRODUCTION

This chapter considers the first and second sub-research questions:

- SRQ1: What is an appropriate design process to follow when refining an ICT platform to support ERW in Mafarafara?

- SRQ2: What challenges related to ERW and ICT4D initiatives need to be considered in the design process?

To answer these questions, the situation of ERW in developing contexts is investigated, as well as of ERW using ICT and conducting research with ERW. The co-creation with ERW is also a focus, in order to consider what an appropriate design process would be when ERW co-design an ICT platform.

Figure 3.1 highlights (with a black triangle) where in the research process the study is currently situated (Phase 1):
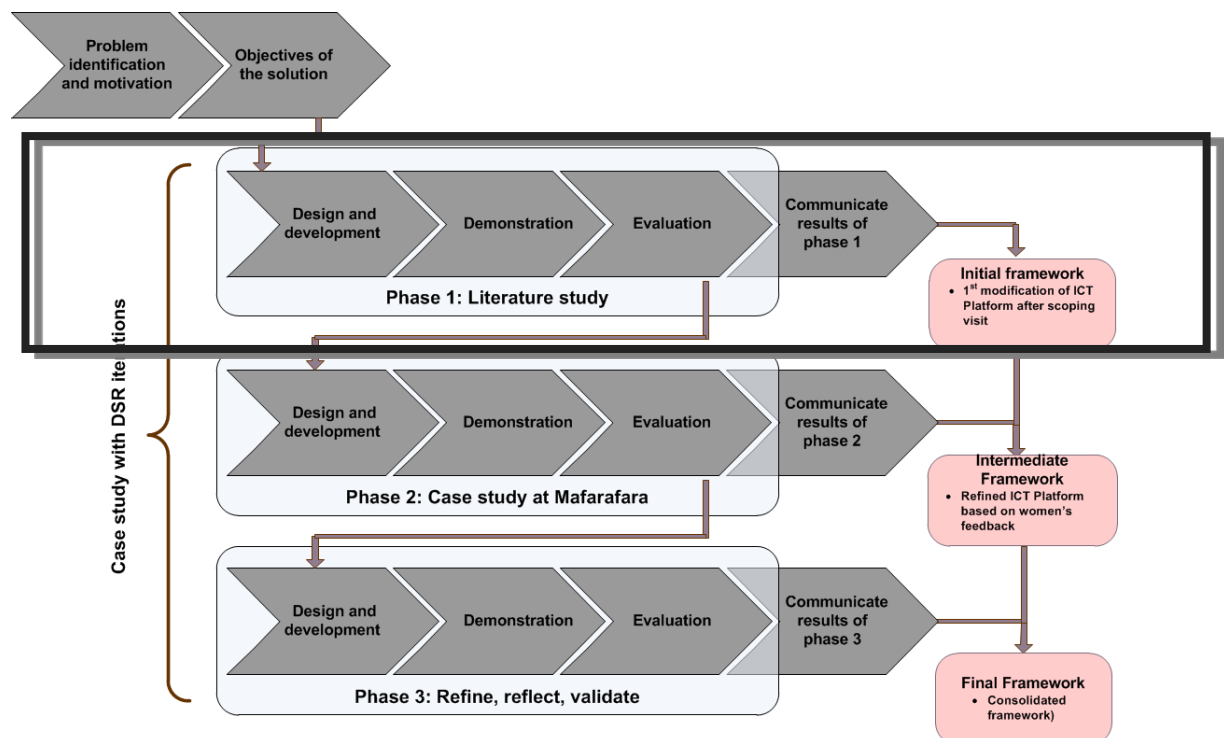
Figure 3-1: Research process and current focus of this chapter

The co-creation design framework is developed through various literature investigations that can influence design decisions related to the initial framework. At the end of this chapter, a summary of the main theoretical concepts and constructs that will influence the design of the framework is provided.

3.2 THE PLIGHT OF RURAL WOMEN IN SOUTH AFRICA

"Women in South Africa are still the face of poverty, inequality and unemployment. Despite the gains made in women's social and economic standing since 1994 … these challenges still persist" (ANC Women's League, 2014::4).

Elderly rural women - (Older Persons' Act, No. 13 of 2006 in Statistics South Africa, 2013) - face significant challenges in their access to information, education, various services, earning opportunities and making themselves heard.

They are the most disadvantaged population group in South Africa (Statistics South Africa, 2016; ANC Women's League, 2014; Statistics South Africa, 2013; Manuel, 2007). ERW are mostly illiterate and poorly educated; isolated and confined to their communities; subject to discriminatory customary laws, persisting patriarchal attitudes and prejudice; have access to severely limited resources, and are marginalised due to the lack of initiatives aimed at their upliftment and empowerment (Jiménez, 2018; Statistics South Africa, 2013; ILO, 2012; Ozoemena, 2010). Socio-cultural norms, values and practices which relegate women to the lowest position in society are still firmly entrenched in rural communities and are adhered to by the elderly and traditional authority structures (Diale, 2013).

Apartheid has left elderly black South Africans in general, and women in particular, to face a complex set of challenges (Lam *et al.*, 2004). They have lived most of their lives under restrictions related to employment, residency and education. The inequality in education between and amongst races was far greater for the current elderly than what they are for younger South Africans. The literacy levels among elderly women are therefore significantly lower than those of their younger counterparts, who received their education after the end of apartheid (Statistics South Africa, 2014, 2013; Lam *et al.*, 2004). In a 2013 Stats SA survey, 58.3% of rural women reported that they have received no education, compared to 41.66% of men; further, older women are less likely than men to have progressed past primary school (Statistics South Africa, 2013).

In a 2014 study, Oxfam (2014) reported that 46% of South African men receive salaries compared with 32% of women, while 27% of women are reliant on social welfare grants compared to 15% of men. This is an ongoing trend that entrenches inequalities in South Africa, as was again highlighted in 2016 (Statistics South Africa, 2016).

3.3 CONDUCTING RESEARCH IN REMOTE RURAL COMMUNITIES (RURAL WOMEN AS RESEARCH PARTICIPANTS)

Conducting research in the remote, resource-scarce rural communities of South Africa presents "outsiders" with unique complexities, as a result of issues such as distrust of politically expedient development projects, the isolation of these communities, and specific socio-cultural traditions (Casale, Lane, Sello, Kuo & Cluver, 2013).

3.4 RURAL WOMEN AND DEVELOPMENT

It is for a number of reasons important to intentionally place the focus of development projects on the empowerment of women. Firstly, the economic upliftment of women can contribute to inclusive and sustainable development (World Bank, 2009a). Secondly, addressing the disparate development outcomes between men and women can have a positive influence on food security and household wellbeing (Desta, 2018; De Schutter, 2013; Etzkowitz, Gupta & Kemelgor, 2010). Highlighting the centrality of rural women's agency in the formulation of economic and technological interventions in developing countries, the World Bank (2009a:398) deplores the fact that "women continue to be left out of key decisions concerning resource allocation and rural livelihoods".

3.5 RURAL WOMEN AND ICT

There is wide-spread acceptance that ICT in its various forms can be instrumental in addressing gender inequalities and in enabling women to empower themselves socially and economically (Jiménez & Zheng, 2018; Fife & Pereira, 2016; Hilbert, 2011; Buskens, 2010; Terry & Gomez, 2010; Kuriyan & Kitner, 2009; Hafkin & Taggart, 2001). The International Telecommunications Union (ITU) acknowledges the importance of gender mainstreaming within the ICT4D domain, stating that a "gender dimension in telecommunications is critical to the attainment of the goal of universal access" (in DAW, 2005:3). However, for ICT4D projects to succeed, researchers and

donors must recognise the agency of women in developing communities; their "experiences, options, choices, dreams, and perspectives" (Nzegwu in Yeganehfar, Zarei, Isfandyari-Mogghadam & Famil-Rouhani, 2018:34; Walsham, 2017:68; Buskens, 2010:48). Rural women themselves recognise the power of ICTs and the communication processes that they facilitate, and will use them to meet their basic needs and advance their strategic interests, if given the opportunity (Efobi, Tanankem & Asongu, 2018; Hilbert, 2011; Odame, 2005).

"It is therefore just as important to understand women's rationalities for development action (or the lack of it) as grounded in their realities, as it is to become aware of the frames of reference that researchers and scholars entertain. The ICT4D knowledge construction processes are neither innocent nor neutral, and refraining to take a normative stand in this field of power relations will automatically render the knowledge that is constructed more viable to the powerful than to the powerless" (Buskens, 2010:20).

3.5.1 Nature, causes and impact of gender inequality in ICT4D projects

Barriers preventing individuals from accessing ICTs are not just about national availability of infrastructure, but also about economic, educational, socio-cultural and political issues (Hussain & Chen, 2018; Torero & von Braun, 2005; Cecchini & Scott, 2003). Rural women in developing countries face significant challenges in terms of access to information, education, various services, earning opportunities and making themselves heard (Efobi *et al.*, 2018; World Bank, 2009a).

ICTs are widely held as socially constructed, and therefore affects men and women differently; ICTs are not gender neutral (Terry & Gomez, 2010; DAW, 2005; Odame, 2005). Women in developing countries in general and those in rural communities in particular are more likely than men to encounter barriers to reaping these benefits due to systemic gender biases towards ICTs and their use, cultural norms that regard technology as a male domain, and social mores that require women to be at home and look after their families (Hussain & Chen, 2018; Joseph & Andrew, 2009; Kuriyan & Kitner, 2009; World Bank, 2009a; Hafkin & Taggart, 2001). Other contributing factors include rural women's lower levels of education and literacy, inappropriate language skills, lower levels of economic security, and a lack of ICTs dedicated specifically for use by women. Further factors include the lack of skilled female trainers and facilitators,

the high cost of access to ICTs, lack of skills to use ICTs, poor and unreliable infrastructure, that results in a lack of interest, lack of available content supporting their needs, and ICT policies that do not directly address rural women's access to ICTs (Lal *et al.*, 2018; Joseph & Andrew, 2009; DAW, 2005; Hafkin & Taggart, 2001).

Hafkin and Taggart (2001) discuss the male-centred gender bias in ICT4D projects. Women are rarely involved when needs assessments for ICT4D projects are conducted. They are still regarded as passive recipients of information rather than active users of technology; the prevailing assumption is that high-end ICTs are not for women. The ongoing delay in addressing the barriers that prevent women from accessing public ICT facilities is adding to the discriminatory practices that prevent women rising from their dire situations (Jiménez & Zheng, 2018). Gurnstein (2009 & 2010), Terry and Gomez (2010), the UNDP (2011) and World Bank (2009a) provide a summary of the barriers preventing rural women's access to, and use of, ICTs. Table 3.1 provides a summary of the barriers that prevent rural women from accessing ICTs.

Table 3-1: Summary of barriers preventing rural women from accessing ICTs

Barriers preventing access to and use of ICT facilities by rural women	
Cultural attitudes about gender and ICTs	• Ingrained cultural perceptions about gender and technology discriminate against women's access to ICTs and ICT related training – 'what could a female farmer possibly want with a computer?'
Resources	• Women have less economic, social and political power than men • Compared to their male counterparts, rural women are less likely to own ICT assets such as radios, mobile phones and especially a computer. • Rural women are less likely than men to use their income in public ICT centres. The exception being when they need to communicate with family or arrange the transfer of money.
Time constraints	• Their very heavy workload and multiple roles in their communities limit the time that rural women has to spend on learning how to use ICTs and visit public access centres. • Public access centres are typically open at times that are inconvenient for women.
Cultural norms and mores	• The position of girls and women is highly determined and structured. Women are expected to maintain their modesty. • What is regarded as acceptable economic activities are gender-determined.
Low education and literacy levels	• Rural women are typically poorly educated with limited literacy levels. They constitute two-thirds of the world's illiterate population • If girls and women do receive ICT training, it is of very poor quality
Lack of relevant content and applications	• For women to use ICTs, they must have a direct relevance to the women's daily lives and basic needs. Western men produce most of the content and applications currently available, making it irrelevant for rural women. • Much of the content and applications are in English which the majority of rural women do not understand.
Infrastructure	• Availability of reliable infrastructure and connectivity. • Public access centres are usually located in urban areas, too far away from the rural women for them to be able to visit on a regular basis. • Public access centres are regarded as "gendered spaces", that is, they are perceived as being masculine places not suitable for women.

3.5.2 Issues to consider when introducing ICTs aimed at rural women

Merely providing access to technology is not enough to ensure rural women's use of that technology (Efobi *et al.*, 2018; Terry & Gomez, 2010; Gillard, Howcroft, Mitev & Richardson, 2008; Goldfarb & Prince, 2008). Rather, "ICTs become advantageous to women when women are able to organise themselves around information that meets or addresses their specific needs" (World Bank, 2009a:398).

An increase in women's access to, and use of, ICTs are not guaranteed by increased ICT penetration. The differences in women's and men's socio-economic contexts must be taken into account in order to successfully plan the delivery of ICT programmes aimed at meeting women's needs (Hussain & Chen, 2018; World Bank, 2009a; Hafkin & Huyer, 2007). ICT interventions must be designed and implemented in a gender sensitive way from their inception, recognising that men and women have different needs and constraints and realising that they must be addressed differently (Hafkin & Huyer, 2007; Global Knowledge Partnership, 2003). To ensure meaningful intervention (both technological and social), it is important that ICTs deliver information that is relevant to the needs of rural women and address the specific issues that keep them from accessing ICTs (Walsham, 2017; Hafkin & Taggart, 2001; UNDP, 2001).

Not including women in ICT4D projects, and not incorporating gender considerations into ICT diffusion strategies, national policies and funding policies, can have the unintended consequence that women are excluded from the project, and contribute to an increase in gender and income disparities (World Bank, 2009a). The gender dimensions of ICT has to be addressed, especially those related to building their capacity, providing access, empowering them and employing them. It is therefore important that ICT4D projects are not only gender aware, but also recognise gender sense-making (Jiménez & Zheng, 2018). DAW (2005), Terry and Gomez (2010) and the World Bank (2009a), summarises the factors to consider when implementing ICT4D projects aimed at rural women (see Table 3.2).

Table 3-2: Factors to consider when implementing ICT4D projects aimed at women

Factors to consider when implementing ICT4D projects aimed at women	
Literacy levels	• Whereas radio and cellular phones are accessible to illiterate users, computers typically require some level of literacy. Emphasising oral and visual communication can play an important role when the literacy levels of intended users are low.
Content	• Content relevant to rural women, that are based on their needs, must be developed at a local level with their participation (Terry & Gomez, 2010; World Bank, 2009a; DAW, 2005). • Successful ICT interventions provide rural women with tools to record, document and share local knowledge (World Bank, 2009a; DAW, 2005). • The recognition of local women as information producers must be emphasised (DAW, 2005).
Public access centres	• Many public access centres are in locations where it is difficult for women to access them due to inappropriate opening times, lack of transport and security issues. • These centres tend to become men-only spaces because the focus is often on technology, not on the content and social context. This effectively inhibits women's access to these facilities (DAW, 2005). • Internet cafés are usually owned or managed by men, and the majority of users are men. Rural women and girls are therefore often reluctant to visit these facilities. • Public access centres operated by women are perceived as being more welcoming by women and are visited more.
Training and capacity building	• ICT training must be provided for women and girls. • ICTs are tools that can support women's digital literacy and thereby address imbalances in education and training. This can be achieved by using ICT platforms to 1) facilitate applied forms of formal and informal peer learning and 2) provide tools to create their own learning material that they can share with other women (World Bank, 2009a). • Women have special needs with respect to capacity building – gender barriers to ICT education and training must be removed (DAW, 2005). • An enabling environment must be created by promoting the participation of women in the formulation of ICT policies (DAW, 2005). • Appoint female trainers and mentors to assist rural women (Jiménez & Zheng, 2018).
Monitoring and evaluation	• Gender-specific indicators on ICT needs and use, as well as measurable performance indicators to allow for follow-up and evaluation of the impact of ICT4D projects aimed at women (DAW, 2005), are required.
Nature of access	Keep in mind the two aspects of access • Physical access to ICTs and the ability to utilise the infrastructure; and • Ability to make effective use of the information and resources. Many women will not benefit from ICTs – even if they could get physical access to and are allowed to use the infrastructure as a result of factors such as illiteracy, language barriers, geographic location, social class and mobility (DAW, 2005).

3.6 RURAL WOMEN, TECHNOLOGY, AND CO-CREATION

As discussed in section 3.4, the active involvement of rural women in ICT4D initiatives is essential to ensure that they benefit from the initiative in general, and the technology artefact in particular. Issues to be addressed include the male centred bias of ICT4D projects, relevance of ICTs to women, and women's contextual realities. This section starts with a discussion of why participatory approaches are important when implementing ICT4D initiatives aimed at rural women. This is followed by an overview of participatory design as 'parent domain' of co-creation, co-creation as design approach, and potential barriers to co-creation. The extent to which women can in fact become co-creators is central to this study.

3.6.1 Why co-creation?

By actively participating in ICT4D initiatives, rural women can contribute their experiences, local knowledge, and contextual realities to the research team's theoretical and analytical capabilities to create a holistic view and improve any research agenda (Meyerson & Kolb, 2000).

When conducting technology-based projects in rural communities in developing countries it is important to remember that ICTs are socio-technical systems (Moens *et al.*, 2010; Stillman, 2010). Western culture, typically unsuited to local requirements, is embedded in the design of technology, and when projects are ICT vendor or donor driven, this culture must be adapted to fit the community (Moens *et al.*, 2010; Morales-Gomez & Melesse, 1998). For ICT4D projects to be successful, context specific requirements and interpretations must be taken into account during the design process, with local community members afforded the opportunity to articulate their requirements, needs and demands (InfoDev, 2003). To maximise the value of co-creation, and avoid a top-down technology push, a bottom-up approach embedded in community participation is vital (David *et al.*, 2013). Co-creation or a participatory approach allows for the incorporation of the social values, perspectives and knowledge of the communities, thereby producing a product or solution that bridges Heeks' design-reality gap (Khumalo & Pather, 2018; Heeks, 2008; Puri, 2007). With all this being said, community participation in an ICT4D context is always more complex than what is reported in the literature (Bailur in de la Harpe, 2014), and even experienced ICT4D researchers and practitioners can find themselves with 'burnt fingers'. The ability to

exploit ICTs is a form of cultural capital that can influence the way people in which people will use technology, therefore the (disadvantaged) position of people does influence the value and use of ICTs in rural areas (Singh *et al.*, 2018).

3.6.2 Conceptualisation and defining co-creation

The label of co-creation has been associated with various topics, such as developing new services, collaborating with users and innovators, adapting a product to the needs of users, participation of stakeholders in a community, creating new knowledge and networks, and exchanging services (Ramaswamy & Ozcan, 2018). However, despite this diversity, there is surprisingly little consensus on what 'co-creation' is.

The term 'co-creation', which has its origin in the innovation domain, is increasingly being used in the development context along with terms such as 'user-driven innovation', 'co-production' and 'collaborative innovation' to describe the intended beneficiaries' involvement in the design of solutions that are relevant to their needs (Smith, 2015b). Co-creation refers to a situation in which research participants collaborate with the research team to add value to the research process and to create something of value (Humphreys & Grayson, 2008).

Co-creation can take place when the researcher and research participants are in contact with one another for a specific reason and/or to achieve a specific result. This contact creates the opportunity for the parties to influence each other's thinking and processes. Interaction must be mutual and reciprocal and should generally be beneficial for both parties, resulting in shared value creation (Grönroos, 2011; Windisch, 2011). Co-creation enables and empowers research participants to interact and collaborate with the researcher in order to create an artefact that has value for both parties (Edvardsson, Tronvoll & Gruber, 2011). The production of the co-created artefact can be viewed as the generation of potential value, whereas use of the artefact is viewed as generation of real value (Grönroos, 2011).

Many papers apply the term 'value co-creation' but do not define 'co-creation', and then add the term 'value'. Attention is then distracted from 'creation' (Vargo & Lusch, 2016). This resulted in comparing 'co-production' and 'value-in-use'. Ranjan and Read (2016) have found that of the 149 papers they investigated, 71 focus on 'co-production' and only 46 addressed 'value-in-use'. A focus on 'value co-creation' was only indicated in 32 papers.

After investigating all concepts related to co-creation, Ramaswamy and Ozcan (2018:200) provide the best definition for co-creation pertaining to this study:

"Co-Creation is the enactment of interactional creation across interactive system-environments (afforded by interactive platforms), entailing agencing engagements and structuring organizations."

Ramaswamy and Ozcan (2018) postulate that the real value of creation does not only apply to co-creating artefacts, but rather lies with the value that the new co-designed artefact within their own contexts can have for participants, based on their involvement in their own networks. This is particularly relevant for this study, as the ERW co-create an ICT platform based on their needs and gain value out of this co-creation process as it improves the quality of their lives.

Ramaswamy and Ozcan (2018) also indicate the relation between co-creation and the structuration theory of Giddens (1984) when they include in their definition the notions of human agency and structure. They state that the test is to understand the role of both structure and agency, and that these two concepts should not be juxtaposed, but that the value of both should be recognised as the interplay between them takes place. The idea is that agency and structure constitute responses that shape their orientations towards their contexts. This is also supported by Booyens, Hart and Ramoroka (2018) when they indicate that, in South Africa, agency has a role to play in innovation in developing contexts, but that the involvement of the government is not very prominent in promoting this. That is why some ICT4D studies do not acknowledge the innovation that takes place at an individual level as they develop products that are rooted in a specific socio-cultural context (Jiménez & Zheng, 2018). In South Africa, this is a challenge as the National Innovation System has to involve local communities when innovating (Booyens *et al.*, 2018).

As one collaborates during co-creation, people from various levels in society join one another to share their visions in the quest to co-design and co-implement refined products and services that focus on deprived community needs (Ranjan & Read, 2016). This can ensue in socio-economic prosperity while a specific challenge in a community is addressed (Ruhl, Richter, Lembke & Allert, 2014). According to Coburn (2003), there are four dimensions when scaling projects:

- Spread: maintaining impact across diverse settings and populations;

- Depth: effecting deep change to the instructional core;

- Sustainability: impact is maintained in the long term; and

- Shift in ownership: each local community is empowered to own and drive forward the change efforts.

This is also supported by Hood (2018), who argues that when we scale, we consider not only to identify the right innovation to implement, but also how best to adapt it to individual contexts. Fundamental to this work are two components: (1) the robust deployment of continuous improvement methods to promote iterative innovation, and sustained learning and progress; and (2) a systemic approach to collaboration through the creation of powerful and well-designed networks.

Co-creation therefore represents an important change in how people interact to develop a value that is shared. This was particularly evident when the ERW co-created the ICT platform.

3.6.3 Co-creation and interaction

Co-creation allows closer interaction between the researcher and research participants than is the case with some other methodologies. This close interaction can lead to the development of enhanced relationships between the two parties, helping them to obtain a better understanding of each other's needs. This understanding in turn can lead to the development of a depth of information and knowledge that is difficult to achieve with more 'hands-off' research methods (Windisch, 2011). Research participants benefit from a co-creation approach through, amongst others, the development of a solution or artefact, that is suitable to their specific needs by learning new things, and through a more in-depth exposure to the research process (Windisch, 2011). Kambil, Friesen and Sundaram (1999:38) describe the co-creation process as an enhanced relationship between the researcher and research participants, which is formed in pursuit of greater value, where the co-created value is "greater than either party could have created independently".

Despite the advantages of a co-creation approach, it is possible that the interaction will not go according to plan, resulting in misunderstandings and conflict. If these are not addressed, they could negatively affect the research process and its outcomes (Windisch, 2011). The adoption of a co-creation approach in a research project raises

the question of ethics, particularly as it pertains to recognition that is given to the contribution of the research participants, as well as to the participants who are deriving benefit commensurate with that of their contributions. These issues are particularly relevant when the participants are disadvantaged and potentially vulnerable to exploitation. In this study, these concerns will be mitigated by two factors. Firstly, should the research results be used for purposes other than the redesign of this specific ICT platform, the women will be recognised as co-creators. Secondly, the ICT artefact co-created with the women will remain in the community after completion of the project.

In summary, co-creation can result in interaction that leads to collaboration, which is in turn relevant to specific needs. This collaboration:

- is user driven;

- adds or creates value through co-production;

- facilitates the achievement of a specific result;

- is mutual and reciprocal;

- is beneficial to both researcher and research participant;

- establishes and enhances relationships;

- empowers;

- increases the visibility and needs of the users of ICTs; and

- enables participants to accomplish more.

3.6.4 Components and processes of co-creation

When the researcher adopts a co-creation approach to research, the research participants are capacitated to accomplish something that they would otherwise not have been able to do, or would have been able to accomplish less effectively or efficiently (Grönroos, 2011).

Through co-creation the research participants can create value for themselves by integrating the resources that are provided by the researcher with existing available resources. Terblanche (2014) proposes that value should rather be in the social context, and not only when using an artefact as the social system also influences the value. An

example from this project is the capturing of local agricultural knowledge and making it available on the ICT platform provided by the researcher.

In some community-based models of co-creation, a central issue is the lack of power of community members who are involved, especially when co-designing with technology, and during value co-creation. In each case, there are inherent power differentials, and this should be carefully managed to allow all involved to participate meaningfully in the co-creation process (Greenhalgh, Jackson, Shaw & Janamian, 2016). Value also lies in empowerment, especially when developed during collaboration as the participant's motivation and ambitions are enhanced (Novani, Putro & Hermawan, 2015).

Various models of co-creation exist (Edvardsson *et al.*, 2011; Andreu, Sánchez & Mele, 2010; Gebauer, Johnson & Enquist, 2010; Zwass, 2010; Payne, Storbacka & Frow, 2008; Zwick, Bonsu & Darmody, 2008; Prahalad & Ramaswamy, 2004), but according to Durugbo and Pawar (2014) and supported by Ramaswamy and Ozcan (2018), most of these focus on the dynamics between the supplier, customer and encounter domains during the co-creation process. Value is derived from value in exchange as well as value in use. Durugbo and Pawar (2014) developed a unified model of co-creation (Figure 3.2). Unlike other studies on co-creation, they explicitly define the key role of existing value and technique selection during co-creation. This research proposes such a 'unified model' that includes an understanding of the needs of customers, learning that happens between suppliers and customers, and involving customers when selecting a method to co-create and an understanding of the value of what will be co-created, as can be seen in Figure 3-2.
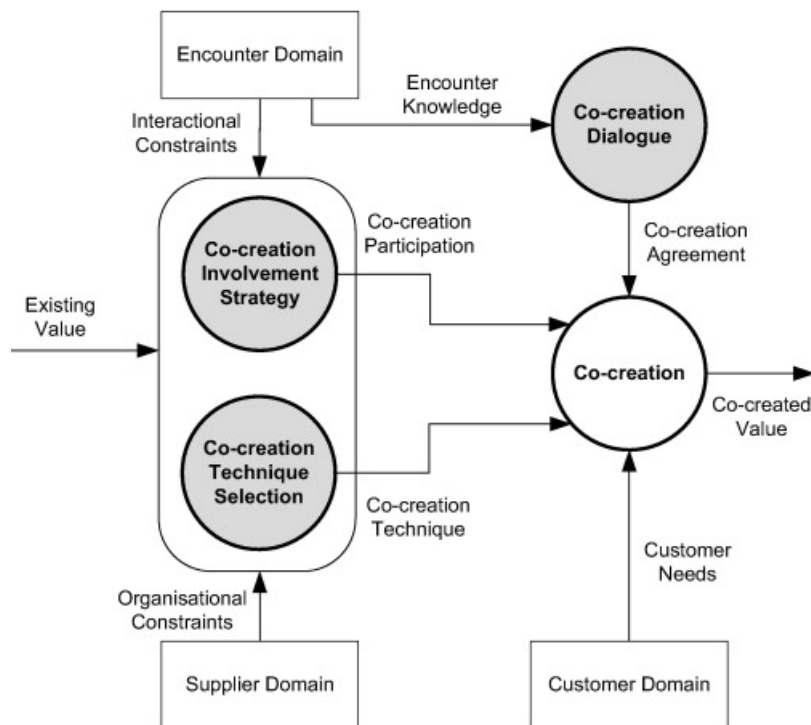
Figure 3-2: A model for co-creation (Durugbo & Pawar, 2014)

This model adds a new perspective on collaboration during co-creation, and includes themes such as capability-, customer-, governance-, intelligence-, value-, role-, process-, service-, and community-focused. This model has particular reference to this study, as co-creation within a specific community is all about dialogue, participation, knowledge sharing, sense-making, needs and ultimately about creating value in the community, in use and in their context.

More recently, Ramaswamy and Ozcan (2018) developed a co-creation framework where resource integration occurs in interactive platforms that involve many interactive system-environments through which interactional creation occurs. The value lies in the interactions, where agencies of actors and structuring organisations operate in a networked structure of system–environment interactions. They bridge the theory–practice divide, where interactive platforms connect new value creational opportunities with resources.
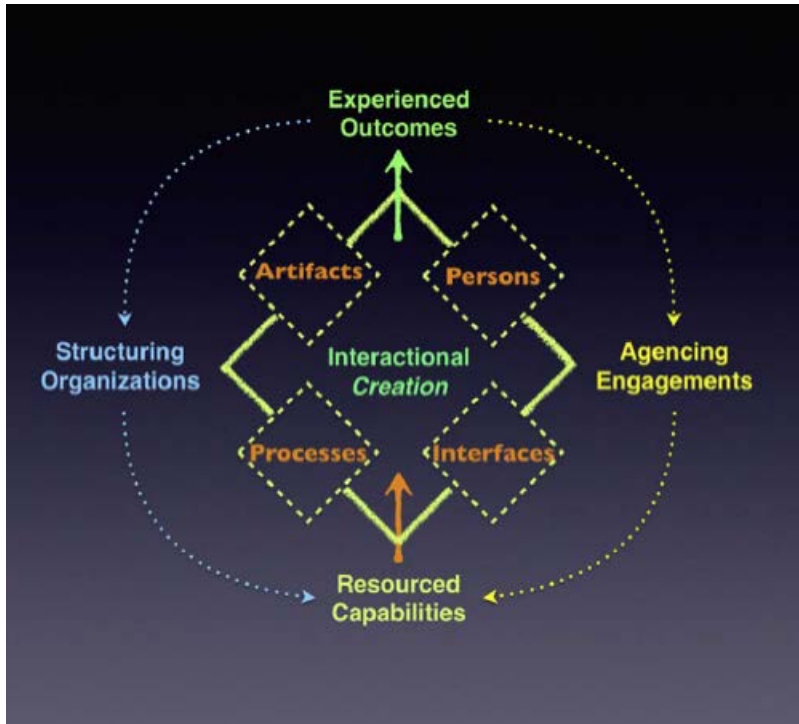
Figure 3-3: Co-creation framework where resource integration occurs in interactive platforms (Ramaswamy & Ozcan, 2018)

Another recent study developed a co-design framework that applied Joint Application Development (JAD) principles, which involve ways to improve user participation, further development and improve the quality of specifications (Khumalo & Pather, 2018).
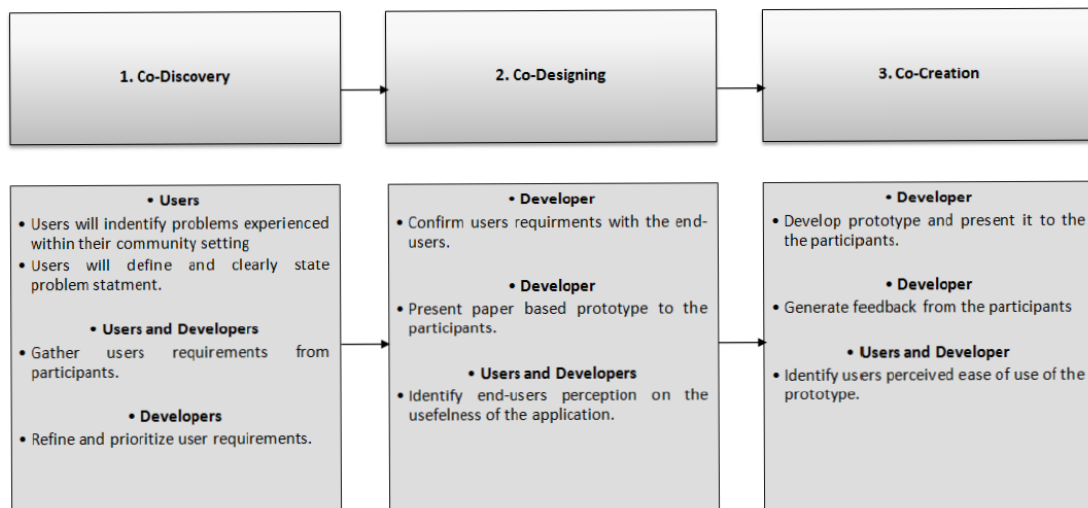
Figure 3-4: Framework for Bottom-up Community Based Co-Design (Khumalo & Pather, 2018)

In this framework, where the community co-design from the bottom up, the concepts of co-discovery of problems and obtaining requirements are evident. This is followed by co-designing where the users must ensure that their requirements of usefulness are met and, finally, by co-creation where a product is developed and improved with feedback from participants. JAD gave the framework structure, in the sense that the iterative focus group sessions and objectives for each session were developed. In developing the framework, it was noted that miscommunication amongst developers and users has misguided systems requirements determination and has contributed to several systems failures. Therefore, the constructs of the Technology Acceptance Model in relation to perceived ease of use and perceived usefulness of a technology, as user-specific dimensions related to acceptance, were incorporated to guide JAD sessions. This was important, given that the model is used to predict and explain ICT usage behaviour, that is, explaining why end users accept or reject the use of information technology.

All these co-creation models provide an opportunity to move research closer to the realities of the world. The key to achieve impact in society from co-creation is to adopt a 'complex system' model of change, whilst concentrating on the sensitive nature of relationships and on conflict management.

3.6.5 Co-creation process, steps and benefits

Various scholars (De Koning, Crul & Wever, 2016; Putro, 2016; Novani *et al.*, 2015; Kijima, Rintamki & Mitronen, 2012) indicate that a co-creation process should include specific steps such as identify, analyse, define, design, realize and evaluate or listen, identify, ideate, collaborate, evaluate and experiment. The application of these steps support the theory for design and action (*cf.* section 2.6.2). However, according to Kijima *et al.* (2012) and supported by Suryana, Mayangsari and Novani (2017), for co-creation to have real value the co-creation process steps should rather be: *co-experience, co-definition, co-elevation, and co-development*. When applying co-experience, the client and supplier should share their understanding of the nature of the problem and process, and comprehend each other's preferences, capabilities, and expectations so that they may co-define and share a common internal model (Putro, 2016). Co-elevation has to do with the process of understanding the expectations of customers and the abilities of the providers. The higher the expectation, the greater the value. Thus, co-

development addresses co-innovation that is the result of people who collaborate (Novani *et al.*, 2015).

The benefits that will result from these steps are that all parties (whether customer, supplier or community ERW) will be involved and *collaborate*, and through this gain knowledge and *learn*. They will curate, which means they will be *encouraged* to co-develop and be or *feel empowered* (this was found under section 6.2.2, during site visit 4) as they gain new knowledge and skills that previously did not exist, and as both see the value of their inputs and are motivated to interact with one another (Kijima *et al.*, 2012). This also supports the theory of diffusion of innovation (*cf.* section 2.6.3). Other benefits are *networking* to expand their social network (social integrative benefits) and enhance a sense of belonging. Furthermore, the more *entertaining and interesting the content* of the co-creation platform, the greater the willingness to discuss and cooperate (Suryana *et al.*, 2017).

True participatory design is more than just getting the users involved in the 'how' of implementation. They should also be involved in setting the agenda and deciding on the approach (Moens *et al.*, 2010). Full and active participation of the end users and local community in the design of an ICT platform is crucial to ensure its usefulness at local level by directly addressing local needs, as well as by promoting buy-in and developing local champions (Booyens *et al.*, 2018; David *et al.*, 2013; Gurnstein, 2003). Carroll and Rosson (2007) propose that participatory design integrates two propositions about design, namely, the moral proposition and the pragmatic proposition. The moral proposition holds that the users of an artefact have the right to make a substantive input in defining the outcome of an initiative, and to also be directly involved in the design and development process. The pragmatic proposition holds that the intended users of an artefact are in the best position to present expert opinions with respect to form, function, deployment, and others. Users should therefore be directly and substantively involved in the design process. Involving users in all facets of the ICT4D initiative increases the likelihood of a successful outcome (Ranjan & Read, 2016).

Traditionally, ICT4D research focuses on women as users and beneficiaries, not as co-creators. In response, the World Bank (2009b:3) emphasises the importance of involving women in projects by stating that various studies have "highlighted the need to ensure greater continuity between design and implementation to integrate women more fully into mainstream development activities". This is further supported by Jagtap

and Larsson (2018) when they indicate that women living in poverty suffer many problems as compared to men living in poverty, as women have different needs and perspectives on the problems that they encounter. This implies that design research in this field can benefit from developing gender-sensitive co-design approaches. This can result in more involvement of women in co-design activities.

Given that design practices and tools influence the outcome of the system, it is important that women participate in the design and development of the ICT systems that are intended for their use (Desta, 2018; Light, Ladeira, Roberson, Bidwell, Rangaswany, Sambasivan & Gitau, 2010).

Morales-Gomez and Melesse (1998), blame failures and inappropriate outcomes on a poor understanding of the social and cultural dimensions of the intended user's context. To mitigate this problem, the ICT4D initiative must employ a strong user-centric approach, utilising participatory approaches (Lwoga & Sangeda, 2018).

Pervasive and persistent inequalities, political mismanagement, the corruption of government officials and tribal authorities and the high failure rate of development projects have led rural communities to view any project initiated by 'outsiders' with distrust and cynicism (Barjis *et al.*, 2013). This 'upliftment fatigue' makes it difficult to gain entry into a community. Using a participatory design approach researchers and practitioners can avoid the pitfall of "trying to implement an externally developed solution (to a different reality), then trying to customise the local socio-cultural reality to the solution" (Barjis *et al.*, 2013:225).

Dearden, Light, Kanagwa and Rai (2010:2) state "if we aim to design ICT that is 4D, the approaches we adopt must be sensitised to how they empower people locally to progress their own visions of the kind of social development and therefore the form and function of ICT that they want". The same sentiment is echoed by Lwoga and Sangeda (2018) when they indicate that ICT applications are best valued when deployed in a specific context where people participate collectively to improve the artefact based on their own needs.

3.6.6 Co-creation in the agriculture sector

Gakuru, Winters and Stepman (2009) point out that the majority of rural ICTs for agriculture initiatives are externally driven and/or funded. The information provided are generated elsewhere and distributed to rural communities through various

mechanisms such as newspapers, radio, television, mobile phone alerts and telecentres. Rural communities are therefore excluded from the "generation, validation, evaluation, understanding and appreciation of this information" and thus remain mere passive observers (Gakuru *et al.*, 2009:18). They continue that rural farmers should not be regarded as "mere consumers of generic information and knowledge" (Gakuru *et al.*, 2009:21). The development of e-agriculture systems should take place through "face-to-face interaction, learning by doing, learning through evaluation and experience as well as participatory research" to "convert the generic information into location specific knowledge and then empower its members through horizontal transfer of knowledge. It should enhance self-directed learning among the rural community" (Gakuru *et al.*, 2009:22). According to Booyens *et al.* (2018:754) innovation systems in agriculture are dependent on "local agents; formal institutions; value chains; investments; and cultural and social capital as part of complex territorially bound systems". This is further supported by Dawson, Martin and Sikor (2016) when they indicate that innovation in rural settings includes not only the sector's traditional agricultural innovation systems; it also involves a network approach to rural innovation, where internal as well as external knowledge sources play a significant role. Co-creation is also linked with innovation, and the term 'innovation for inclusive development' (were the marginalised poor can share in opportunities of improvement) is also applicable here. If you want to use this term, the following is necessary: *smart infrastructure, creative cultural environments, trust, identity to a larger goal and diversity of knowledge in a network*. These elements have to be nurtured to create an entrepreneurship mindset where technology can be used to assist with the facilitation of innovation (Jagtap & Larsson, 2018; Lamprini & Bröchler, 2018:5). This is evident within the Mafarafara community, as the leader of the ERW (Mma C) is a local agent with cultural and social capital who makes use of her network of other ERW to share their knowledge to co-create and improve the ICT platform based on their own needs and requirements.

3.6.7 *Participatory design and co-creation in ICT4D*

Kyng (2010:49) describes participatory design as being "about design and about participation in design by people who are potential users of the result of the design activities". Light *et al.* (2010) add to this that participatory design involves the establishment of relationships, participation of the intended users in the design program and their participation in the evaluation of the design. Industry has learnt this lesson

well. Having moved away from the bespoke design approaches from previous centuries where the customer and designer were both directly involved in the design, production, and evaluation of an item, to the mechanisation of the industrial revolution, and increasingly specialised design and production processes with very limited room for end-user involvement. The higher standards expected by customers and increased competition have forced industry to once again pay particular attention to the views and requirements of their end-users by involving them in the design process. This approach delivers better quality products and services, which are increasingly relevant to end-user requirements (David *et al.*, 2013).

Participatory design has a definite role to play in the evolution of ICT design practices to a place where designers are more 'aware' of ICT users and as a result meet their needs better. Participatory design in IS has traditionally focused on business contexts in the Western world. Its application in a developing world setting, and particularly in relation to socio-technical development, has been limited (Khumalo & Pather, 2018; Kyng, 2010; Byrne & Sahay, 2006).

For co-creation to be successful, particularly in the ICT4D domain, all stakeholders must share the same vision, taking into consideration that those involved might have different socio-cultural backgrounds, as well as different perspectives, knowledge and expectations (Booyens *et al.*, 2018; David *et al.*, 2013). De Koning *et al.* (2016) indicate that co-design is a process used in participatory design that differs in meaning from co-creation. Co-design is used to describe the process of collaboration in which co-creation takes place. Further, co-design is a type of co-creation as well as community design. For the purpose of this study, both will be applied (*cf.* Figure 4.13).

3.6.8 *Participatory design in DSR*

Lee, Alter, Chiasson and Krcmar (2012:3) indicate that DSR can sometimes place too much emphasis on the technology or place the artefact as the central focus. Hovorka (2010:12) supports this when he identifies issues with/implications of the artefact-centric view of DSR:

- Hevner *et al.* (2004): DSR does not focus on the actors using the artefact, nor on the way in which the artefact or work practices are modified over time;

- Researchers adhering to these guidelines are therefore likely to privilege the technical artefact over an evaluation of social processes, secondary design, or emergent benefits in their theorising;

- Design researchers often do not share the same model of the task domain as the users;

- Systems are often used in ways that the designers did not anticipate;

- If intended users of the artefact are not co-creators thereof, it will be a model of the design researcher's view of the problem domain only;

- Human agency and learning play a large role in the enactment of technology (Ramaswamy & Ozcan, 2018). Human actors who tailor information processes are acting as secondary designers in the ongoing creation and recreation of information environments;

- Power imbalance between designers and clients: there are several examples of power imbalances - the language and terminology used by the designer is so foreign and unfamiliar to the users that they cannot be full and equal participants (Weedman, 2008). In some cases the users become 'hostages' to the designers who orchestrate decisions, while claiming that they have all been made by participants (Olsen in Weedman, 2008);

- Time cost of participation: The time required to participate in the design process is at the cost of their normal day-to-day commitments, for example, the Mafarafara women who needed to collect their pension pay-outs, as discussed in section 5.5.6.2 (Weedman, 2008);

- Intended users' perception of failure: Failure, diagnosis, and resolutions of problems are integral elements of the design process. However, for rural communities who have lost patience with failed outside interventions, it creates stress and distrust in the researcher's motivations; and

- Experimentation: A key requirement of DSR is the generation of new knowledge, a process that inevitably involves experimentation. An artefact, which is either not always available or functioning as expected, can lead to user frustration, particularly in resource-poor rural communities.

These factors or issues have to be noticed and should be considered when developing the co-creation design framework.

3.7 SUMMARY

ICT4D strategies and initiatives aimed at improving the situation of rural women must place more emphasis on local realities – such as power structures and indigenous sources of knowledge – than has been done to date. For women to benefit from 'new' knowledge gained from ICTs, it must be integrated with their local knowledge within the context with which they are intimately familiar. To make new technologies work for rather than against women in rural areas, it is important to consider that they have different needs, capacities and skills than men. Consulting women when co-designing and co-creating with ICT is essential, as this can empower them towards capacity building. Specific steps in the process of co-creation during design are crucial to follow, as is a specific co-creation model. Soliciting the views of ERW on new technology and involving them in the design can result in the development of the technology that is more user-oriented and that will improve the likelihood of adoption.

3.8 LITERATURE COMPONENTS FROM CHAPTER 3: TOWARDS THE INITIAL CO-CREATION DESIGN FRAMEWORK

Based on all the findings from literature one can develop a synthesis of the most important aspects or components to consider when developing a co-creation design framework for ERW. The following table provides an overview of the most prominent components in this chapter.

Table 3-3: Towards the initial co-creation framework with components from Chapter 3

No	Component	Key issues within the component	Reference
1	Education and literacy levels and skills of ERW	Inequality in education, literacy and income between men and women in rural areas are a reality.	(Efobi *et al.*, 2018; Hussain & Chen, 2018; Oxfam, 2014; Statistics South Africa, 2014; Casale *et al.*, 2013; Statistics South Africa, 2013; Lam *et al.*, 2004; Cecchini & Scott, 2003)
2	Isolation and socio-cultural traditions	Values, norms and policies prevent ERW to have a voice or be consulted during decision-making. Ingrained cultural perceptions about gender and technology discriminate against women's access to ICTs and ICT related training – 'what	(Jiménez & Zheng, 2018; Fife & Pereira, 2016; Casale *et al.*, 2013; Hilbert, 2011; Buskens, 2010; Terry & Gomez, 2010; Kuriyan & Kitner,

No	Component	Key issues within the component	Reference
		could a female farmer possibly want with a computer?'	2009; World Bank, 2009a; Hafkin & Taggart, 2001)
3	Empowerment of ERW when using ICT	ERW are developed and power imbalances disappear if ERW use ICT. ICT provide access to information that can support their capacity building and training while they interact with ICT.	(Lal *et al.*, 2018; Greenhalgh *et al.*, 2016; Novani *et al.*, 2015; Lee *et al.*, 2012; Grönroos, 2011; Windisch, 2011; World Bank, 2009b; Weedman, 2008; Hafkin & Huyer, 2007; DAW, 2005)
4	Agency and structure of ERW	Their experiences, dreams, choices, perspectives and voices have to be heard while interacting with, and partaking in, developing or improving ICT in their context.	(Efobi *et al.*, 2018; Ramaswamy & Ozcan, 2018; Yeganehfar *et al.*, 2018; Walsham, 2017; Buskens, 2010; Giddens, 1984)
5	ICT meeting needs and requirements of ERW	Development of ICT should meet all needs of communities and ERW, and they should provide requirements during the co-creation process to see improvements.	(Efobi *et al.*, 2018; Hussain & Chen, 2018; Hilbert, 2011; Moens *et al.*, 2010; World Bank, 2009a; Odame, 2005)
6	Infrastructure and content	A stable infrastructure that can support the use of ICTs in rural areas is essential, as is suitable content that ERW can use to improve the quality of their lives.	(Lal *et al.*, 2018; Lamprini & Bröchler, 2018; Joseph & Andrew, 2007; DAW, 2005; Hafkin & Taggart, 2001)
7	Social values are supported through the co-creation and participation of a specific product or solution	Social values such as trust, ownership and identity are important to consider when co-creating, so as to ensure sustainable use of ICTs.	(Khumalo & Pather, 2018; Lamprini & Bröchler, 2018; Lwoga & Sangeda, 2018; Dearden *et al.*, 2010; Heeks, 2008; Puri & Sahay, 2007)
8	Collaboration/collaborative innovation in a context that is community focused	Collaborative participation in the rural context in the community drives innovation.	(Ramaswamy & Ozcan, 2018; de la Harpe, 2014; Durugbo & Pawar, 2014)
9	Benefit of co-creation	Value-in-use Value-in-context Value-in-exchange Socio-technical impact	(Ramaswamy & Ozcan, 2018; Suryana *et al.*, 2017; Vargo & Lusch, 2016; Terblanche, 2014; Kijima *et al.*, 2012; Grönroos, 2011)
10	Design process of co-creation	Apply specific steps such as design, production and evaluation, or	(Khumalo & Pather, 2018; Suryana *et al.*,

No	Component	Key issues within the component	Reference
		identify, analyse, define, design, realize and evaluate. Co-experience, co-define, co-design, co-production, co-develop, co-discover, co-construct, co-implement, co-evaluate	2017; De Koning *et al.*, 2016; Putro, 2016; Ranjan & Read, 2016; Novani *et al.*, 2015; Ruhl *et al.*, 2014; David *et al.*, 2013; Kijima *et al.*, 2012; Kyng, 2010; Gakuru *et al.*, 2009)
11	Participatory design process	Establishment of relationships, participation of the intended users in the design program, as well as their participation in the evaluation of the design.	(Khumalo & Pather, 2018; Kyng, 2010; Byrne & Sahay, 2006).
12	Models of co-creation	Various models have been recorded, such as value co-creation, co-creation framework with resource integration, unified model of co-creation and, finally, and the most applicable to this study: *Framework for Bottom-up Community Based Co-Design*	(Durugbo & Pawar, 2014; Edvardsson *et al.*, 2011; Andreu *et al.*, 2010; Gebauer *et al.*, 2010; Zwass, 2010; Payne *et al.*, 2008; Zwick *et al.*, 2008; Prahalad & Ramaswamy, 2004) (Durugbo & Pawar, 2014) (Ramaswamy & Ozcan, 2018)

In responding to the sub-research question "What is an appropriate design process to follow when refining an ICT platform to support ERW in Mafarafara?", the suggested way forward is to combine the co-creation design process with the participatory design process and also include the benefits, impact and value of co-creation in the initial co-creation design framework for ERW.

4.1 INTRODUCTION

This chapter provides an overview of ICT4D, the debates relevant to the benefits of ICT4D projects, as well as the reasons why these projects fail. A perspective on what makes ICT4D projects work is also necessary to counteract the failures.

This chapter continues to address the second sub-research question:

- SRQ2: What challenges related to ERW and ICT4D initiatives need to be considered in the design process?

It also responds to the following research objective: Conduct a literature study on the challenges faced by ERW in an ICT4D context in order to inform the appropriate design approach and process. To respond to the mentioned objective and sub-research question, the challenges faced by ICT4D initiatives will be investigated.

In the second part of this chapter, an overview is provided on the ICT4D technology used in this study, namely the ICT platform (*cf.* section 4.3).

Figure 4.1 highlights (with a black triangle) where in the research process the study is currently situated (Phase 1):
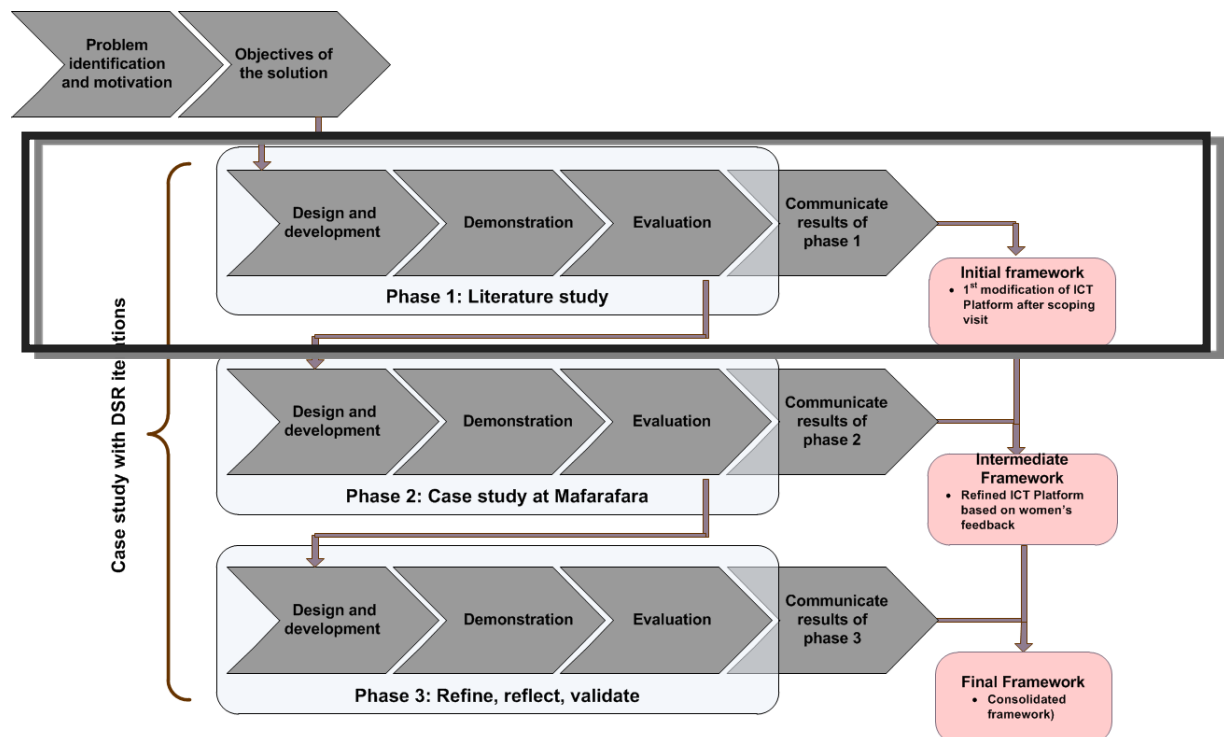
Figure 4-1: Research process and current focus of this chapter

4.2 ICT4D

The poor do not benefit when practitioners, agencies, NGOs and governments "dump hardware down and hope magic will happen" (Trucano, 2010).

The discipline of ICT4D has as its focus on the role that ICTs can play in development (Unwin, 2009b; Heeks, 2008). To this end, researchers must "understand the nature and complexity of information systems (IS) implementations in socioeconomic development efforts" (De & Ratan in Andersson & Hatakka, 2013:283). Gaining this understanding can be challenging, given what van Biljon and Alexander (2014) describe as "the multi-, inter- and trans-disciplinary nature" of ICT4D. While the field of Information Technology focuses on what can be achieved through ICTs, the focus of ICT4D must be on "what should be done and how we should do it" (Andersson & Hatakka, 2013:283; Unwin, 2009b).

4.2.1 Background

Mengaseha describes ICT4D as a "complex socio-technical activity in which the social and the technical negotiate and evolve together" (in Dodson *et al.*, 2012:4). To this Tongia and Subrahmanian (2006:2) add that ICT4D issues are "ill-structured and wicked problems" which cannot be evaluated immediately or definitively. ICT4D practitioners and researchers frequently, and mistakenly, view technology as a neutral tool without bias. "Yet, as imbued with meaning as any object, technologies affect communities and social ecosystems with an intrinsic value system" (Dodson *et al.*, 2012:57). Deploying ICTs in social settings invariably results in the development of complex socio-technical relationships. How a particular community will react to ICTs, and what influence a particular community setting will have on the use of ICTs, is difficult to predict.

Important issues central to ICT4D research and implementation, which must be addressed, are the identification of success factors, establishment of indicators to measure the effect of ICT4D projects, and the formulation of practice guidelines. On this point, Kleine (2010) argues that benefits from ICT4D projects should evolve from the ways in which users choose to use the technology, rather than being predetermined by funders (Meyer, 2017). 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). It is important to understand the impact that an ICT implementation has on a rural community (Heeks & Molla, 2009; Krauss, 2009). Further, the conscious and active participation of the intended beneficiaries in all phases of the development process is key to successful rural development (Isabirye, Flowerday, Nanavati & Von Solms, 2015; Food and Agriculture Organisation, 2011).

4.2.2 ICT4D and the development and empowerment of rural communities

The debate surrounding the potential contribution of ICTs to the economic, social and political development and empowerment of rural communities is ongoing (Masiero, 2016; Walsham, 2012; Avgerou, 2010; Chigona, Pollock & Roode, 2009; Krauss, 2009). Many authors argue that ICTs have the potential to significantly contribute to the socio-economic development and empowerment of rural communities (Mthoko & Pade-Khene, 2013; Dodson *et al.*, 2012; Food and Agriculture Organisation, 2011; World Bank, 2009b). The already substantial and ever increasing investment in ICT4D is paralleled by an increasing expectation of what Dodson *et al.* (2012:56) terms "development 'achievement'". However, many authors (Heeks & Ospina, 2018; Hussain & Chen, 2018; Singh *et al.*, 2018; Zheng *et al.*, 2018; Chianca, 2008) join Dodson *et al.* (2012:58) in arguing that ICT4D interventions are not "unequivocally effective in improving the lives of community members in developing areas". In fact, the failure rate of ICT4D initiatives in developing communities consistently outnumbers the success stories (Mbuyisa & Leonard, 2017; Veldsman & van Greunen, 2015; Mthoko & Pade-Khene, 2013; Dodson *et al.*, 2012; Krauss, 2009). Heeks (2010) estimates that up to 80% of ICT4D projects in developing communities end in absolute, partial or sustainability failure. The World Bank's Independent Evaluation Group (2011) describes most of the Bank's $4.2 billion investment in ICT4D efforts as "largely unsuccessful". The simplistic assumption that the introduction of ICTs will automatically result in a "better world for humanity" by bringing about socio-economic development and political equity, and the accompanying high failure rates of ICT4D initiatives, are increasingly leading to scepticism, particularly in recipient communities (Lwoga & Sangeda, 2018; Morales-Gomez & Melesse, 1998:4).

Judicious voices consistently caution that it is important to subject apparently successful ICT interventions to intensive scrutiny to determine what works, what doesn't, and why (Desta, 2018; da Silva & Fernández, 2016; Ojo, 2016; Dodson *et al.*, 2012; Morales-Gomez & Melesse, 1998). Only then can any assumptions be made about the role of ICT in reducing poverty, the way rural communities can benefit from ICTs and the impact of ICT4D on their lives and livelihoods (Jiménez & Zheng, 2018; Dodson *et al.*, 2012; Bhavnani, Won-Wai Chiu, Janakiram & Silarszky, 2008; Torero & von Braun, 2005; Arunachalam, 2004). These authors continue to argue that the so-called digital divide is not just a case of not having access to ICTs, but part of a much bigger development divide, and that "realising the poverty-reducing potential of ICTs is not guaranteed" (Lwoga & Sangeda, 2018; Cecchini & Scott, 2003:76). Effective access to ICTs is dependent on an enabling environment that includes, amongst others, education, appropriate language skills, income, wealth and social position, and not just the availability of technology (Booyens *et al.*, 2018; Harris, 2016; Independent Evaluation Group, 2011; Torero & von Braun, 2005). The nature and causes of persistent poverty should be investigated and strategies devised to address these causes. With this done, it will be possible to assess when and how ICTs can make a difference (Mthoko & Pade-Khene, 2013; Arunachalam, 2004). Furthermore Meyer (2018) indicates that one has to view ICT4D projects in communities as affecting the whole system (micro through to meso environment). Here, through systems thinking, one can ensure that you monitor and evaluate the effect of such projects on the whole system and not just on a select few (Meyer, Marais, Ford & Dlamini, 2017b; Turpin, 2017).

Despite the increasing amount of data available about the spread of ICTs in developing countries, limited tangible evidence exists about the sustained impact or contribution that ICTs have had on the development of these countries (Lwoga & Sangeda, 2018; Dodson *et al.*, 2012; Bhavnani *et al.*, 2008; McNamara, 2003). Although much has been written about the potential of ICTs to improve the lives of rural people, thoroughly researched evidence is sparse (IDRC in Walsham, 2017; Dodson *et al.*, 2012; DAW, 2005). There are abundant anecdotal 'success stories', but few have been subjected to detailed evaluation and an in-depth exploration of why they succeeded or failed in a specific context (Jiménez & Zheng, 2018; Moens *et al.*, 2010; Arunachalam, 2004; McNamara, 2003). Ramadani *et al.* (2018) indicate that the reason why the ICT in ICT4D do not have a substantial impact is due to its failure to acknowledge social

structures in communities, as well as due to unique cultures, political motives or institutional rules. According to Walsham (2017) and Mbuyisa and Leonard (2017), further investigations in ICT4D research are needed on economic well-being, systemic poverty, monitoring, managing and forecasting environment issues and climate change impacts, humanitarian crises caused by natural disasters, wars and terrorism (i.e., activism for social justice), internet security and protection (i.e., cybercrime, identity theft), global health, social media and big data. Heeks and Krishna (2016) accordingly indicate that more research in ICT4D studies should focus on development management, food and agriculture, development finance, inclusive development, rights and justice, data revolution development 2.0, growth and jobs, security and violence, cross-border flows, resilience, governance, and urban development. To this list, Jiménez and Zheng (2018) add a focus on ICT4D studies where women play a role in developing products. ICT4D research needs to have a particular theme or issue in its development agenda as an effective way to engage users, practitioners, and policy makers and achieve the desired outcome (Walsham, 2017). This has resulted in a paucity of rigorous knowledge about what works and what does not (Lwoga & Sangeda, 2018). McNamara (2003) argues that because the international community in general and funders in particular have not done a good enough job of monitoring and evaluation, the results of efforts to increase the deployment and adoption of ICTs in developing countries are inconclusive.

4.2.3 Making ICT4D work

It is important that ICTs should be regarded as tools or means to enable the desired changes that will lead to poverty reduction and sustainable development, and not as an end in itself. ICTs in and of themselves are not a magic bullet for solving complex social and development challenges, and do not guarantee a successful intervention and socio-economic development (Lwoga & Sangeda, 2018; Diniz, Bailey, Dailey & Sholler, 2013; Krauss, 2009; McNamara, 2003; Chapman & Slaymaker, 2002). To ensure sustainability and success, ICT4D initiatives must be culturally sensitive, context specific, conducted with the active participation of the community, apply an appropriate mix of technology based on the local context, and consider project risks during the design phase (Zewge, Dittrich & Bekele, 2015; Heeks, 2010; Krauss, 2009; Heeks, 2008; Heeks, 2002). In the South African context, ICT4D researchers must be cognisant of and prepared to deal with issues such as extreme poverty, lack of socio-

economic development, community empowerment and the importance of the socio-cultural context (Krauss, 2009).

The 'bottom up' approach that scholars such as Heeks (2010) and McNamara (2003) advocate is aimed at ensuring that the technology deployed is appropriate for the specific context. This aim can often be realised by following a community-centric design approach, which is led by community participants. Central to this approach are the socio-cultural context and other sociological community-centred issues (Dodson *et al.*, 2012; Heeks, 2003). Community-centric projects generally originate from a need identified by/with the community, with ICT design and implementation following to address that specific need (Dodson *et al.*, 2012). In contrast, a technology-centric approach to ICT4D that delivers ICTs that are usually externally conceived and complete before the rural community is engaged in serious dialogue, frequently results in the failure of ICT4D initiatives (Dodson *et al.*, 2012).

Success in the ICT4D domain starts with contextually relevant initiatives. Researchers should address cultural and context related issues to help community leaders and members recognise the value and need for ICTs (Krauss, 2009:232). For ICT4D to be successful it must be community focused, grounded in local needs and challenges, and undertaken with community consent (Mthoko & Pade-Khene, 2013; Heeks, 2010; Kleine, 2010; Krauss, 2009; UNDP, 2001). The community must be able and willing to participate (Veldsman & van Greunen, 2015). When entering a community the 'outsiders' must know their customs and act accordingly. The way in which a community functions must be respected, and their social structures and cultural practices acknowledged (Ramadani *et al.*, 2018; Krauss, 2009). Researchers must recognise and understand the diversity and changing nature of rural areas, as well as the significance of cultural contexts in social action (Mthoko & Pade-Khene, 2013; Dodson *et al.*, 2012). ICTs are social constructs and must therefore be sensitive to the context in which they are implemented, and adapted to suit different social contexts (Mbuyisa & Leonard, 2017; Mthoko & Pade-Khene, 2013; Krauss, 2009; McNamara, 2003). ICT4D researchers and practitioners will do well to remember that users are not passive recipients whose only choices are to accept or reject ICTs that do not address their needs. Community members are perfectly able to adapt technology to suit their needs and must be included in all phases of the project (UNDP, 2001).

ICT4D initiatives are effective, sustainable and worth the effort only if they are an integral part of a comprehensive development strategy (McNamara, 2003; UNDP, 2001). The poor often do not benefit from ICT projects since they are not scalable and only implemented at pilot level. Policy has to be informed such that practises are aimed at changing the conditions of the poor, and that monitoring and evaluation as well as impact assessment results of ICT4D projects become public knowledge. Projects should be aligned with an overall development philosophy, and should not only focus on the supply side – such as the benefit of the investment in ICT infrastructure – but should also compare the development outcomes of the investment in education, health and others. (Lwoga & Sangeda, 2018; Mbuyisa & Leonard, 2017; Zewge *et al.*, 2015; Duncombe, 2007).

In short, the following principles should be adopted: put people first; build relationships and partnerships; adopt the appropriate position on the needs driven vs. technology push continuum; practice interactive communication; obtain community buy-in; have a community champion; facilitate active community participation; foster change readiness, whilst respecting the social structures at all levels of the community.

4.2.4 Why ICT4D initiatives fail

Heeks (2002:101) attributes the high failure rate of ICT4D initiatives to a "mismatch between IS designs and local user actuality".

Because ICTs continue to be designed without an understanding of the rural context and its priorities, developing countries are attempting to implement ICTs designed for use in developed countries (Ramadani *et al.*, 2018; Moens *et al.*, 2010; Arunachalam, 2004; Chapman & Slaymaker, 2002). A 2001 UNDP Evaluation Office Report quotes Gomez to highlight this problem: "a focus on ICT-based information in development means the systems and knowledge that arise in poor communities are often ignored. In fact, it is this local information that is often most relevant and useful to the poor" (UNDP Evaluation Office 2001:11).

> *"Access to information through ICTs is a question not only of connectivity but also of capability to use the new tools and relevant content provided in accessible and useful forms" (Torero and Von Braun 2005:5).*

ICT4D initiatives fail for a variety of reasons, which can loosely be classified as technology-, community- and process related. Projects that emphasise technology and

economic development often overlook the challenges associated with ICT4D projects (Meyer, Ford, Marais & Dlamini, 2017a; Kleine, 2010). The importance of communities to become resilient (their ability to cope with external shocks) is an area that should be focused on in ICT4D projects, together with impact assessment and the benefits of readiness assessment and decision support at all levels (Heeks & Ospina, 2018; Meyer, 2018; Ramadani *et al.*, 2018; Zheng *et al.*, 2018; Meyer *et al.*, 2017b). Components such as social and cultural values, technical experience, and political and economic background related to the researcher's own context are embedded in the ICT artefact (Heeks, 2002). Top-down standardised techno-centric approaches to ICT4D interventions therefore frequently produces ICTs which are irrelevant to the context of the community in which they are deployed (Heeks & Ospina, 2018; Mthoko & Pade-Khene, 2013; Dodson *et al.*, 2012; Sterling & Bennett, 2012; Krauss, 2009). Practitioners who re-use international best practice to conserve effort, save money, and achieve results quickly present communities with technology that will very likely be unusable in the specific context (Gregor *et al.*, 2014). ICT is not a magic bullet that can solve all development issues (Diniz *et al.*, 2013; McNamara, 2003; Chapman & Slaymaker, 2002). Lwoga and Sangeda (2018) request more ICT4D studies that emphasise the development of ICTs to address illiteracy in citizens. Further, more studies should have "a focused development objective", adopt participatory designs where "different stakeholders are involved", and facilitate access to data to influence decision-making "at all levels". The authors also call for more "theories that address the ICT innovation context and ICT enabled development perspectives", more studies covering Arabian and Asian countries, and studies on increasing "revenue generation and alternative funding models". In addition, there is a need for more "systematic reviews to maximize validity and reliability and reproducibility of study findings", "extensive qualitative studies, such as ethnographic field studies, and triangulation with quantitative surveys (i.e., mixed methods) to gain more insight into the local context". Research should be conducted "with a large sample, longitudinal studies, and with the inclusion of a detailed methodology statement", "designing and developing applications with users", combining "explanatory and predictive theories in order to understand the complex interaction of different stakeholders". Stakeholders as well as "processes, and context within which the ICTs are used" should be recognised and, finally, there is "a need to conduct multiple levels of analysis, with specific indicators

for analysis based on the development perspective and level of analysis" (Lwoga & Sangeda, 2018:11).

Designers often make preconceived assumptions about the contextual reality of a community. They therefore do not have an appropriate understanding of the expectations, culture, skills, and objectives of the intended recipients (Zheng *et al.*, 2018; Heeks, 2002). A lack of community participation and a disregard of community traditions and customs, their traditional leaders and lack of ownership by the community results in a discrepancy with local realty and "mismatched expectations between the technologist and target community" (Sterling & Bennett, 2012:1012; Heeks, 2010; Krauss, 2009).

ICT projects also fail because of a lack of processes around conceptualisation and execution, which include flawed assumptions about what technology can and cannot accomplish. An example of this is to recognise that ICTs facilitate change; they do not create it. If there is neglect to foster an environment of technology adoption, and failure to plan for and adhere to the long-term commitment essential for project sustainability and societal change, then ICT4D initiatives will dwindle. Technology- and community-related issues will then become obsolete (Ramadani *et al.*, 2018; Dodson *et al.*, 2012; McNamara, 2003; UNDP, 2001). Sterling and Bennett (2012:1012) highlight three poor assumptions with respect to ICT4D: "because a community did not have a certain technology before, the community will certainly be better off now that the project has been implemented; the quality bar for humanitarian technologies is low…; and install and forget works in development". It is important that developing country governments formulate and enact policies to guide the application of ICTs that are appropriate for that specific country's socio-cultural, political and economic contexts (Lwoga & Sangeda, 2018; Morales-Gomez & Melesse, 1998).

The introduction of ICTs is in and of itself not a dependable development approach (Morales-Gomez & Melesse, 1998). ICTs that are properly adapted to specific circumstances, and that are developed in conjunction with other resources, partnerships, policies, and regulatory- and investment frameworks, have significant potential to contribute to sustained rural development (Lwoga & Sangeda, 2018; Khalil et al.World Bank, 2009b; Guislain, Zhen-Wei Qiang, Lanvin, Minges & Swanson, 2006; Chapman & Slaymaker, 2002). However, as stated by the United Nations Development Programme (UNDP) Evaluation Office (2001), there is no one size fit all approach.

ICTs that are culturally appropriate, with designs relevant to a specific community have a far higher change of acceptance and adoption (Lal *et al.*, 2018; Gregor *et al.*, 2014).

Table 4-1 summarises the components from the above literature review on ICT4D projects that have to be considered when developing the initial co-creation design framework.

Table 4-1: Literature Components from Chapter 4: Towards the Initial Co-Creation Design Framework

No	Component	Key issues of the component	References
1	Nature of ICT4D	Multi-disciplinary, interdisciplinary and transdisciplinary	(van Biljon & Alexander, 2014)
2	ICT4D is a socio-technical activity	Value is generated and socio-technical relationships are created if social and technical aspects evolve together	(Dodson *et al.*, 2012; Tongia & Subrahmanian, 2006)
3	Measure effect/impact of ICT4D & monitoring and evaluation	Based on how the user uses technology Improving lives of community members What works, what does not, and why Compare benefits and outcomes	(Heeks & Ospina, 2018; Hussain & Chen, 2018; Jiménez & Zheng, 2018; Lwoga & Sangeda, 2018; Meyer, 2018; Zheng *et al.*, 2018; Mbuyisa & Leonard, 2017; Ojo, 2016; Zewge *et al.*, 2015; de Silva, Goonetillake & Wikramanayake, 2012; Kleine, 2010; Heeks & Molla, 2009; Krauss, 2009; Bhavnani *et al.*, 2008)
4	Active participation of rural communities; community centric design approach (adapt to their needs)	This is needed in all phases of development Appropriate to context Grounded in local needs Community consent Manage expectations	(Zheng *et al.*, 2018; Walsham, 2017; Isabirye *et al.*, 2015; Dodson *et al.*, 2012; Food and Agriculture Organisation, 2011; Heeks, 2010; Krauss, 2009)
5	Contribution of ICT4D to empower, bring economic, political and socio-economic development	Development achievement	(Lwoga & Sangeda, 2018; Walsham, 2012; Avgerou, 2010; Chigona *et al.*, 2009; Krauss, 2009)
6	Sustainability of ICT4D	Partial, complete failure Culturally sensitive, context specific, conducted with active	(Meyer *et al.*, 2017b; Zewge *et al.*, 2015; Heeks, 2010; Krauss, 2009)

No	Component	Key issues of the component	References
		participation, apply mix of technology Consider project risks during design phase	
7	Access to technology is not only about availability	Includes education, appropriate language skills, income, social position	(Booyens *et al.*, 2018; Harris, 2016; Torero & von Braun, 2005)
8	ICT4D affect the whole system of society	Systems thinking Use the knowledge and local information of the whole system Acknowledge all stakeholders	(Lwoga & Sangeda, 2018; Ramadani *et al.*, 2018; Mabila, 2017; Meyer *et al.*, 2017a)
9	ICT4D has to acknowledge social structures in communities	Unique customs, cultures, institutional rules, social embeddedness. Recognise diversity of community	(Ramadani *et al.*, 2018; Mbuyisa & Leonard, 2017; Walsham, 2017; Veldsman & van Greunen, 2015)
10	Scalability of ICT4D	Not just in a pilot phase but longitudinal study	(Lwoga & Sangeda, 2018; Mbuyisa & Leonard, 2017; Zewge *et al.*, 2015)
11	Acknowledge policies and regulatory frameworks	Formulate and enact policies for working in ICT4D	(Lwoga & Sangeda, 2018; Guislain *et al.*, 2006; Morales-Gomez & Melesse, 1998)

4.3   THE ICT PLATFORM

The ICT platform in Mafarafara is an ICT4D study. It forms part of the larger Digital Doorway (DD) project that was initiated in 2002 between the CSIR, Meraka and the Department of Science and Technology (DST). The DD project, as it was termed, formed part of the South African Government's strategic mandate for ICT development and was supported by the then President Thabo Mbeki. The project focus was to close the digital divide and allow ordinary citizens, especially the marginalised in resource deprived areas of South Africa's deep rural areas, to obtain access to ICT and information, and to maximise their digital literacy skills (Gush, Cambridge, de Villiers & Smith, 2010).

4.3.1   Background to the DD

In 1999, Dr. Sugata Mitra of the National Institute of Information Technologies in India (NIIT) commenced a project known as the 'Hole-in-the-Wall' experiment (HITW), based on the idea that children can learn computer literacy skills incidentally if they can

get access to a computer (Gush *et al.*, 2010). The Hole-in-the-Wall project in India was the inspiration behind the design of the DD project.

At that time, this Indian project faced challenges related to social-, educational-, and long-term sustainability, as questions were asked about collaborative learning, sustainability of the initiative and the depth of learning that took place if not facilitated by a teacher (Arora, 2010). According to DeBoer (2009), a number of interventions could be applied to optimise the kiosks and make them more sustainable for use. These included a knowledge of user behaviours, customised educational games and software, community action plans for using the kiosks based on demographics, as well as media attention and researcher interventions on the kiosk users.

The learning from the 'Hole-In-The-Wall' project (Mitra, Lenzmeier, Steffensmeier, Avon, Qu & Hazen, 2000) was used to develop the first Digital Doorway (named like this to avoid confusion with the India project). The first DD was deployed in 2002 in Cwili in the Eastern Cape Province of South Africa in 2002, and was funded by the South African Department of Science and Technology (DST) with the purpose of ascertaining whether unassisted learning was a viable means of teaching basic computer literacy skills in impoverished, rural South African communities.

Figure 4-2: The first DD in South Africa

The news about the DD quickly spread in the community, and soon the DD was visited by almost everyone close to Cwili and was regarded as the first computer in the area that they could use to access information (Gush *et al.*, 2010).

According to Gush (2011:34), the "high acceptance of the Cwili DD led to the establishment of a second site in Mamelodi, in Tshwane, Gauteng, in 2003. A decision was taken to move away from the MS Windows operating system and to embrace open source software, in particular Linux. For the Mamelodi site, Debian Linux was installed on the computer". The purpose of using Open source software was to entice illiterate people from the communities to improve their skills and browse through the content. Through installing security cameras, it was possible to track usage as well as collaboration between people using the DDs.

Both government (DST) and the communities where the DDs were deployed indicated that this was a successful project. Even Dr Mitra from India supported these statements (Gush, 2011). Therefore, the DST decided to increase funding for more deployments of the DDs. Between 2003 and 2010, the deployment of the DDs increased.

At that time most DDs did not have Internet connectivity and contained mostly English content such as Wikipedia and Gutenberg books (Smith, 2011). The DDs were mostly placed in either school libraries or in centres in the communities (Gush & De Villiers, 2011). DDs were also deployed in Lesotho, Ethiopia, Uganda, the Solomon Islands, New York (at UNICEF), and Australia (Stillman, Herselman, Marais, Pitse-Boshomane, Platinga & Walton, 2012; Herselman, Smith, Gush, Cambridge, Botha & Marais, 2010). Figure 4-3 indicates where the DDs are distributed throughout South Africa:
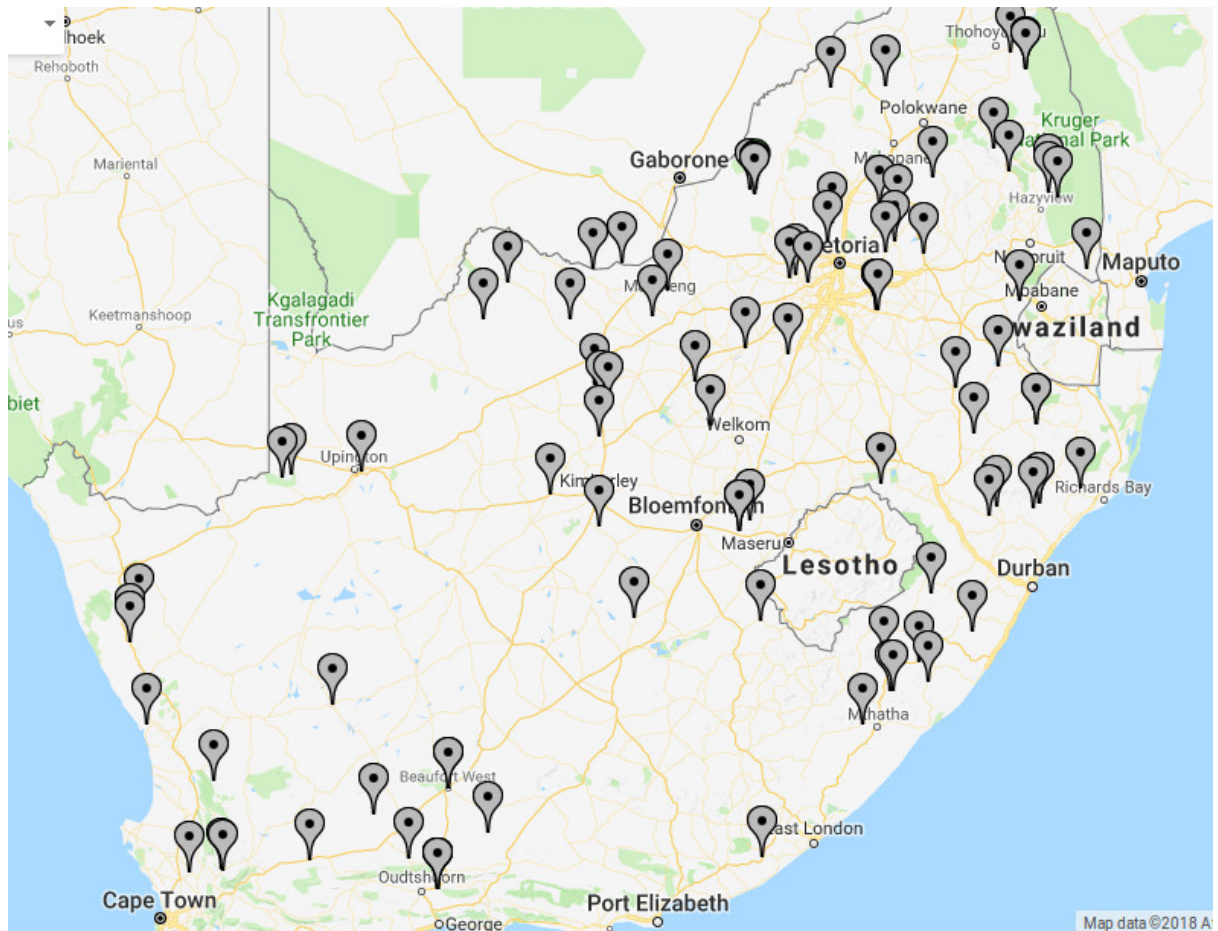
Figure 4-3: Distribution of Digital Doorways in South Africa

The assumption was that if you provide people with a robust (unbreakable) computer-type device that was tested and approved by the South African Bureau of Standards, they will use it and teach one another to improve their computer literacy skills; further, they will gain access to information that was previously only found in books in the library (Gush, 2018).

4.3.2 Evaluating the DD for its purpose

In 2012, the DST provided funding to monitor and evaluate whether this project achieved its objective of promoting computer literacy, as well as to determine how the DD has improved over time (Van der Vyver & Marais, 2015). Outcome evaluation (a type of evaluation method) was applied to the DD project. The results indicated that especially the DDs installed at schools were well utilised, and that entertainment (educational games) was the most popular content that was accessed. The project therefore did address its objective. Evidence of mutual learning (people assisting each other to use the machines) was also found (Van der Vyver & Marais, 2015).

4.3.3 Evolution of the DD

The DD is a low-maintenance kiosk with four screens or terminals, a client/fileserver PC and two diskless clients for out-of-doors deployment for public/community access (Smith, 2011).

The photo below provides a visual representation of the evolution of the DD:

Figure 4-4: Photos of the evolution of the Digital Doorways since 2002

Improvements since 2002 include access for disabled citizens, a four-terminal kiosk instead of a single terminal, metal keyboards to replace plastic ones, and replacement of the touch pad with a "joystick and large buttons". In 2008, "a 3-terminal solar powered container DD" was deployed that could function without access to electricity (Gush, 2011:65).

The initial blue colour of the DD was later changed to orange based on requirements from the Department of Science and Technology. Further, a mobile container was developed in which to house the terminals, so that DDs could be placed anywhere without having to use scarce space in buildings in a community.
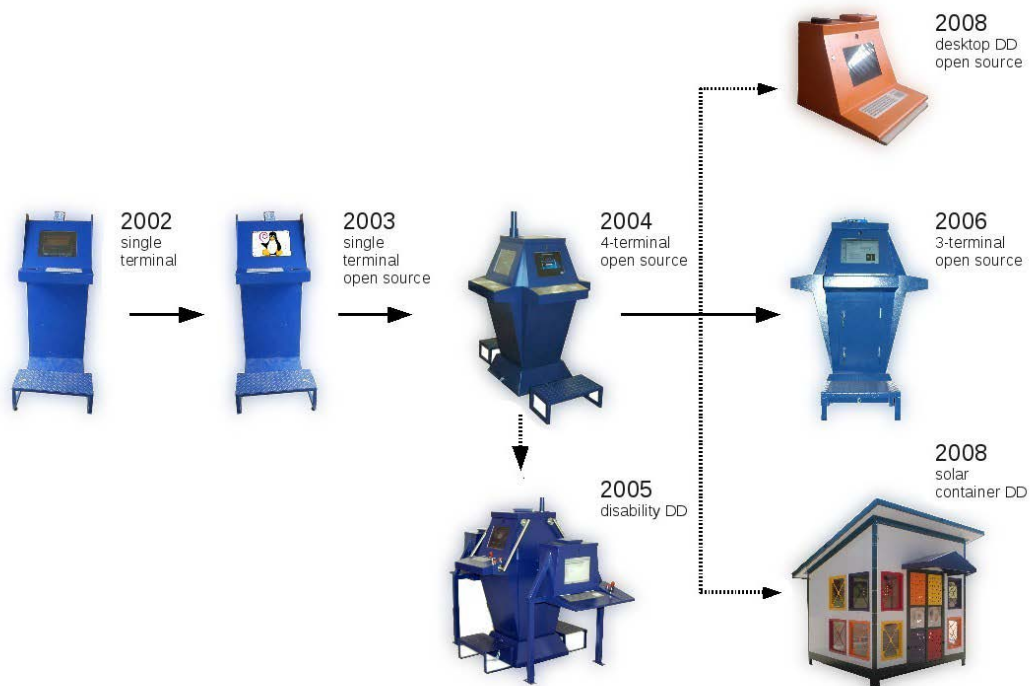
Figure 4-5: Changes to the DD between 2002-2008 (Gush, 2011)

The Department of Rural Development and Land Reform (DRDLR) also became involved in the DD initiative, and partnered with CSIR, Meraka to deploy DDs to more rural areas (as part of the DRDLR infrastructure vision). The DRDLR mandate includes achieving Outcome 7 in the National Development Plan entitled "Vibrant, equitable and sustainable rural communities with food security for all". The DRDLR seeks to achieve this with the assistance of other role players, namely the Department of Public Works, Department of Water Affairs, Department of Trade and Industry, Department of Social Development, Department of Energy, Economic Development Department, Department of Higher Education and Training, Department of Transport, Department of Public Service Administration and Department of Science and Technology. Five outputs need to be implemented in order to achieve Outcome 7 of the South African National Development Plan (National Development Plan, 2011). These are as follows (Smith, 2015a):

- Output 1: Sustainable agrarian reform with a thriving farming sector;
- Output 2: Improved access to affordable and diverse food;
- Output 3: Improved rural services to support livelihoods;
- Output 4: Improved employment and skills development opportunities; and
- Output 5: Enabling institutional environment for sustainable and inclusive growth.

The DRDLR's Comprehensive Rural Development Programme is one of the mechanisms through which the DRDLR intends to work towards some of these goals. The Comprehensive Rural Development Programme (CRDP) is a national-level DRDLR programme that includes all three tiers of government. The CRDP seeks to achieve social cohesion and development of rural areas by ensuring improved access to basic services, enterprise development and village industrialisation (Department of Rural Development and Land Reform (DRDLR) South Africa, 2009). As outlined by the DLDLR, the CRDP "embraces a proactive, participatory, community-based planning approach rather than an interventionist approach to rural development" (Department of Rural Development and Land Reform (DRDLR) South Africa, 2009:3). This also focuses on the provision of technology to the most remote rural communities in the country that do not have access to it.

The vision of the DRDLR is to provide satellite internet connectivity and to further deploy new container DDs to the already operational and deployed 155 DDs in various rural communities throughout South Africa. Monitoring and evaluation of the process and development of a sustainability plan for the DD project will also be done before 2020.

Figure 4.6 provides a detailed overview of the changes that have been made to the DD since 2002.
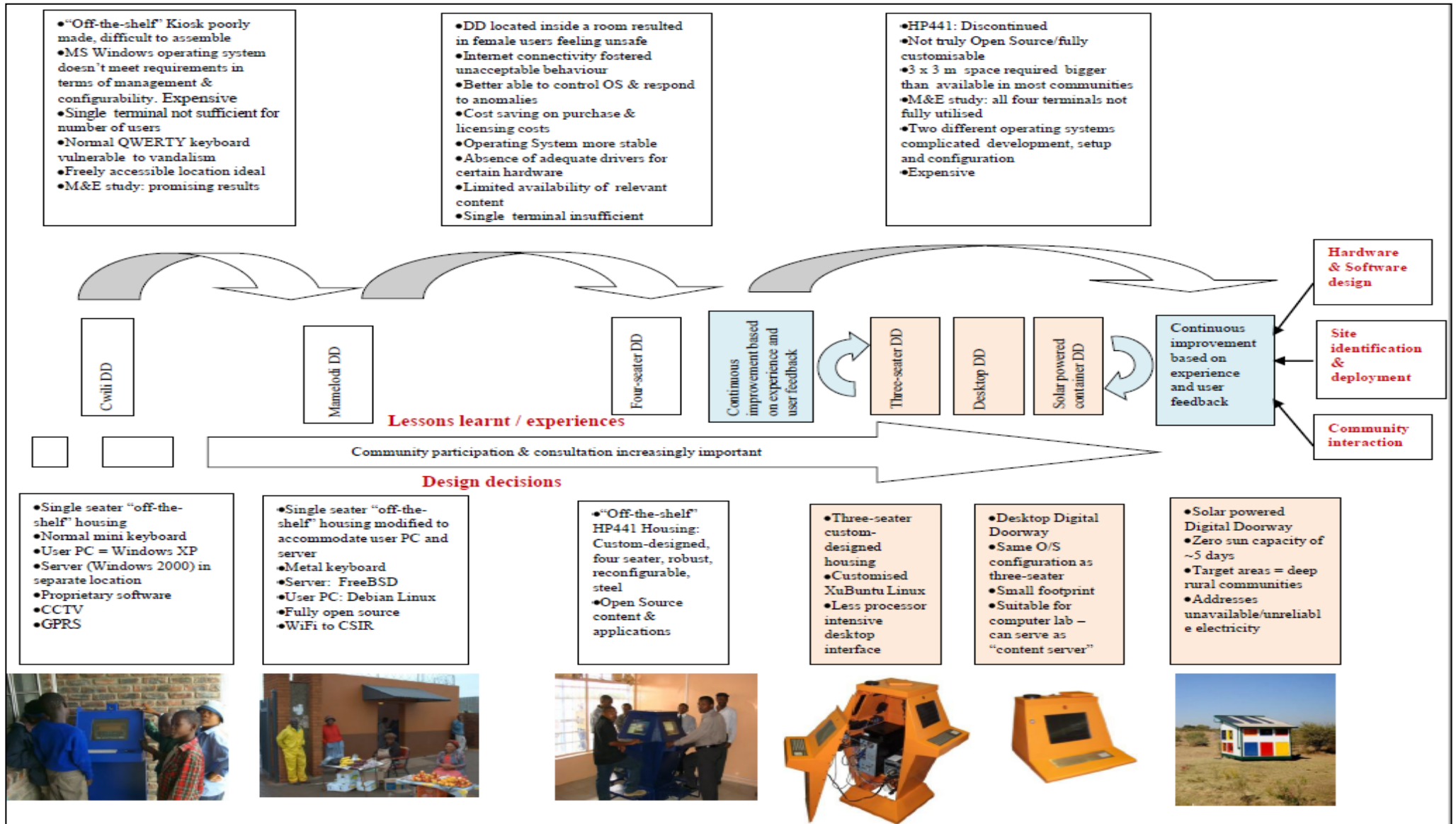
Figure 4-6: Summary of the evolution of the DD (Researcher, 2018)

4.3.4 Current DDs

To date, more than 300 units have been deployed throughout South Africa (see Figure 4-3), mostly in deep rural settlements. A number of Digital Doorways have been deployed internationally: 30 in Uganda, four in Australia and one each in Lesotho, Ethiopia, and the Solomon Islands. The Digital Drum, a Digital Doorway in a 20 gallon drum developed with UNICEF for use in Uganda, was nominated by the Time Magazine as one of the top 50 inventions in the world for 2011 (Smith & Turpin, 2017). Most of the sites support VSAT Internet connectivity, enabling transmission of near-real-time data (comprised of many parameters) back to a monitoring server and support desk. There is thus a large amount of raw data available (Gush, 2018).

The current DDs include a satellite downlink and GPRS backhaul to access content and to log file retrieval. A Bluetooth dongle and GUI application allow users to save files from the DD to a personal device. Users can create a personal account and enter their information (age, gender, home language). These data, as well as specific application usage, are hosted on a server. A webcam allows users to create a personalised profile, and they receive incentives for logins. This ensures the validation of demographic data. The system is based on Open source software, employing a modified Ubuntu Linux OS with the Xfce display. The Linux security mechanisms prevent unauthorised modification to essential folders and files (Gush, 2018).

Monitoring and servicing of rural installations pose unique challenges, including difficulties of road access (long drive times, difficult roads), connectivity concerns (e.g., cellular phone coverage not being available in some areas) and reliability of support staff on site. Sites require adequately trained administrators, good communication between administrators and project support teams, functioning technology and timeous repairs to equipment if there is a malfunction. Community administrators (champions) tasked with monitoring the equipment often require supervision themselves. A successful site will be well utilised, well managed and well maintained (Gush, 2018).

The DD is typically deployed in unsecured public areas. Over time, various configurations of the Digital Doorway have been developed that are robust and vandal proof to ensure that it is suitable for the environment in which it is used, to provide

access to multiple users at the same time, to combat misuse and to minimise support and maintenance costs (Gush *et al.*, 2010).

The DD project was proven to be extremely popular, useful and seen as a success as it resulted in more than expected evidence of skills gained and use of information in rural areas of South Africa.

4.4 THE ICT PLATFORM AT MAFARAFARA

The Mafarafara project was born from the larger Digital Doorway initiative. In various discussions with the project stakeholders, the CSIR decided to explore and extend the role of the DD beyond its initial intention. The decision to propose a project focusing on ICTs, women and agriculture was informed by the high priority that the South African government affords these focus areas. It was modified with the active participation of the ERW in Mafarafara to produce an ICT platform, co-created to uniquely suit their requirements. The DD was selected as the technology base for this research project because it has proven itself to be very reliable and well suited to the harsh environment of a rural area such as Mafarafara. The researcher's on-going involvement with the larger Digital Doorway initiative would be of value when hardware and software modifications based on the ERW's feedback would be required.

4.4.1 Description of ICT platform technology installed

The ICT platform was installed at the Setsong Community Centre in August 2013, during the study's second research site visit. The women derive their income from pension, sewing and small-scale farming. The approach that was followed to engage with the community and the key figures.

The following photos depict where the ICT platform was placed in the Setsong Community Centre in Mafarafara.

Figure 4-7: ICT platform deployed at Mafarafara in their community centre

Figure 4-8: Mafarafara community in Limpopo Province

The ICT platform in Mafarafara is a digital kiosk with three screens (terminals) that has been designed to be sturdy and to require low maintenance.

Figure 4-9: Type of kiosk that was installed in Mafarafara (Van der Vyver & Marais, 2015)
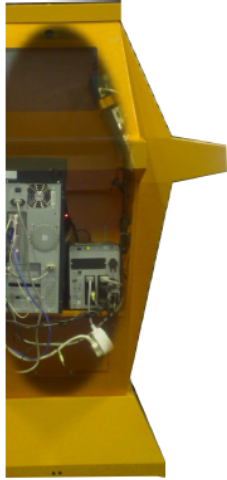
Hardware:
- 1 server and 2 clients per housing
- 15 or 17" LCD screens with protective acro-glass
- Metal keyboards with inbuilt touch-pad
- UPS
- Switch
- GPRS modem
- Mindset server
- Satellite dish
- Cooling fan

Server:
- 2.2 GHz CPU
- 1 Gig Ram
- 250G Hard drive
- Web-cam
- Speakers
- Bluetooth adapter

Client:
- 1.5 Ghz CPU
- 512 Meg Ram
- Web-cam
- Speakers
- No hard drive

Cross section, showing server and UPS inside housing

Figure 4-10: Hardware configurations (Gush, 2011)

Figure 4.10 provides an overview of the hardware configurations whilst Figure 4.11 indicates the view from the top of a three terminal machine.
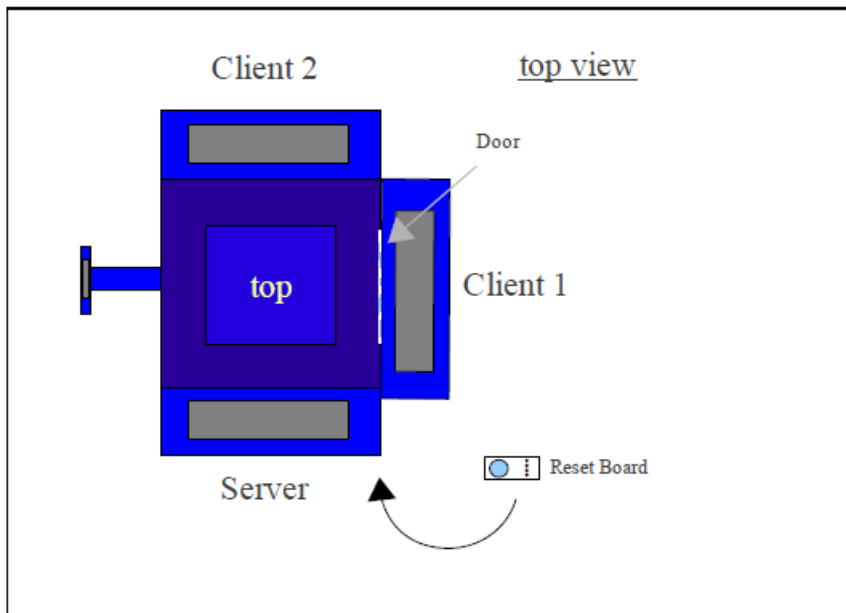
Figure 4-11: Top view showing server and positions of clients (Gush, 2011)

The user interface of the ICT platform is based on the DD's interface, which is as follows. Once a user logs in, access is provided to tutorials in Flash and locally developed life skills games, namely Themba's Journey and a quiz game called WhatWhat Mzansi (Gush, 2011). The rest of the applications and content are accessible from within one of two task-bar menus, namely the Programs and Resources menus (Figure 4.12).

The users' activities are logged. Users have the option to give feedback on their preferences and what they feel is missing. The developers at CSIR (Pretoria) are able to access the logs to improve the DDs based on the feedback from the users. Where the DDs have internet connectivity, the user logs and feedback can be remotely accessed. In the case of Mafarafara, the ICT platform does not have internet connectivity. User logs hence have to be downloaded from the machine during inspection visits.
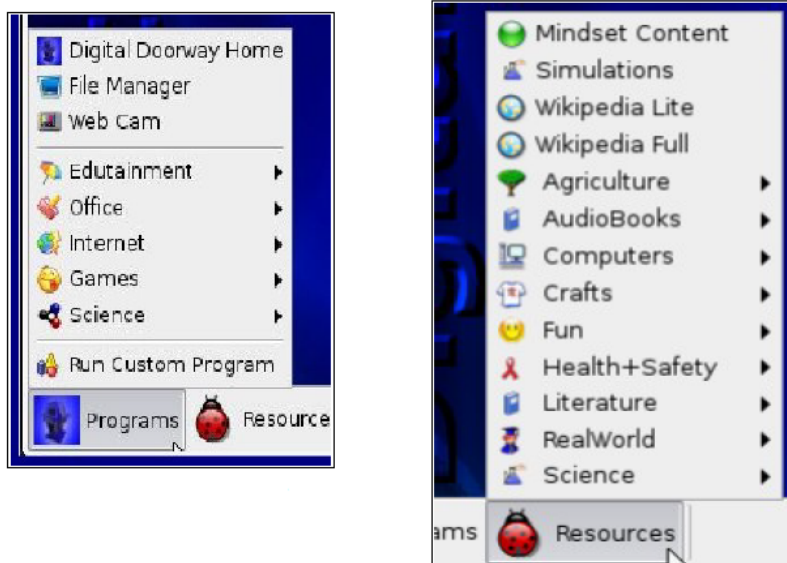
DDhomepage	Information on the project, user feedback form and links to popular resources
File-manager	Application to allow navigation of all files on the DD
Web-cam	Simple web-cam viewing application
Edutainment/	Sub menu containing edutainment applications
Office/	Sub menu containing office applications (e.g., word processor, spreadsheet)
Games/	Sub menu containing games
Internet/	Sub menu containing Firefox browser and applications for inter-DD comms
Science/	Sub menu containing science simulations and various science applications
Run Custom Program	Quick launcher for any program whose name is known to the user

Mindset	Curriculum-based content (grades 10-12)
Simulations	Science simulations, direct link
Wikipedia	Encyclopaedia, direct link
Agriculture/	Sub menu of agricultural documents
AudioBooks/	Sub menu of audio clips
Computers/	Sub menu of computer-programming documents
Crafts/	Sub menu of craft related documents
Fun/	Sub menu of various fun documents and movies
Health+Safety/	Sub menu of electricity safety and health information
Literature/	Sub menu of literature resources
RealWorld/	Sub menu of documents related to employment and policies
Science/	Sub menu of science documents and videos

Figure 4-12: Homepage information when users log in (Gush, 2010)

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The following table provides details of how the DD has been improved since its inception in 2002:

Table 4-2: Summary of the improvements made to the DD since 2002 (Gush *et al.*, 2010)

	Issues	Improvements
1	Difficulty experienced by non-English speaking users in understanding the login procedure and supporting tutorials	Catering for multiple languages through the translation of onscreen instructions and tutorial menus
2	Difficulty experienced by system maintainers in performing remote management and monitoring on the proprietary operating system (MS Windows). Inability to customise closed (non-open source) code.	Improvement of remote monitoring and management of systems as well as customisation facilities for the software, by moving from a proprietary (MS Windows) operating system with closed (non-modifiable) code, to an open source operating system with open (modifiable) code.
3	Crowding around DD terminals, and the restrictions resulting from many users at a single terminal.	Progression from a single terminal device to a multi-terminal device.
4	Damage and wear-and-tear to the keyboards over time, due to frequent use in an unsupervised context.	Progression from low-quality plastic keyboards, through 'industrial' keyboards, to final establishment of expensive metal vandal-proof keyboards with touchpads.
5	Lack of direct feedback from the community. The need for cleaning and turning on and off the DD.	Appointment of site champions.
6	The need to obtain user experience feedback/suggestions/requests.	Implementation of a software feedback mechanism where users can input text into a form that is sent back to a central server.
7	Content not always relevant to users in rural areas.	Provision of additional content focused on the needs of rural areas (e.g., agriculture, finding employment, HIVAIDS information).
8	Physical location of the DD (e.g., enclosed room versus open veranda); the impact of this on who used the DD.	Discerning selection of physical locations of DD housing, taking into account each particular context and environment.
9	Desktop and file system liable to become 'cluttered' due to extensive use of the same guest accounts over weeks and months.	The use of scripts to restore guest user accounts on a daily basis.
10	The need to understand application usage and demographic information of users.	The implementation of user detail logging and application usage logging for improved understanding of user demographics and application usage.
11	Requests from users for functionality to enable them to save their work or content from the DD on a personal device.	The provision (at certain sites) of external USB ports to allow external access to information on the DD.
12	Typical multiuser, time limited interactions at DDs made it difficult for users to study complex material in depth.	The addition of content (e.g., short video clips and reference material) more suited to a public kiosk environment where long-term in-depth study is not feasible.

It is evident from Table 4.2 that many adjustments have been made to the Digital Doorway that affected this project, since these updates occurred before the deployment of the ICT platform in Mafarafara. While these adjustments can be regarded as changes based on feedback from various communities using the technology, the ICT platform in Mafarafara is the first example of co-creation and co-design done by and with ERW based on their agricultural needs and to support and improve their quality of life.

4.5 THE INITIAL CO-CREATION DESIGN FRAMEWORK BASED ON THE COMPONENTS OF CHAPTERS 3 AND 4

Following the literature study presented in Chapters 3 and 4, it is now possible to revisit and combine the literature components derived from the two chapters towards the initial framework. The literature components from Chapters 3 and 4 (Tables 3.3 and 4.1) were numbered, and a high level synthesis was applied to combine and pair components from the two chapters. Following this, the relevance of the combined set of components was matched with the characteristics of the ICT platform to indicate how this Platform supports the components, and hence how it meets the identified criteria. The combined components and the evidence of ICT platform support are presented in Table 4.3.

The combined set of components serve as inputs into an initial co-creation design framework for ERW in Mafarafara. The framework is used to inform the co-creation process between the ERW and the CSIR team for refinement of the ICT platform. This approach enables the refined ICT platform to address the ERW's requirements and socio-cultural and socio-technical needs so that it can be a sustainable initiative that can support policy and address educational and literacy access and skills.

Table 4-3: Components from Chapter 3 and 4 combined

Component name (guidelines)	Chapter 3 Component	Chapter 4 Component	Evidence of ICT platform support for component
Socio-cultural Socio-technical Needs and Requirements of ICT and ERW Empowerment Minimize isolation Values, structures, traditions, agency and structure	2 (isolation and socio-cultural traditions), 7 (social values) 4 (agency and structure) 5 (ICT meeting needs and requirements) 3 (empowerment of ERW)	2 (ICT4D is a socio-technical activity) 9 ICT4D acknowledges social structures) 5 (Contribution of ICT4D to empower, bring economic, political and socio-economic development) 4 (Active participation, community centric) 8 (ICT4D affect whole system)	Co-created and co-designed based on needs and requirements of the various communities (resource deprived and rural) Vandal proof Use ICT Champions from community to do support and maintenance User creates own account and profile Acknowledge social structures as well as agency
Participation Co-creation Collaboration (models, process, steps) Community centric, in context	11 (Participatory design process) 12 (Models of co-creation) 10 (Design process of co-creation) 8 (Collaboration/collaborative innovation in context that are community focused)	4 (Active participation, design approach, community centric)	Very popular, especially amongst the youth Apply unassisted learning, minimal invasive education and peer learning Provide feedback on improvements to CSIR team Evolution since 2002
Sustainability through measuring impact Measure impact/effect Benefits (value-in-use, value-in-context, value-in-exchange)	9 (Benefits of co-creation)	6 (sustainability of ICT4D projects) 3 (Measure effect/impact of ICT4D & Monitoring and evaluation)	Monitoring and evaluation was done in 2014-2015 on success of the intervention. Evidence was found of value-in-use and value-in-context as well as value-in-exchange. Useful for school projects Educational games very popular
Scalability Longitudinal Infrastructure and content	6 (Infrastructure and content)	10 (Scalability of ICT4D)	In existence since 2002 Over 300 units distributed in South Africa Units also in Australia, Uganda, Solomon islands, Lesotho & Ethiopia
Education and literacy Access	1 (Education and literacy levels and skills of ERW)	7 (Access to technology is not only about availability)	Purpose of platform is to influence skills and literacy gains Open source content and organised information and content on platform Open Access

Component name (guidelines)	Chapter 3 Component	Chapter 4 Component	Evidence of ICT platform support for component
			Leads to human capital development
Policies and Frameworks Regulatory	1 (Education and literacy levels and skills of ERW)	1 (Nature of ICT4D) 11 (Acknowledge policies and regulatory frameworks)	Influence policy on skills and literacy Supports National Development Plan

It can be deduced from Table 4.3 that the most significant components that a co-creation design framework has to consider when co-creating are **socio-cultural** structures, values, traditions where agency and structure (Efobi *et al.*, 2018; Ramaswamy & Ozcan, 2018; Moens *et al.*, 2010) plays a role to develop **socio-technical** interventions through social relationships. Through this, the **needs and requirements of ERW** can be addressed through interacting with the ICT Platform to empower ERW, overcome their isolation and support socio-economic activities when **participation, collaboration and co-creation** occur in a community-centric fashion. For this to take place, there has to be a co-creation process that applies a specific co-creation model/framework with steps that happens in context. This affects **sustainability,** as impact can be measured through monitoring and evaluation to determine the effect and benefits (value-in-use, value-in-context and value-in-exchange) (Ramaswamy & Ozcan, 2018; Ranjan & Read, 2016; Vargo & Lusch, 2016; Grönroos, 2011).

If successful, this can lead to **scalability** based on longitudinal evidence of success to **influence education and literacy through infrastructure and content** that support user requirements. In the end, this can all happen if **policies and regulatory frameworks** (Lwoga & Sangeda, 2018; Mbuyisa & Leonard, 2017; Zewge *et al.*, 2015) are considered and policy recommendations can be made.

To visualise the initial framework the following Figure 4.13 is provided:
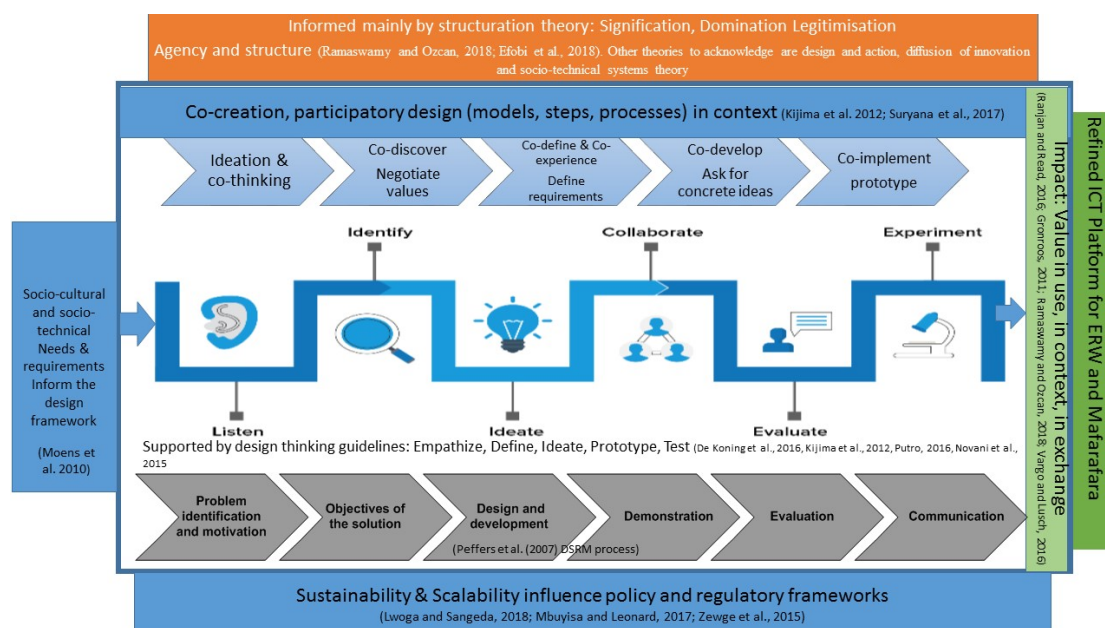
Figure 4-13: Visualisation of initial co-creation design framework when co-creating with ERW

4.6   SUMMARY

This chapter provided details about the challenges and benefits of ICT4D projects as was found in literature. It also provided an overview of the ICT platform and how it originated from the CSIR, Meraka Digital Doorway project. A motivation for why the DD was chosen as the ICT platform for Mafarafara was also provided.

A combined set of guidelines for an ICT4D implementation for ERW is presented in Table 4-3. These guidelines were informed by literature on challenges facing ERW in South Africa (Chapter 3), co-creation principles (Chapter 3), lessons learned from ICT4D literature (Chapter 4) as well as learning from good practices developed during previous DD installations (Chapter 4). These synthesised guidelines defined the framework's components, and as such informed the initial co-creation framework presented in Figure 4-13. The guidelines and the initial co-creation framework present the study's knowledge base at the time of entering Mafarafara, hence at the point of departure of the empirical study. The case study is presented in Chapter 5 that follows. It commences with demographic and historical context to the Mafarafara case site. After providing contextual background, the execution of the empirical study is described,

where the ICT platform was deployed and refined as part of a co-creation design process with ERW, over a total of seven site visits.

CHAPTER 5: CASE STUDY: MAFARAFARA

5.1 INTRODUCTION

Chapter 4 ended with a description of the ICT platform at Mafarafara. Its location in the community of Mafarafara was also indicated. This chapter sets the scene for the case study. It outlines the background to Mafarafara, the village in the Limpopo Province of South Africa that was the rural community selected as the setting for this study.

First, a demographic overview of Mafarafara is presented. This is followed by a brief history of the region. The power struggles experienced in the Bapedi tribe over the different eras are discussed, ending with an overview of the more recent power and chieftainship concerns. The third part of the chapter introduces the research study conducted at Mafarafara. It will describe the site visits conducted from 2013 through to 2016.

The aim of this research is to develop a co-creation design framework for ERW, which is iteratively developed through the co-creation of an ICT platform with ERW in Mafarafara that incorporates the implications of the social interplay in the community. This chapter contributes to addressing sub research question 3.

SRQ3: How does the social interplay amongst the different role players influence the refinement of an appropriate ICT platform?

This chapter focuses on the demonstration component of Phase 2 in the DSRM process of Peffers *et al.* (2007), as indicated in figure 5.1:
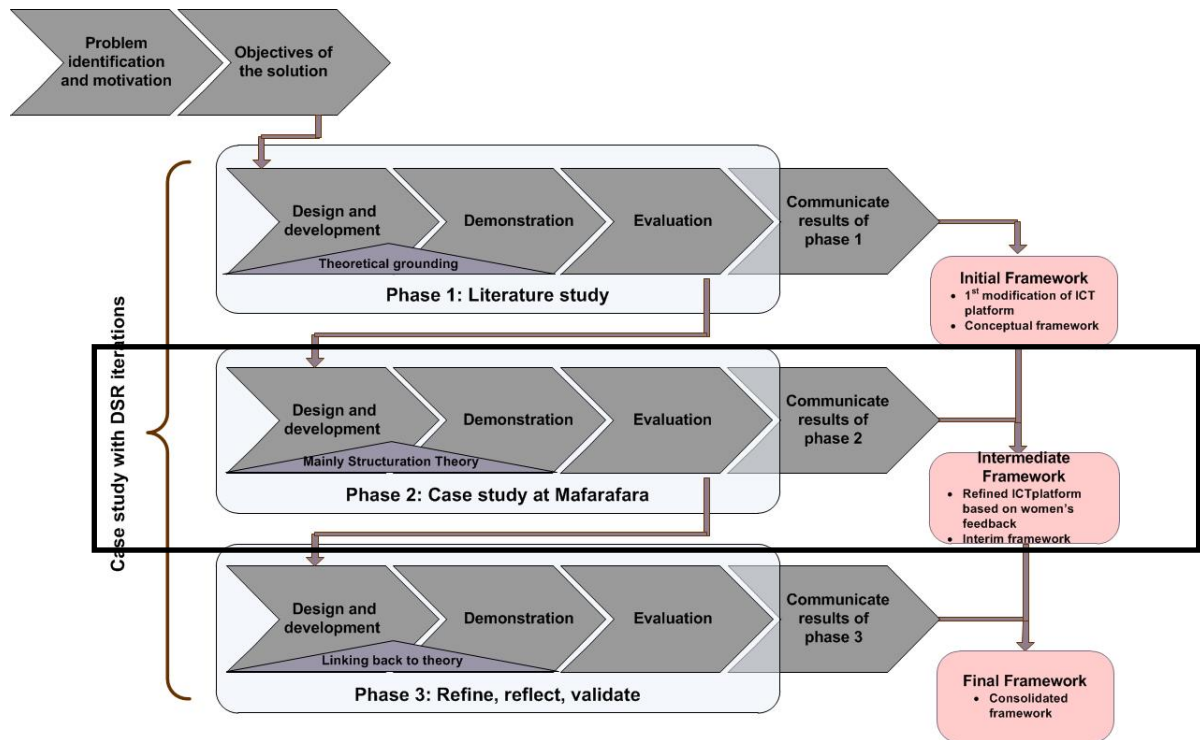
Figure 5-1: Research process

5.2 MAFARAFARA

Mafarafara is a small, remote community surrounded by mountains, about 60 kilometres north of Burgersfort in South Africa's Limpopo Province. On the South African map it can be found as shown in Figure 5.2 below.

Figure 5-2: Tubatse Local municipality where the town Mafarafara can be found (Greater Tubatse Municipality, 2009)

Mafarafara is located in the Greater Tubatse Local Municipality, which forms part of the Sekhukhune District Municipality (area number 47 in Figure 5-3), one of five district municipalities in the Limpopo province of South Africa.
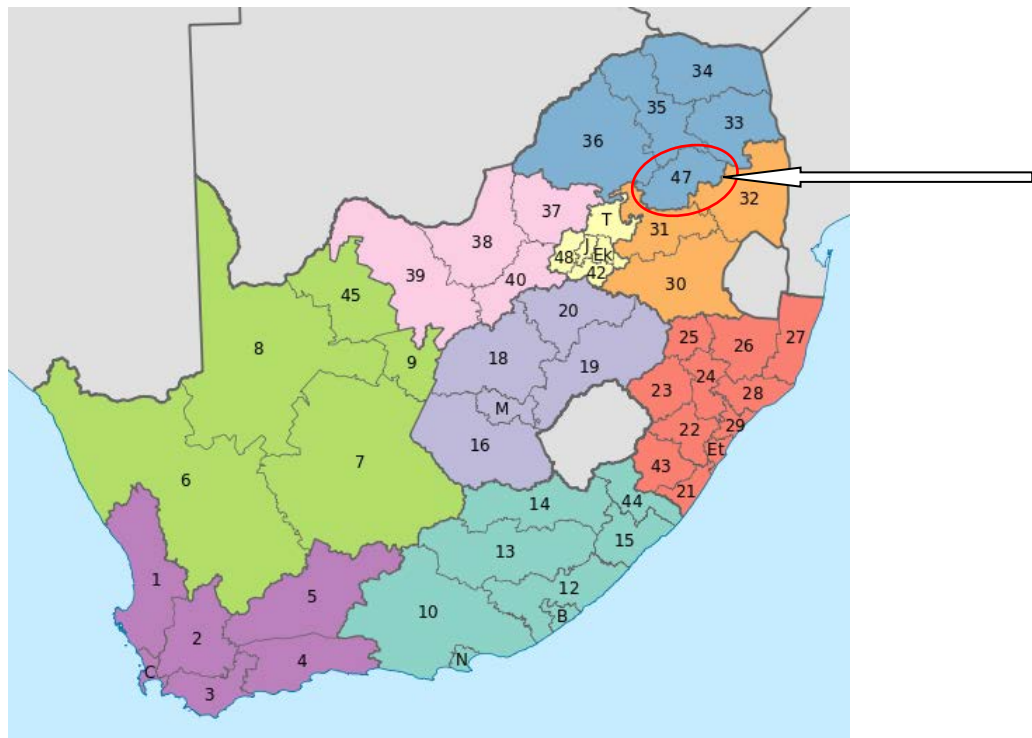
Figure 5-3: Map of South Africa indicating provinces and district municipalities (Census, 2011)

The most recent demographic survey was done in 2016, during which it was found that the population in the Limpopo Province consisted of 5,799,090 people (Statistics South Africa, 2016). Further, 52,8% of the population in Limpopo are females and 5.11% are aged between 62 and older. The black block in Figure 5.5 below summarises the 2016 population demographics of the Sekhukune district, of which the Greater Tubatse/Fetakgomo forms part (LIM 476).

District and local municipality	Black African		Coloured		Indian/Asian		White		Total
	N	%	N	%	N	%	N	%	
DC33: Mopani	1 130 512	97,5	2 128	0,2	2 918	0,3	23 628	2,0	1 159 185
LIM331: Greater Giyani	255 353	99,7	154	0,1	413	0,2	207	0,1	256 127
LIM332: Greater Letaba	216 577	99,3	238	0,1	153	0,1	1 062	0,5	218 030
LIM333: Greater Tzaneen	403 488	97,0	1 068	0,3	1 661	0,4	9 929	2,4	416 146
LIM334: Ba-Phalaborwa	159 298	94,3	426	0,3	602	0,4	8 611	5,1	168 937
LIM335: Maruleng	95 796	95,8	242	0,2	89	0,1	3 819	3,8	99 946
DC34: Vhembe	1 375 123	98,6	2 499	0,2	5 036	0,4	11 291	0,8	1 393 949
LIM341: Musina	127 073	96,3	578	0,4	444	0,3	3 914	3,0	132 009
LIM343: Thulamela	493 951	99,3	538	0,1	2 571	0,5	177	0,0	497 237
LIM344: Makhado	406 970	97,7	1 104	0,3	1 723	0,4	6 931	1,7	416 728
LIM345: Collins Chabane	347 128	99,8	280	0,1	298	0,1	269	0,1	347 974
DC35: Capricorn	1 290 255	97,0	7 766	0,6	5 598	0,4	26 817	2,0	1 330 436
LIM355: Lepelle-Nkumpi	234 844	99,8	250	0,1	176	0,1	110	0,0	235 380
LIM351: Blouberg	171 207	99,2	228	0,1	188	0,1	979	0,6	172 601
LIM353: Molemole	123 919	98,9	95	0,1	193	0,2	1 120	0,9	125 327
LIM354: Polokwane	760 285	95,4	7 193	0,9	5 041	0,6	24 608	3,1	797 127
DC36: Waterberg	680 815	91,3	2 272	0,3	2 673	0,4	59 998	8,0	745 758
LIM361: Thabazimbi	79 344	82,5	274	0,3	0	0,0	16 614	17,3	96 232
LIM362: Lephalale	126 997	90,6	395	0,3	322	0,2	12 526	8,9	140 240
LIM366: Bela-Bela	64 642	84,7	733	1,0	386	0,5	10 535	13,8	76 296
LIM367: Mogalakwena	315 814	97,1	500	0,2	1 756	0,5	7 222	2,2	325 291
LIM368: Modimolle/Mookgophong	94 017	87,3	370	0,3	210	0,2	13 102	12,2	107 699
DC47: Sekhukhune	1 153 458	98,6	2 175	0,2	860	0,1	13 269	1,1	1 169 762
LIM471: Ephraim Mogale	124 319	97,8	202	0,2	170	0,1	2 477	1,9	127 168
LIM472: Elias Motsoaledi	261 819	97,6	508	0,2	229	0,1	5 700	2,1	268 256
LIM473: Makhuduthamaga	283 830	99,8	221	0,1	232	0,1	152	0,1	284 435
LIM476: Greater Tubatse/Fetakgomo	483 490	98,7	1 243	0,3	229	0,0	4 940	1,0	489 902
Limpopo	5 630 163	97,1	16 839	0,3	17 085	0,3	135 003	2,3	5 799 090

Source: Stats SA, CS 2016

Figure 5-4: Distribution of population by population group, district and municipality (Statistics South Africa, 2016)

In 2011 it was reported that there were 164 households in Mafarafara, with a population of 752, and 4.5 people per household (Statistics South Africa, 2011); note that these data were not updated in 2016, as the focus was then only on municipalities and not on specific towns within each municipality. Most families survive through government grants, the produce from their gardens, and the livestock they keep. There are no proper roads, and there is a lack of infrastructural development. There are connections for running water, but there is no piped water because the main pump was stolen (Ratshosi, 2014). Electricity was installed at a section of the community in October 2013. However, many of the households for which electricity sockets were installed cannot afford electricity. Government-sponsored houses have recently been built for the upper part of the village. There are a high school and a primary school in the community.

5.2.1 Reflecting on Mafarafara

The following excerpt (entitled "Reflections") from a site visit report that formed part of this study serves as an appropriate introduction to Mafarafara:

"I visited a village in the Limpopo Province called Mafarafara with the view of exploring it as a Digital Doorway site. Mafarafara is a deep rural area surrounded by mountains and the Lubatse River runs through the village. The name Mafarafara is suitable because it means 'to be surrounded'. In my view it is a viable heritage site in South Africa. Besides hosting one of the country's rarities, Baobab trees, it is full of tradition, natural resources and livestock – a labyrinth of indigenous knowledge where mostly old people live. For someone keen on understanding the relationship between nature and humanity it is a prestigious destination and an experience tantamount to initiation. There is no electricity or sanitation or proper roads like I'm used to, yet it is sympathetically healing, literally. I mean I fell really badly losing a lot of blood through my mouth while visiting a plantation. With no clinic or medical facility of any kind in the vicinity the best treatment available was gaggling (sic) with salt-water and sleep. In terms of ICTs it has the typical barriers that one would find in a deep rural setting. Internet connectivity is found only on certain land marks. A cell phone is more useful for taking photographs than to communicate. However, once the battery is flat it takes a drive around the village to find a place to charge it. As a field researcher I discovered that in this area mistakes and minor accidents quickly turn into emergencies. During this trip I was in charge of making sure that the team had the necessary equipment and tools in the field. We arrived without our documents and had to drive an hour and half to the nearest facility in Kgautswane that had Internet and a printer. A first aid kit is insufficient to treat a serious injury. Finding solutions to problems is hard and ICTs might all the more be necessary" (Rampa, 2013:1).

Figure 5-5: Photos of the area - Kgautswane (Smith & Turpin, 2017)

The next section provides an overview of the people from the Greater Tubatse local municipality in which Mafarafara is situated.

5.2.2 Greater Tubatse local municipality

On 3 August 2016, the Greater Tubatse and Fetakgoma local municipalities were amalgamated to form the Greater Tubatse/Fetakgoma local municipality. Economic statistics for the combined local municipality are not yet available. The figures below are for Greater Tubatse local municipality (LM) for the July 2014 - June 2015 financial year (South AFrica. Treasury, 2016).

The Greater Tubatse Municipality (GTM) is located to the north of the N4 highway, Middelburg, Belfast and Nelspruit, and to the east of the N1 highway, Groblersdal and Pietersburg. The area of jurisdiction is approximately 4,600 square kilometres in size, with a population of 335,676, and a population density of 72.9 people per square kilometre (Greater Tubatse Municipality, 2009). The population in the municipality is constituted of 97,8% black Africans and 1,6% white people, with other population groups making up the remaining 0,7%. The gender ratio in the municipality is 88, meaning that for every 100 women there are 88 men. The municipality forms part of the Sekhukhune District Municipality in the Limpopo Province, which also includes the Greater Marble Hall LM, Greater Groblersdal LM, Greater Fetakgomo LM, and the Greater Makhuduthamaga LM. The GTM was established after the local government elections of 2000, as an outcome of the municipal demarcation process (Greater Tubatse Municipality, 2009). It is made up of 29 wards comprised of 166 villages and suburbs, as well as 175 farms. The vast majority of villages, particularly in the northern part of the GTM, are scattered in deep rural areas; 61 farms are under the control of tribal authorities. Each ward is represented by one councillor, and is administered by a local

municipality of which the main offices are located in Burgersfort. The GTM is largely rural, with a strong reliance on agriculture and mining. The inhabitants of the dispersed settlements are dependent on subsistence farming. The Traditional Authorities and Magoshi (chiefs) within the GTM play a role in local management. The main municipal office is located at Burgersfort, with satellite offices at GaMapodile, Praktiseer and Ohrigstad (Greater Tubatse Municipality, 2009).

The GTM generates 34.62% of its income locally from residents who pay for water and electricity, rates, licenses and fines, and from interest and investments. The remaining 65.38% of the municipality's income, is received from the National Government (South AFrica. Treasury, 2016). Hence, the GTM is not self-sufficient, but heavily subsidised by the national government.

5.2.3 *The people of Mafarafara*

Of the GTM population, 99,9% are black Africans, with Sepedi the home language of 94.3% of inhabitants. Females are in the majority, comprising 54.1% of the population. As can be seen in Figure 5-6 below, the dominance of females is most prominent in the older age categories. From ages 35 and above, females constitute 64% of the population, and males only 36%. From this, one can infer that there is a high number of female headed households.
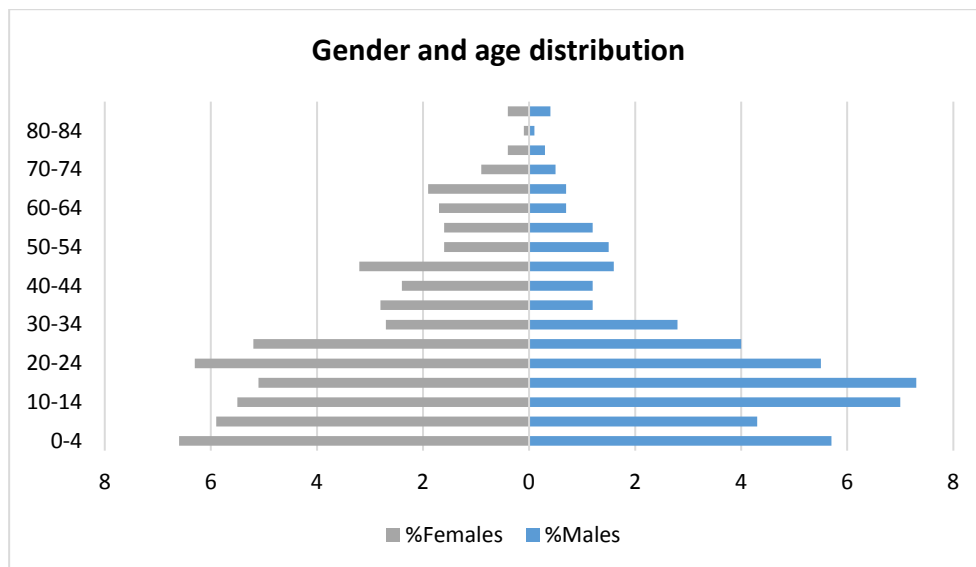
Figure 5-6: Gender and age distribution (Statistics South Africa, 2011)

Only 1.3% of inhabitants older than twenty years have obtained a post-matric qualification. 30.1% have had no schooling or did not complete primary school, as reflected in Figure 5.7:

Education level attained

Education level	Percentage
Higher education	1.3%
Matric	19.5%
Some secondary	44.1%
Completed primary	5.1%
Some primary	14.2%
No schooling	15.9%
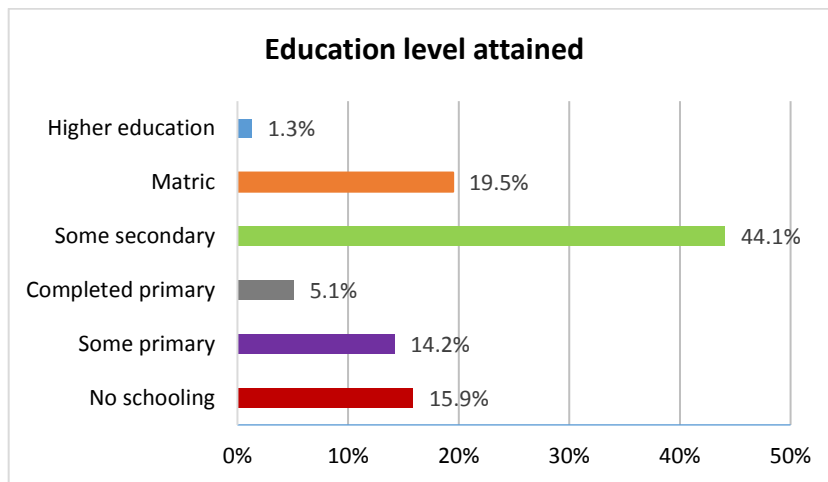
Figure 5-7: Education level attained (Statistics South Africa, 2011)

The majority of the inhabitants only has some form of secondary education, and only 19.5% had matric at the time of collection of the data.

5.2.4 Living conditions

The entire Mafarafara area is under traditional leadership. At the time of the 2011 census, 4.3% of inhabitants had electricity for lighting. In October 2013, additional pre-paid electricity were installed for lighting only. At the time of the 2011 census, 95.1% of inhabitants used candles for lighting. Wood was used for cooking by 98.2% of people and for heating by 95.1%. There is no refuse removal in Mafarafara. In terms of connectivity, 98.2% of people have no internet access, 1.2% have internet access from their mobile phones and 0.6% have access through work (Statistics South Africa, 2011). The 2016 statistics reflected only on the local municipality as a whole, and did not specifically focus on Mafarafara. Figure 5.8 highlights the ownership of household goods in the Mafarafara community in terms of amenities such as phones, cars, stoves and others.
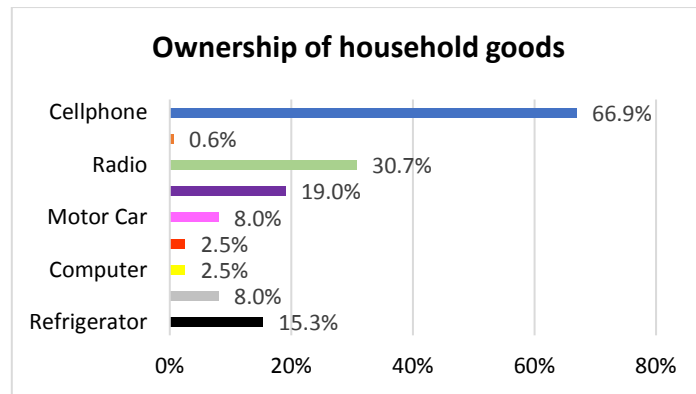
Figure 5-8: Ownership of household goods (Statistics South Africa, 2011)

Details about the sources of water are provided in Figure 5-9 below:
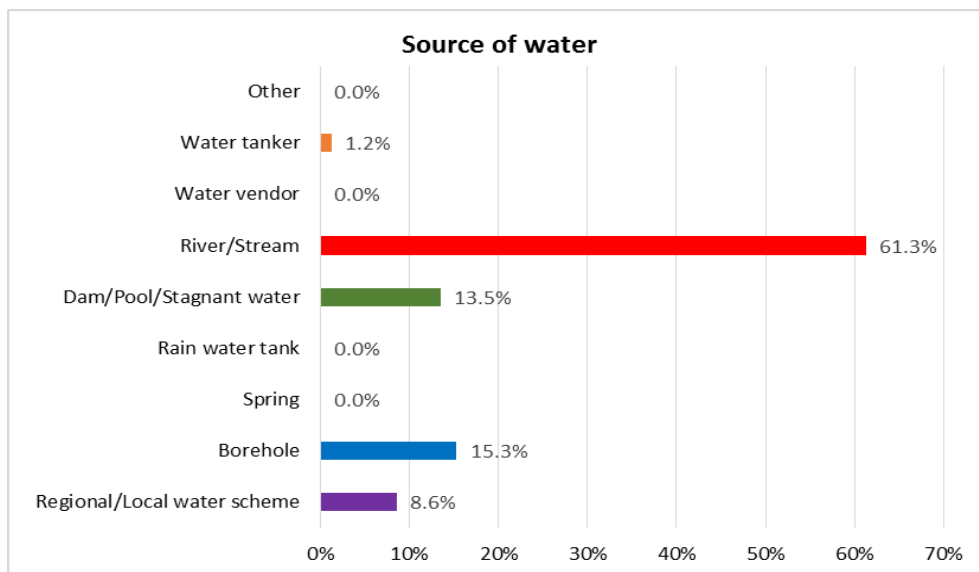
Figure 5-9: Sources of water (Statistics South Africa, 2011)

Information about toilet facilities in Mafarafara is provided in Figure 5-10 below:
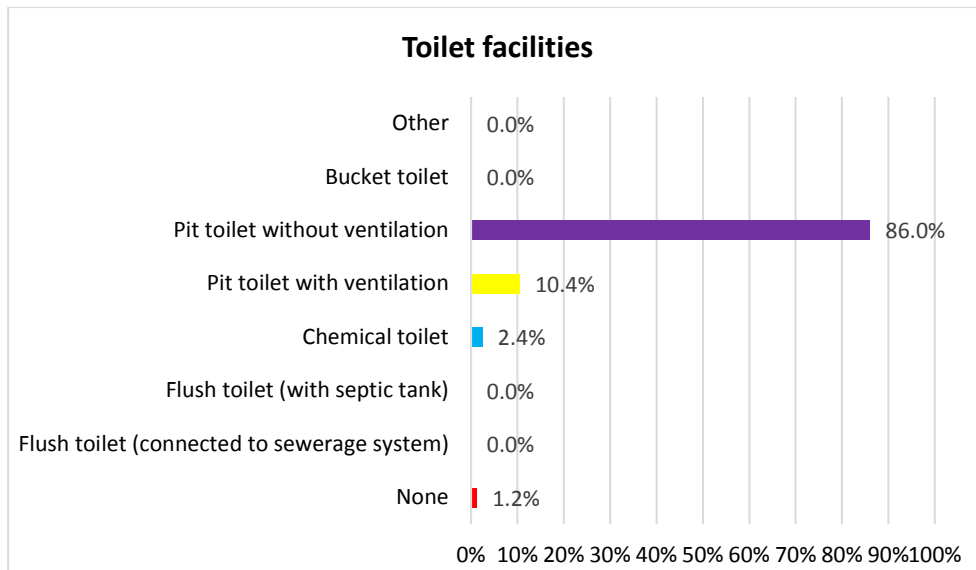
Figure 5-10: Toilet facilities (Statistics South Africa, 2011)

5.2.5 Economy

The average annual salary for individuals in South Africa is R89,316 (Statistics South Africa, 2011). The inhabitants of Mafarafara are significantly worse off. In fact, 85.3% of households have an annual income that is less than the suggested minimum wage of R3,500 per month, which equates to R42,000 per annum.
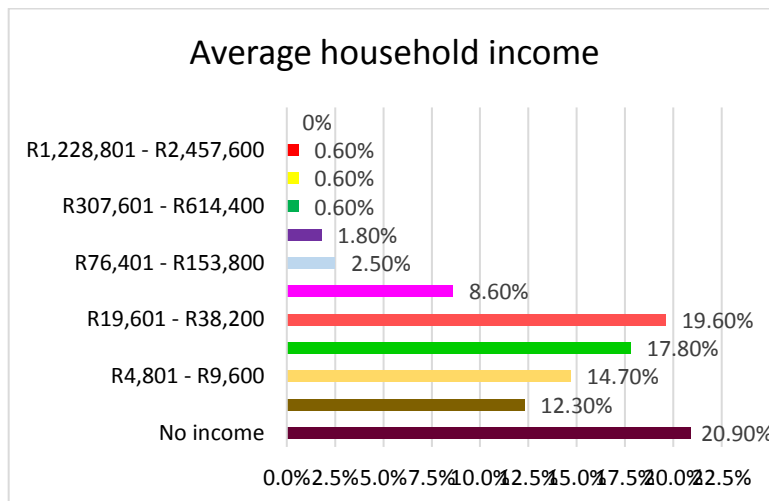
Figure 5-11: Average household income (Statistics South Africa, 2011)

Using statistics from the 2016 survey (Statistics South Africa, 2016), the socio-economic status of Mafarafara is compared in Figure 5-11with the Greater Tubatse LM in which it is located, with the Polokwane LM in which the Limpopo capital is located and with the Johannesburg LM which is part of the Gauteng province (Gauteng is viewed as the economic powerhouse of South Africa).

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There are 84.8 men in Mafarafara for each 100 women, while the gender ratio in Johannesburg is 100.7. In Mafarafara, 57.3% of households are headed by females, compared to 44.8% in the Polokwane LM and 36.2% in the Johannesburg. LM.

It can further be seen from Figure 5-11 that Mafarafafa is socio-economically worse off than all entities with which it is compared, even the Greater Tubatse LM.
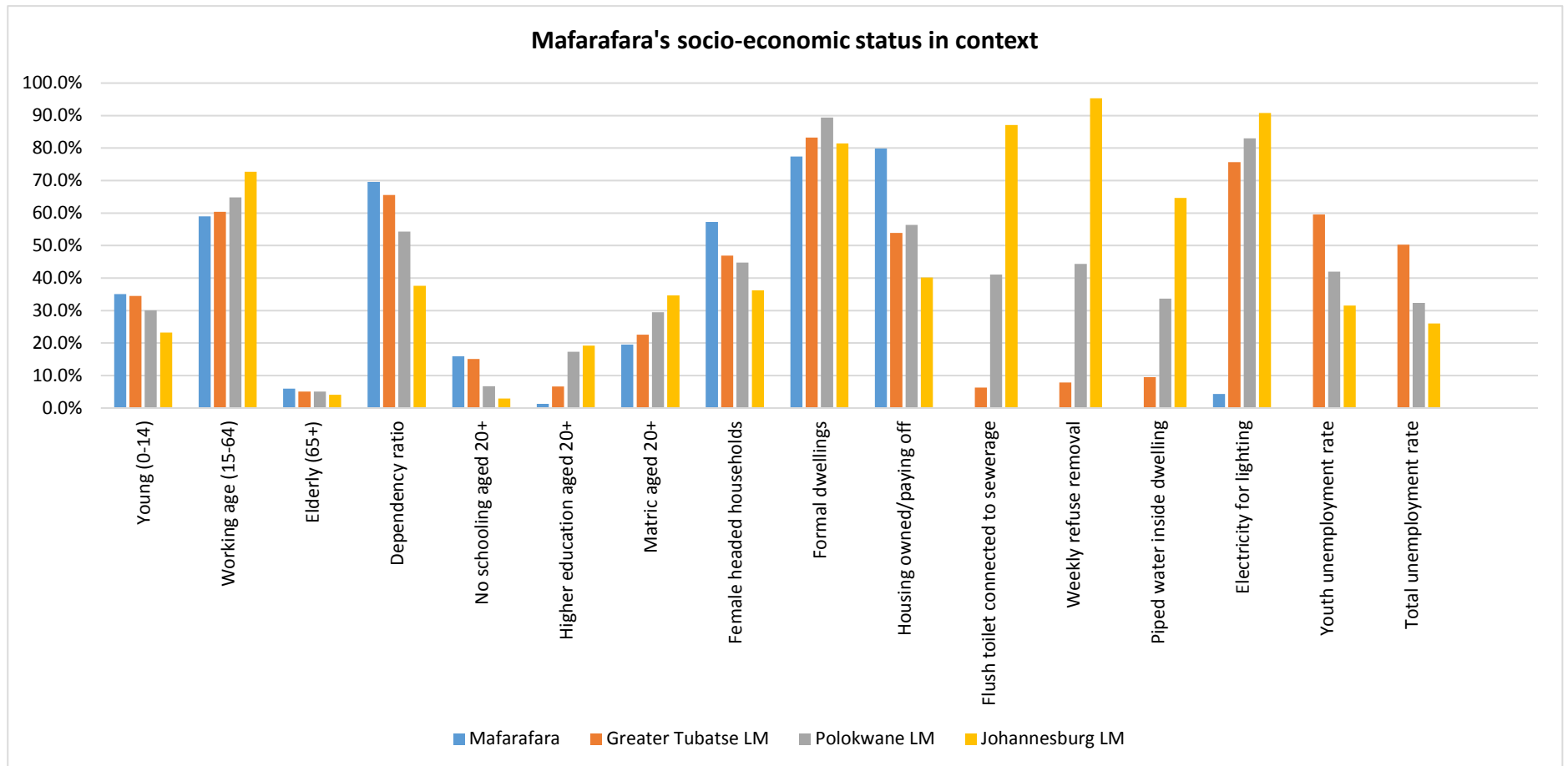
Figure 5-12: Mafarafara's socio-economic status in context

The next section provides an overview of the history of the kingship of the Bapedi nation from which the people from Mafarafara originated, as context for the case analysis that follows.

5.3 BAPEDI

In pre-colonial times, Africans were governed by a tribal leadership system, with the tribal leader known as kgoši in the Sotho speaking communities, of which the Bapedi are a part. Terms such as chiefs, paramount chiefs, and kings were introduced by the colonial powers (*Bapedi Marota Mamone v Commission on Traditional Leadership Disputes and Claims and Others)* (Küsel, 2008)

5.3.1 Location

Sekhukhuneland, the modern day heartland of the Bapedi nation, is situated between the Olifants river and its tributary the Tubatse river, and bordered on the east by the Drakensberg mountain range. The Leolo mountains cross Sekhukhuneland (Küsel, 2008). The area is named after Kgoši Sekhukhune, the son of Sekwati I. At the height of the Bapedi nation during the reign of Thulare I (c. 1790-1820), the area stretched from the present day Rustenburg to the Lowveld in the west, and the Vaal river in the south (SA History Online, 2016).

Figure 5-13: The Greater Sekhukhune district map

Several places played an important role in the history of the Bapedi (Küsel, 2008). Mogokgomeng, where Diale settled in 1650 after fleeing with his wife and child; Schilpadfontein, where Tabane initially settled; Phiring, where Sekwati established his

first seat of power; Mosego, the stronghold that Sekwati established after he left Phiring; Tjate, also known as Ntswaneng, where Sekhukhune I established his heavily fortified village which also served as his seat of power; Mpotswane ("rotten place") where the British soldiers were buried in a mass grave after the battle with Sekhukhune; and Manoge, the Bapedi village established after defeat by the British, and where Sekhukhune was murdered.

5.3.2 History

Successive waves of the Batswana people migrated southwards from the Great Lakes region of Central Africa in the late fifteenth century. The last group, known as the Hurutse, settled near the Vaal river towards the beginning of the sixteenth century. The Bapedi originated from an offshoot of the Hurutse, called the Bakgatla, under its kgoši/king and founder named Mokgatla. Little is known of the first generations of the Bakgatla people, until a further split when a kgoši named Tabane left and settled with his followers in the vicinity of what is today known as Skilpadfontein in the Mpumalanga province. (Küsel, 2008).

In 1837, a group of Voortrekkers (white Afrikaner pioneers migrating northwards, away from the colonial settlements in the Cape) under Louis Trichardt passed through the Eastern Transvaal (currently known as Mpumalanga). In 1845, Hendrik Potgieter entered the Bapedi kingdom with another group to establish Ohrigstad (Kinsey, 1973). Stock theft by the Bapedi, and land encroachment by the Boers (Voortrekkers) resulted in a constant tension and bickering between the two peoples. Due to attacks by the Boers under leadership of Hendrik Potgieter in 1847 and 1852, Sekwati who was then king moved his village to Thaba-Mosego on the eastern slopes of the Leolo Mountains in 1853, naming it Tjate. Towards the end of his life, the Bapedi nation numbered some 70 000 people, with an army of 12 000 – of which nearly a third was armed with guns (Küsel, 2008). Sekwati died in 1861, and was buried at Mosegokop.

After Sekwati's death, his son Sekhukhune I became king. After the death of Sekhukhune I, the Bapedi kingship was characterised by successive regencies. Sekhukhune's half-brother, Kgoloko, was regent until Sekhukhune II became of age and ascended the throne. His son and heir, Thulare II, who did not have an heir from his *timamollo* (senior wife), Legolane, predeceased Sekhukhune II. After the death of

Sekhukhune II, Morwamotshe III, a brother of Thulare II, was appointed as regent until his death in 1965 (Küsel, 2008).

Over the next hundred years, the Bapedi land became part of reserves that were variously combined and separated by series of government planners, giving rise to the creation of a supposedly independent homeland in the Transvaal in 1972, named Lebowa; it covered an area of around 24,540km^2 and comprised two major and several minor detached portions (exclaves). The capital was Lebowakgomo, which is now the seat of the Lepelle-Nkumpi Local Municipality. After the 1950s, the population of Lebowa increased rapidly due to forced relocations from other rural areas and cities, combined with voluntary relocations by farm labourers and labour tenants (sharecroppers) to escape deprived conditions on white-owned farms (Küsel, 2008). Lebowa was reincorporated into South Africa in 1994 as part of the Limpopo province.

The apartheid government created ten homelands (Transkei, Bophuthatswana, Ciskei, Venda, Gazankulu, KaNgwane, KwaNdebele, KwaZulu, Lebowa and QwaQwa), of which four were granted 'independence' by South Africa. Each homeland was designated to a specific ethnic group (South African History Online, 2011).

- Ciskei and Transkei: Xhosa
- Bophuthatswana: Tswana
- KwaZulu: Zulu
- Lebowa: Pedi and Northern Ndebele
- Venda: Vendas
- Gazankulu: Shangaan and Tsonga
- Qwa Qwa: Basothos
- KaNgwane: Swazi
- KwaNdebele: Ndebele

The idea of the homeland system was the separation of white and black South Africans, and to make the latter responsible for running their own independent governments. Black South Africans could have citizenship of the Homelands, but not of South Africa. This denied black South Africans any rights and protection in South Africa. The economies of the homelands were poorly developed, and almost entirely dependent on

white South Africa's economy. Black South Africans owned only 13% of South Africa's land (South African History Online, 2011).
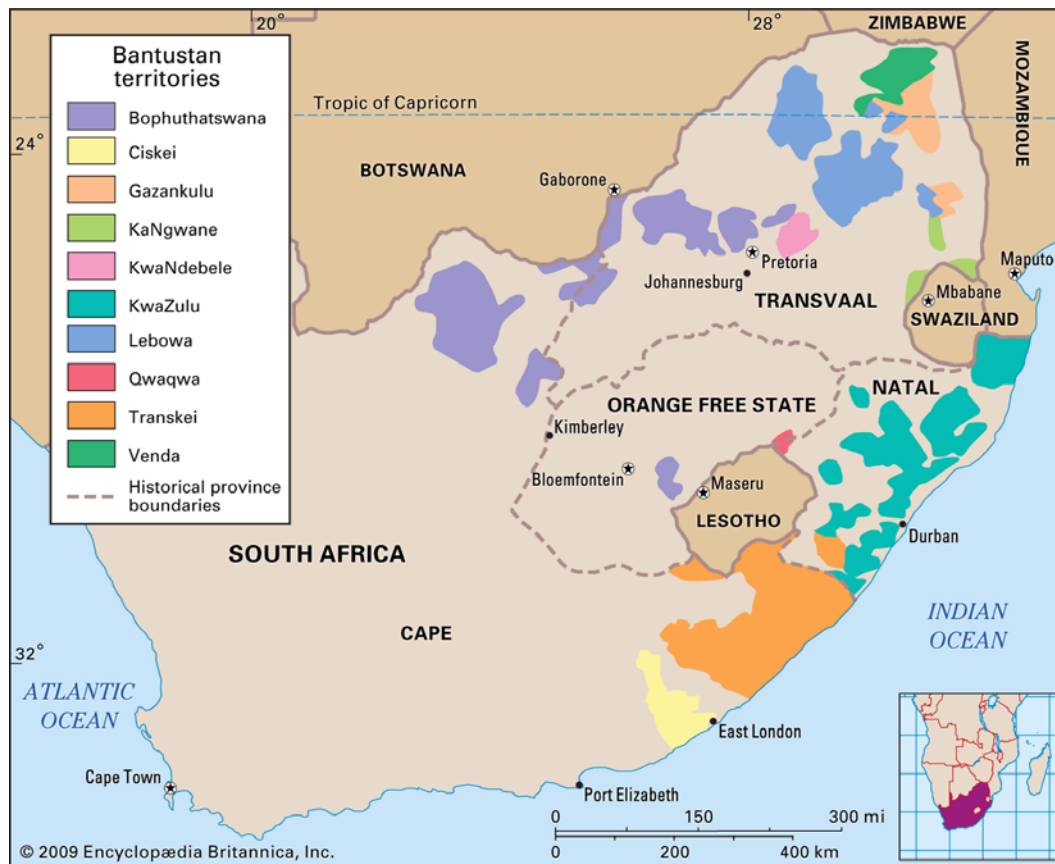
Figure 5-14: Apartheid Homelands / Bantustans (Britannica Online for Kids, 2016)

Since the early 1990s when apartheid was abolished, the homeland system ceased to exist and the homelands were re-incorporated into the new nine provinces of a democratic South Africa. However, the kingship dispute still carried on until 2014, until the Constitutional Court made a final decision on the matter.

5.3.3 *Kingship dispute – Royal houses of Sekhukhune and Mampuru*

"Chapter 12 (sections 211 and 212) of the Constitution of the Republic of South Africa provides for the recognition of the institution of traditional leadership, its status and role according to customary law, subject to democratic principles" (CLAIMS, 2008:1). In 2004, State President Thabo Mbeki, appointed a Commission on Traditional Leadership Disputes and Claims ("the Commission") in order to "restore the dignity of the institution of traditional leadership" which "has been undermined, distorted and eroded". Factors identified by the Commissioners as some of the main causes of this distortion and erosion include "imperialism and colonisation; repressive laws, in

particular, the Black Administration Act 38 of 1927, and Apartheid laws that provided for the creation of territorial authorities, self-governing states and pseudo independent enclaves" (Nhlapo Commission, 2010:193).

The Commission has country-wide jurisdiction, and has the authority to investigate both on request and of its own accord. Cases, which falls under the Commission's remit, are:

- Where there is doubt whether a kingship, headmanship, or senior traditional leadership was established in accordance with customary law and customs;

- A traditional leadership position, where the title or right of the incumbent is contested;

- A claim by a community to be recognised as a traditional community;

- The legitimacy of the establishment or disestablishment of "tribes";

- Disputes arising from the merging or division of "tribes" and the determination of traditional authority boundaries;

- If good grounds exist, any other matters relevant to those mentioned above, including considerations of events that may have arisen before 1 September 1927.

The Bapedi kingship was the subject of a long, drawn out, and bitter legal battle between descendants of Sekhukhune I and of Mampuru II, based on the two factions' different versions of the status of the two half-brothers. In response to a case brought by the Mampuru/Mamone royal house, the Commission on Traditional Leadership Disputes and Claims determined on 30 April 2008 that the paramountcy of Bapedi is a kingship, and exists under the lineage of the Sekhukhune royal house. The Commissioner ruled that the Mampuru royal family had lost the kingship to the Sekhukhune royal family in 1861, when Kgoši Sekhukhune I challenged and drove Kgoši Mampuru II from the kingdom in what is now called the Limpopo Province of South Africa (CLAIMS, 2008). An application by the Bapedi Marota Mamone to set aside the ruling of the Commission, went to the North Gauteng High Court in Pretoria in 2012. Thereafter the matter was appealed at the Supreme Court of Appeal, and subsequently the Constitutional Court, which ruled on 15 December 2014 that the determination of the Commission stands (*Bapedi Marota Mamone v Commission on Traditional Leadership Disputes and Claims and Others* [2014] ZACC 36).

5.4 SUMMARY: HISTORY AND DEMOGRAPHICS

From the historical account of the region and its people, it can be seen that the Bapedi people's tenure was characterised by conflict, strife and instability. Since the Bapedi settled in the area, they experienced conflict with the Voortrekkers, the British soldiers, the various structures of government in the twentieth century, as well as conflict among the Bapedi themselves. Rivalry over kingship and disputes went as far as the South African Constitutional Court, and was only recently settled.

In terms of the current socio-economic situation of the people in Mafarafara, the demographical analysis performed in section 5.2 confirms the observations made by the research team during site visits. The situation can be summarised as follows:

Mafarafara is a remote, rural community. It is geographically isolated by a mountain range, a river and poor road infrastructure. The community is completely isolated when the Tubatse river is in flood. In terms of connectivity, there is limited and unreliable cell phone coverage. The majority of families in Mafarafara survive on government social welfare grants and subsistence agriculture. Since there is no piped water for irrigation, the yields of crop farming is restricted.

The typical homestead is built from mud bricks with a thatch roof. There is no electricity (a portion of houses has prepaid electricity, but most cannot afford it). People use candles for lighting and wood for cooking. They have to fetch water from the river. They make use of pit toilets. While most people own mobile phones, they have to make special arrangements to have it charged.

The people in Mafarafara are homogeneously black African and are Sepedi speaking. There is a high proportion of female-headed households, with almost two thirds of people aged 35 and over being female. Overall, most people have some secondary education; however the older people – and especially the older women – are largely illiterate.

5.4.1 The importance of empowering the women

In Mafarafara, women are found in leadership positions and they maintain the community. The women are regarded as the cohesion and social fibre of the community. Empowering and improving the economic condition of rural women has elsewhere been shown to have a positive multiplier effect that results in improved nutrition and health,

as well as in access to education for their family members (Smith, 2015b). The prevailing opinion is that ICTs have an important role to play as vehicle through which rural women in particular can empower themselves economically and socially (Efobi *et al.*, 2018; Smith & Turpin, 2017). Women play an important role in decision-making and they act as gatekeepers, deciding who are allowed to enter into their community for research or other purposes and who not. For this reason, the focus of this study is on the women's role: how their inputs are valued to co-create and refine the ICT platform, and how this co-creation informs the development of the co-creation design framework.

5.5   THE CASE STUDY WITH ERW AT MAFARAFARA

An empirical study was conducted in Mafarafara with ERW as participants. The reasons for selecting Mafarafara as a site are discussed in section 1.5. Mafarafara had a concentration of socio-economically disadvantaged ERW, who were involved in agricultural activities and who could potentially benefit from a co-created ICT platform. The process of establishing community entry was discussed in Chapter 1 (*cf.* section 1.5) and Chapter 2 (*cf.* section 2.5.2). In short, a relationship was established with the community through Mma C, a local leader. Mma C is well educated and fluent in English, and was therefore ideally positioned to act as a cultural interpreter between the CSIR team and the ERW.

The study commenced in 2013 and consisted of seven research site visits conducted between April 2013 and October 2016. The research visits were supplemented by three technical visits to install, maintain and update the ICT platform. At the time of writing, the relationship and interaction with the community is still ongoing. However, this thesis limits itself to data collected in the period of April 2013 to October 2016. Table 5-1 summarises the research visits; these were each time undertaken by a small CSIR team, to facilitate consistency in the team composition.

Table 5-1: Research visits to Mafarafara

Visit #	Year	Date	Dura-tion (days)	Who reported	Format of report
1	2013	April 22nd to 25th	4	Kanye Mpho Larry	Site visit report Site visit report Field notes
2		August 19th to 23rd	5	Lungie Kanye Author (Ronel)	Site visit report Verbal feedback (at debrief)

Visit #	Year	Date	Dura-tion (days)	Who reported	Format of report
					Debrief session notes, after team returned from site
3		November 25th to 27th	3	Lungie	Site visit report
4	2014	April 1st to 4th	4	Lungie Sifiso	Site visit report Site visit report
5		August 22nd to 26th	5	Lungie Sifiso	Site visit report Site visit report
6	2015	April 20th to 24th	5	Tumi Lungie Charles	Site visit report Site visit report Site visit report
7	2016	October 23rd to 26th	4	Lungie Tumi	Site visit report Site visit report

The research activities that took place before, during and after the site visits are summarised in the next few sections.

5.5.1 Empirical context

The South African rural context is of importance for this study, due to its unique socio-cultural characteristics, which influenced the interaction with both the women who participated in the study as well as their community as a whole.

As indicated in the demographic overview, the local language in Mafarafara is Sepedi. The majority of women who participated in the study were illiterate and spoke Sepedi only. Mma C acted as their interpreter and facilitator, since she was literate and fluent in English. Some of the women had to be assisted with reading and writing. The women were keen to participate in the study as they felt that it would help to improve their literacy. They were willing to use the ICT platform for providing feedback to improve its design.

The group of approximately 25 women who participated in the research project formed part of a community initiative initiated by Mma C. By site visit 3, the number of participants stabilised at 11, where it remained until site visit 7. The participants were all involved in agricultural activities. Other than Mma C and the crèche teacher, none of the women involved with the research project had any civic responsibilities.

5.5.2 Before the first site visit

The process below was followed to prepare the community and the research team before the first visit:

- Obtain ethics clearance from CSIR and University of Pretoria;

- Develop interview guidelines;

- Develop ethics documentation consisting of DD project background, background on this research project, authorisation by the local chief to conduct research in the community, and an informed consent form. All documentation was to be available in both English and Sepedi;

- Develop training material for users;

- Pilot the ethics process in Mabopane with a group of women with the same profile as the elderly women of Mafarafara, but who have had exposure to the DD;

- Amend ethics documentation based on the feedback received; and

- Share the documents with Mma C via e-mail before the visit, and follow up with a telephone conversation to explain the process, introduce the names of the project team members and explain the reason for the documents.

5.5.3 Piloting the ethics process

Adhering to ethical research practices in remote rural areas, with research participants who are mostly illiterate and not English speaking, is a challenge. Therefore, it was decided to pilot the informed consent process. This was done in Mabopane in March 2013 with 25 women with the same profile as the participants in Mafarafara (age, language and socio-economic conditions). The intention was to assess the comprehensibility of the background information and the consent form, whether the Sepedi and Tswana translations were correct, whether the process worked and to see whether any other issues arose that the researcher did not consider.

The original plan was to conduct one-on-one informed consent sessions with the research participants. However, this was a time-consuming and tiring process, as it took about an hour for each participant. The questions and comments that arose from the individual interviews were similar to one another. Furthermore, interviewing the women individually in a separate room created an impression of 'secrecy'. It was realised that this was not a feasible approach. It was decided to test a focus group approach as an alternative. One of the senior women, who had completed the ethics process the previous day, was approached to gauge her willingness to lead the focus group. She was taken through the document again. She then led the remaining women,

as well as some of those who had already completed the consent process, through the documents. The researchers acted as observers. The questions that were raised were addressed in the group. Opportunity was provided for the group to discuss issues raised among themselves. Once the women had been guided through the consent document, the researchers went through the signature process on a one-on-one basis. Based on their feedback, it was decided that (Smith & Stillman, 2014):

- The lengthy and comprehensive document based on the template provided by the CSIR ethics board would be too detailed for one-on-one interviews and that this should be explained by applying a focus group in the ERW's native language.

- Where the consent form states that the data collected will be stored in a safe place for three years and then destroyed, it has to be explained how it will be destroyed (shredding).

- The statement 'no names will be mentioned in any publications' should be expanded to include specific examples of publications, such as newspapers and academic papers.

- The term 'legal representative' caused concern, as for this community this word meant that you have trouble with the police. A number of participants also felt that if that clause were included on the form, the chief would insist on signing it and thereby remove the decision making from the participants themselves. All the participants strongly insisted that the clause be removed from the form.

- The type of photographs that will be taken, and where it will be stored needed to be indicated.

- The meaning of 'potential risk and discomforts' or 'potential benefits to subjects and/or to society' should be precise. The problem lay with the word 'potential'.

- The Sepedi versions of the ethics document and the consent form needed to be made shorter, as Sepedi is a verbose language.

Denison and Stillman (2012:1047) offer a definition of informed consent, which accepts the requirements of the traditional view of informed consent but leaves room for adaptation to specific conditions: informed consent requires that participants be provided with sufficient information, in a language that they understand, "which describes the purpose, methods, demands, risks, inconveniences, discomforts, and

possible outcomes of the research to be undertaken … Depending on the community involved, this may mean not only obtaining the individual's consent, but also that of the … community or collectivity, to which they belong", and allowing for consultation between community members (Allan, 2011).

Informed consent is closely related to, and interacts with, other values such as trust, privacy and security (Freeman, 2006). How these values are defined has implications for the identification of the actions that require informed consent.

The target group of the research, ERW, are the most disenfranchised members of the community; they are subject to the chief's power and authority, and would not participate either as individuals or collectively without his permission.

Signing a pro-forma document does not constitute true consent. True consent can only be given because of an iterative process during which the researcher provides information to potential research participants in a way and language that they can understand and interpret correctly, and who are competent to make informed decisions within their own socio-cultural context. Informed consent must therefore be a 'shared decision-making process' during which the parties reach consensus about all the essential elements of a valid contract, as well as an agreement to work collaboratively (Allan, 2011:151).

Research of this type in impoverished rural communities places an additional burden on the researcher to conduct the research with integrity and accountability. These communities often have one overriding goal: to ensure their survival on a day-to-day basis. This aspect is very clear from the circumstances of the case study. It is therefore very possible that people will regard the researcher as somebody who is in a position to contribute to their wellbeing and survival, and therefore agree to participate in order to benefit in some way. This may not be obviously stated, but it is clear from the researcher's experiences in the past in other communities that researchers are seen as a resource. This can also lead to understandable confusion, because expectations are often not voiced directly when communicating with researchers (Smith, 2015a; Smith & Stillman, 2014).

Ideally, when conducting research in rural communities it is therefore important to recognise and honour potential research participants' agency and capacity to respond within their own socio-cultural context, even though they might be described as

'vulnerable' within a Western research context. Research ethics demand that participants (here: community members) are treated respectfully. As far as possible, researchers must ensure that community members genuinely understand what the research project is about, what the foreseeable outcomes are and what benefits (tangible, immediate and longer term) the participants can expect (Byrne & Alexander, 2006). Researchers must present the intention of the research project in such a way that mismatches of expectations are prevented. They must also ensure that individuals do not feel compelled to participate.

With this in mind, it was decided to adapt the ethics approach and process before visiting the identified area or case study for this research. It was also decided to visit this area regularly to overcome mistrust and to show commitment to support the community to use the technology that they have co-created. Therefore, several site visits were planned to Mafarafara.

5.5.4 Overview of project execution

A total of seven research visits were made to Mafarafara, as indicated in Table 5-1. Team members stayed at Mma C's house during site visits.

By the seventh visit, the building that housed the ICT platform was severely damaged by a storm, and the project could not continue as a new building first had to be built. Building a new community centre is very time consuming, as the people build it from bricks that they produce themselves; this takes time, especially in a resource-constrained context. The construction is beyond the control of the researcher, and it was decided not to wait for this to be finalised before completing this study. Therefore, the study is limited to the list of visits indicated in Table 5-1.

5.5.5 Setsong centre

The ICT platform in Mafarafara was housed in the Setsong community centre; a centre established by the ERW in the community. The centre is a mud house with a thatched roof, that was built by the community members. The Setsong project was an initiative by the community elders, which meant to expose the youth to the roots of culture. The centre is a place where the older women gather to work on projects such as sewing, beadwork, reed work (e.g., making brooms and baskets) and farming on a communal farm (*cf.* section 4.4, Chapter 4).

Most of the women in the project are involved in agricultural activities, where they plant crops for supplementing the food that they buy with their pension grants. Most of these women have two types of agricultural practices, namely, their own homestead gardens and the communal garden, which belongs to women in the Setsong project. The communal garden is divided into little plots to accommodate the number of women in the project. The agricultural local office has started to offer tractor services to the project and some seeds for the woman to plough. Prior to this initiative, the woman had to collectively invest money for hiring a tractor to work on the land.

5.5.6   Site visits

The seven research site visits that took place from April 2013 to October 2016 are discussed below. The summaries of the site visits are based on site visit reports and field notes submitted by the various research team members who visited Mafarafara.

5.5.6.1   First site visit: 22nd to 25th April 2013

This site visit was conducted by two researchers from the CSIR, Meraka. They were accompanied by an expert from Australia who has worked intensely with rural communities throughout the world. The purpose of this site visit was twofold, namely to obtain community buy-in, and to do a baseline needs analysis should permission be given to continue with the project. In keeping with local tradition, the research team first obtained permission from the chief to work in the community. The idea of co-creating the ICT platform known to them as the DD was then presented to the group of ERW, who agreed to participate in the project. The team then dedicated the remaining four days on site to get to know the women. They did a baseline needs analysis to understand how the women work, their aims, the problems that they were experiencing, available information, level of exposure to ICTs, and additional information required to be more productive. Feedback from the participants was used to update the content of the standard DD (before installing it in Mafarafara) to meet the information needs expressed during the interviews.

The team arrived in Mafarafara in the late afternoon of 22 April 2013. After dinner, which Mma C and her neighbours prepared, Mma C stated that she was unclear about the purpose of the team's visit. She mentioned that she had heard that the team would assist the women with their crop project by providing them with needed infrastructure facilities, such as irrigation. The team reviewed the project and the reasons behind their

visit, referring back to the telephone discussions she had had with the person who introduced her to the author, and with the author herself, as well as the hard copy documentation that was delivered to her. The documentation provided information on the ICT platform research project in particular. The research team noted that, although Mma C was one of the most educated people in the community (she used to be a school principal), talking about ICTs and the ICT platform was like communicating in a language that is foreign to her. Although Mma C had a cell phone, she rarely used it, as she preferred engaging with the community face to face.

- **Meeting with the village chief**

When outsiders visit Mafarafara, their host must introduce them to the local chief. Mma C took the team to meet the village chief on the morning of 23 April 2013. On arrival, the chief was not there but his heir met with the team. Mma C introduced the team in Sepedi and told him the purpose of their visit to the village, and when team would be leaving. Visitors were expected to pay a fee of R100 to the chief. Records of visitors are kept in a book, which all the team members signed, giving their names and the organisation they were from. This introduction served to "open doors" for the project before engaging with the community. Once the meeting with the chief was concluded, the team were free to meet with the women.

- **Consent process**

The first point of order was to complete the informed consent process. Given the learning gained form the pilot ethics process (*cf.* section 5.10), this was done in a focus group. The venue was the community centre where the women met to do their sewing, work in their communal garden, and to just 'hang out'.

The research team met with a group of 25 women and one man, the husband of one of the women. The session started with an introduction to the ICT platform research project, as well as the CSIR. This was followed by the consent process. The ethics forms were read to the women, and explained in Sepedi. It took nearly two hours to administer the ethics protocol, since this included explanation about the project, answering questions and assisting the participants to sign. Mma C clarified some of the project details, and also helped to interpret where necessary. All the participants signed the consent forms. The consent process was repeated at the beginning of each successive

focus group (during the subsequent site visits) for any of the women who wanted to participate, but who did not previously sign a consent form.

- **Site inspection**

On 19 June 2013 a member of the technical team conducted a pre-installation technical site survey. The purpose of this visit was to assess the infrastructure available at the community centre, to identify the best location for the ICT platform, and to identify and mitigate any potential obstacles the team might encounter during installation. In consultation with the women, a decision was made to install the ICT platform inside a small side room leading off from the main room of the community centre. Three factors influenced the decision. Firstly, the community centre is for the women's use only and they have the keys for the centre, making it both easy to access, and a secure location where it was highly unlikely that it would be vandalised. Secondly, the mud floor of the room was thicker and more densely packed than that of the rest of the centre – an important factor, as the batteries for the solar panels are very heavy. Lastly, because the roof of the centre is thatch, the solar panels were mounted on a frame that was installed outside the community centre. The best location for the frame was directly outside the small room, allowing for easy installation of a cable running from the solar panels to the batteries.

Figure 5-15: Community Centre location where the ICT Platform was installed

The site inspection was not counted as a separate site visit, as it was a short visit during which the research team was not presented to collect data.

5.5.6.2   Second site visit: 19th to 23rd August 2013

A research team consisting of two researchers and a member of the CSIR technical team conducted the second site visit. The purpose of this visit was to install the ICT platform and provide participants with training.

The ICT platform and a solar panel were installed on the first day, with the assistance of two local young men. The women also wanted to help, and they held the rods in place that were used while installing the solar panel. One of them remarked:

> *"We want to hold on to the rods so that people can see that we were part of this occasion and making our own contribution" (Lungie's site visit 2 report)*

The installed ICT platform contained information on its hard drive according to the information needs that the ERW expressed during the first site visit. It also contained information that was popular at other installation sites, such as games and a numeracy programme.

On the second day at the site, the team visited the chief to pay their respects. Following this, a session was held at the community centre with the participants. The research team revisited what was discussed and agreed during the first site visit by discussing the topic of informed consent again. Participants who arrived for the first time completed informed consent forms.

During the lunch break, the CSIR team shared the juice and biscuits that they brought along. However, it became clear that these snacks were not substantial enough, as lunch was the people's main meal.

On the third day, training continued. However, not many women arrived as it was the monthly pension payday and they had to visit the paypoint to receive their money. Training continued on day four.

During the visit, interviews were held with participants while others received training. Information was collected about participants' livelihoods as well as their information needs. Twenty-five participants were interviewed during this site visit.

The research team was well received throughout the visit. They found the interest and enthusiasm of the women contagious. When the women started working on the ICT platform, their faces "just lightened up" (Lungie's site visit 2 report). The women all wanted to know how to use the computer and were very patiently assisting those who

lagged behind. The team emphasised the importance of keeping the momentum going. Mma C was encouraged to identify someone within the group who she could mentor to be her assistant. This would be important in the event of her not being available or able to assist. The two young men who helped with the installation of the ICT platform and solar panel frame were identified to be trained as technical assistants for the maintenance and technical support of the ICT platform.

During the interviews, it became clear that the ERW's most pressing problem was the lack of irrigation for their vegetable gardens. The following comment was heard repeatedly:

"Is it possible for you to organise a reliable source of water for our garden project?" (Lungie's site visit 2 report)

The ICT platform's information on vegetable farming would be of limited help if the ERW lacked the basic resources to farm. One research team member recommended that the CSIR assist the women in this regard.

- **First update to the ICT platform**

During this visit, the first update was made to the system, namely to increase the font size on the screen to accommodate the eyesight of the elderly women.

5.5.6.3 Third site visit: 25 to 27 November 2013

The aim of this site visit was to conduct follow-up interviews with the women, focusing on what worked, what did not and what changes were needed to the physical design of the ICT platform as well as its content.

Focus group discussions were held to gain feedback and suggestions about the ICT platform. It was found that the women liked visiting the community centre to use the ICT platform. During training, a login was created for each woman, where she could upload her personal information. The following comment is about this aspect:

"The DD is also used for storing our personal information. We have our own files and this makes us feel good about ourselves." (Lungie's site visit 3 report)

The following feedback was received during the focus groups about how the participating ERW spent their time at the community centre:

"We kill two birds with one stone. Whilst waiting for your turn to work on the computer you can sew in the meantime" (Lungie's site visit 3 report)

During this site visit the research team made a visit to the local agricultural office in a neighbouring town, to find out what help this office could provide to the Mafarafara community and the woman participating in the project, especially with regard to irrigation and food production. The research team did not have success and planned to follow up with the agricultural office at a later stage.

As far as the ICT platform was concerned, the ERW's interest in using the computers was still there. The women informed the team that they were still waiting for them to upgrade the ICT platform as promised. They were appreciative about the technical training that the two ICT champions from their community gained to assist with the ICT platform; however, they were not clear about CSIR's intentions for training the young men. Even though they were informed that the training received would not necessarily meant that the two would be employed, there was in some quarters that wish and hope. During the data collection of this visit, the concept of ownership in the project, personal responsibility and empowerment, were emphasized. The action-oriented research was geared towards finding practical solutions to their understanding and challenges experienced as part of the co-creation and development of the artefact.

5.5.6.3.1 *Interim technical visit for updates and maintenance*

In February 2014, between site visits 3 and 4, a technical visit was made to upgrade the solar panels in order to enhance their battery life. During this visit, the information base of the ICT platform was also updated to address information requests expressed by the ERW during site visits 2 and 3. The additional information was on agriculture and health. During site visit 2, a need was expressed for information to identify and combat diseases affecting crops as well as livestock. During site visit 3, needs were expressed for information on health ailments and how to treat them (for example, arthritis). The ERW also asked for agriculture information in their native language, Sepedi, about growing crops and managing livestock.

5.5.6.4 Fourth site visit: 1 to 4 April 2014

The purpose of this site visit was to get more feedback on the use of the ICT platform by the elderly women, and to get a continued understanding of the women's everyday

life. There was also a need to follow up on the engagement with the office of Rural Development that was initiated during the third site visit. The motive for getting the DRDLR on board was to find ways in which these women could be assisted with their gardens, which were their main source of survival. During this visit, there was a need to get more perspective from the trained community ICT maintenance champions, who had become part of the project and received training on ICT with the help of CSIR. There was also a need to engage other community members who are directly or indirectly involved in the project and get their perspective on how the ICT platform was benefiting the people of Mafarafara.

During this visit, the CSIR research team consisted of two people, one of whom was new to the project. Upon their arrival in Mafarafara, Mma C. welcomed the research team. The team delivered the food that they brought to the community centre, namely vegetables and porridge meal. The ERW were at the centre awaiting the research team. Some of the women expressed their concern about the change in the team's composition. They asked after one of the team members that came along during previous visits. It was clear that the relationships they had developed with individual research team members were important to them. The food that was brought was highly appreciated, and the women praised the CSIR for their humanity. They divided the food into half so that they could eat it on two separate days.

Following community protocol, the team started the next day by visiting the Chief's place. The only person there was the chief's daughter who told them that the chief's wife was in court and the Kgosana (chief) was at work in Burgersfort. This day started slowly due to two funerals in the village. The community members were pre-occupied with the traditional act of going to pay their respects to the bereaved, because the relationships of people in Mafarafara were still embedded in a culture that believes that neighbours have to rally around to give support.

The CSIR team experienced unexpected social dynamics around the position of the two young men that were identified by the ERW as their local technical assistants or champions. The champions were required to provide part-time user assistance on the ICT platform, on a volunteer basis. They were invited to a training course in Johannesburg, of which this study's funds covered the expenses. Upon return, they eagerly assisted the ERW on a regular basis. The CSIR's aim was to empower the community with their own localised skills base, but not to create a financial dependency.

While a stipend or salary was never agreed, the CSIR later learned that the champions expected to be financially rewarded because of the commitment they showed. An unspoken local norm informed this expectation, namely that if you helped someone, that person would notice your needs and help you in return. The young champions were poor and hoped that the more eagerly they assisted the ERW, the better their chances of receiving payment. In hindsight, the CSIR project leader said that if they were to know this expectation would develop, they would have managed the situation better.

In-depth individual interviews were held with 11 women who regularly used the ICT platform. They showed an overwhelmingly positive response as to what the ICT platform meant to them. They were proud of being able to log in and use the system – for them this was a major accomplishment since they did not believe they would be able to do it, given their age and lack of education. The interviewer learned that the women not only felt 'capacitated'; regular visits to use the ICT platform also gave them a sense of purpose, since most of them were retired. There was a repeated message that especially the computer games took away their stress, as it was a means to escape from their daily worries:

> *"I can log in and out, get into my file, type my name and sign. I can now sign my name when asked to do so. That is development." (Mma ST)*

> *"I'm able to play games and can entertain myself." (Mma LK)*

> *"This DD.... has become our pastime. It reduces our stress." (Mma MM)*

Another significant activity during the fourth site visit was a follow-up visit to the Agriculture offices (DRDLR). The CSIR team was determined to locate an official who could help them, and did not leave until they were able to do so. They persuaded the two Agriculture people they met with to come along and visit the Mafarafara project, which they did. Once the Agriculture officers from DRDLR saw the setting and crop fields for themselves, they realised that the ERW had legitimate requests for assistance with farming infrastructure, and committed to engage in a process to assist them.

5.5.6.5 Fifth site visit: 22 to 26 August 2014

The team arrived at Mafarafara on a Friday afternoon and found the women at the centre. While happy to see the team again, the women also complained about the fact that CSIR took a long time to return. However, they also admitted that they themselves were not

available earlier due to their involvement in the initiation school run by Mma C and her brother. The team spent the afternoon with the women discussing what had happened with the project after they left in April. Through observations, it was clear that not much has changed at the centre; it was also revealed that some members had lost interest in the project, as the Setsong centre seemed not to be moving forward.

The woman mentioned that it would have been impossible for the researchers to visit them earlier since they were pre-occupied with the festivities of the "Lebollo": the initiation of young men, women and young girls. The team was informed that this was the first week that women were active at the centre, because most of them were involved in the festivities and in particular Mma C who was one of the organisers.

This initiation was significant in the sense that initiates came from as far as Gauteng and other provinces. From the fees that initiates had to pay, the Mafarafara community gained through the services they offered, for example collecting wood used for cooking, clearing the area used by initiates, providing vegetables for all the meals, and providing services such as cooking for the initiates. Some of the women in the project were active in some of these activities, and have been able to gain in monetary terms. The team was told that the initiation is done every other year, and that this was a blessing because of the amount of planning and work involved.

During the feedback interviews, a concern emerged that caught the CSIR team unaware. During the fourth visit, a male researcher performed interviews with the women who used the ICT platform. Mma C suggested that he spoke to them individually and privately, so that they could speak more openly. Times and venues were agreed upon: he agreed with the women to come and interview them at their homes. None of the interviewees objected to the venues, and 11 interviews were conducted successfully. It appeared that the women's husbands were unhappy when they found out afterwards, and the moral blame was shifted to the researcher. In hindsight, it is easy to say that the researcher should not have conducted the interviews at their homes. However, at the time it seemed to him the obvious thing to do. For the sake of the social relationship, the male researcher was withdrawn from the project even though the quality of his field reports and interview data were very good.

The use of the ICT platform seemed to have become more entrenched in the daily lives of the participants:

"In the morning we first pray and then the [ICT platform] is switched on. We then log in… and start playing games or looking at our personal files… Some days, we log in for a while and then go and work in the garden." (Mma MM)

"The day starts with having to clean the room and the [ICT platform]. [We] then log in and participate in the different offerings. When tired, it is time to give others a chance. [We] help each other during the process…. Others [are] sewing clothes…. Others sew reed mats and traditional outfits…" (Mma C)

"It's like work, I'm there every day" (Mma FM)

The women's descriptions of their daily activities showed that they visited the community centre on a daily basis, where they took turns to work on the ICT platform and do craft activities such as weaving and sewing. The two young male champions still switched on the machines for them. Throughout the day, the women assisted each other, as some of the illiterate older women required help in typing their names.

In line with the CSIR's exit strategy, they needed to prepare the community to take over the maintenance of the ICT platform. While the women confirmed that they realised this, it was clear that they were not yet ready for this responsibility. Some of the younger women would have to be trained to give technical support, but no one volunteered.

5.5.6.5.1 *Update and maintenance of ICT platform*

Between visits 5 and 6, the ICT platform was removed to perform technical maintenance and updates. It was removed in February 2015 and returned during site visit 6. Content (database) modifications were done in response to the following information needs that were expressed during interviews:

i. Health related information:

    a. Remedies that could help with old age ailments such as cramps, arthritis, asthma, ulcers, high blood pressure and sugar diabetes; and

    b. Ailments that affect children.

ii. Agricultural information:

    a. Plants to grow, when to grow them – suitable seasons, diseases that can affect them and remedies, the insects which are harmful and what insecticides to use;

b. Information about indigenous plants and where they could be found, their properties and use;

c. Livestock and small stock – information about livestock and small stock their diseases and which remedies to use; and

d. Information on how to take care of their chickens and some of the diseases that affect them.

iii. Information on lightning and thunderstorms:

a. Women claimed that Mafarafara gets severe lighting and thunderstorms that are destructive in nature.

b. They would like to educate themselves on what to do to avoid fatalities and destruction.

iv. A variety of patterns for clothes, for the sewing group.

v. Ideas on crafts that do not cost much, for example how to create crafts from recycled goods.

vi. A simple accounting programme to assist the women to account for their business profits and losses.

vii. Programmes on short educational stories: one of the women suggested television programmes such as Khumbul'ekhaya.

viii. Information about different funders – both government and non-government – and their contacts and areas of interest.

Infrastructure needs:

i. A printing/ photocopying facility. This will be of assistance not only to the ERW, but also their children and the community.

ii. Women to be provided with chairs while working on the ICT platform, so that they do not get tired while standing.

5.5.6.6 Sixth site visit: 20 to 24 April 2015

The aim of this site visit was to reinstall the modified ICT platform after it was temporarily removed to make the changes requested by the women, and to train the

participants on the updated feature. A new team member described the trip to Mafarafara as follows:

"We left for Mafarafara on the 20th of April 2015 around 8 am at the CSIR. The journey was long and tiring, but still the journey was fun and educational. The nearest town to Mafarafara is Burgersfort (Limpopo) and in this town, one finds mines with industrial trucks. The road used was N14 from Pretoria and when we got out of Gauteng and into Mpumalanga Province, the route chosen by the GPS was a road unfamiliar to the researcher who was part of the previous visit and who knew the other road via Dullstroom to get to Mafarafara. As we got closer to the destination, we asked for the direction that would lead us to the village and funny enough when leaving we overheard one of the ladies whom we asked for directions saying that 'Where are these people coming from if they don't know where Mafarafara is'. For us it was amusing, as we could not find the GPS coordinates for Mafarafara and the women did not realise how remote this place is. We arrived at the destination (Mafarafara) at around 3pm in the afternoon, and were welcomed with open and loving arms by the community. We settled in and enjoyed the rest of the day by catching up and meeting new people, getting a better understanding of Mafarafara and the ICT project embedded within the community."

On the first day, the matter of consistency in the composition of the CSIR research team was raised again. A request was made to keep the team the same until the end of the project.

The focus of the data collection exercise was to obtain a rich understanding from participants about their experience with the ICT platform and the project at large. At the outset, the participants were reminded of the informed consent forms that they signed and a short overview of its content was provided. A total of twelve one-on-one interviews were conducted.

One of the topics that was discussed was the composition of the group of women participating in the project. It was found that the group of ERW that regularly visited the community centre to use the ICT platform remained consistent. These women all believed that being a member of the group had benefit in the group's development and in their own empowerment through the sharing of knowledge and ideas and giving advice.

The ICT platform was re-installed following its removal. Upon its return, the ERW all required refreshment training before they were able to use it again. The social impact of the removal of the ICT platform was larger than expected: the women were "sorely missing" it and did not know what to do. "We were bored" (Mma C). They were happy to have it back so they could play their favourite games, and it gave them something to talk and boast about again.

A meeting was held to discuss the responsibility of taking charge of the printer/photocopier. The ERW would have to buy cartridges and paper once the installed stock ran out, and hence had to decide on a pricing policy. It took a while to identify an individual to take responsibility for collecting and handling the money for prints and copies.

It was found that the women dreamed of upgrading their community centre. That would give them and the village more social prominence. Since their resources were limited, these changes would take some time to achieve.

5.5.6.7 Seventh and final site visit: 23 to 26 October 2016

The main aim of visit 7 was to assess the situation after a storm damaged the community centre and its thatch roof caved in. While the women were concerned about not having a community centre and missed using the ICT platform (it remained sheltered in the damaged building, but the building was not safe to use any more), they still had hope and a shared dream for a new multi-purpose centre.

Before the storm came, they were, as a group, in a better position than ever before. They valued the printer since it gave them a way to provide a service to the community. They renovated the lapa adjacent to the centre and made the site pretty with a rock garden. They were proud to host a wedding there for a village couple.

Their high spirits were not totally crushed by the storm damage and they were pro-actively, with Mma C's leadership, soliciting support for a new multi-purpose brick building.

When asked during interviews how they experienced not being able to use the ICT platform, the consistent reply was that they were missing it. They missed the games the most. One of the women felt that the ICT platform should not be taken anywhere as it had given them knowledge and information that they would otherwise had not known

especially in the area of health and agriculture. The ICT platform kept them busy and away from idleness, and thus reduced stress in their lives. Mma C said:

"We were bored."

It was significant that all women mentioned that their ailments (for example, arthritis) were now bothering them because they were no longer exercising their fingers. They maintained that moving from one computer to the next was also one form of exercise. One of the women stated that she might not be educated but some of these developments at the Centre allowed her to operate on a different level. She was more empowered. The women started focusing on their other activities. They spent their time sewing and making grass brooms and mats.

5.5.6.8   Status of ICT platform project since site visit 7

At the time of site visit 7, there was no appropriate building in which to relocate the ICT platform. Hence, the project was put on hold while the ERW were busy with the slow process of fundraising for a new community centre. The plan was to gradually build a new structure with the building materials and cash collected over time.

5.5.6.9   Technical inspection: 7 November 2018

Early in November 2018, a technical site inspection was made to assess the progress with erecting a new building, and to inspect the state of the ICT platform. It was found that the ICT platform and printer were still protected and intact. However, the technology would require upgrading as it had aged since its original installation in 2013, and the solar panel battery would need to be replaced.

It appeared that a new community centre was completed, with a corrugated iron roof. This would be an appropriate structure to host an upgraded ICT platform. Unfortunately, Mma C was not available at the time of the visit to plan for re-installing an upgraded ICT platform.

At the time of completing the thesis, the CSIR technical team were preparing to upgrade and re-instate the ICT platform early in 2019.

The case study as contained in this thesis is limited to the seventh site visit, which was the last time that research data were collected.

5.5.7 *Challenges*

During the various site visits, the following challenges were experienced that influenced the progress of the project:

Firstly, the remoteness of Mafarafara posed a practical challenge. The condition of the access roads were not good, which affected travel time. Two days had to be put aside for travelling (there and back), which added to the time as well as the cost of the project.

Secondly, there was a language barrier as the ERW spoke a regional dialect of Sepedi. The research team could manage with the help of Mma C as translator. Some research team members knew Sepedi, and could conduct unsupported interviews with the ERW. However, the interview and video transcriptions and translation posed a challenge. The researcher had to search extensively to find people who knew the regional dialect of Sepedi well enough to help with transcriptions and translations.

Another challenge in executing the project was the limited educational content that was available in Sepedi for the ICT platform, in particular the agriculture and health-related information that the ERW asked for.

Lastly, the limited literacy of many of the ERW meant that they remained dependent on support when using the ICT platform. Here, the helpful and inclusive spirit that existed between the ERW and with the local ICT champions enabled them to interact with the ICT platform.

5.6 CHAPTER SUMMARY

This chapter focused on the Mafarafara community where the ICT platform case study was executed. It commenced with a demographical overview of the region as well as the Mafarafara community. The demographical analysis made it clear that the people of the Greater Tubatse Local Municipality, and in Mafarafara in particular, are socio-economically disadvantaged, as summarised in section 5.2.2. The history of the Bapedi provided insight into their troubled and conflicted past. The historical and demographical overview assisted to provide a contextual understanding of the community. It also served as motivation of why ERW are regarded as the most disadvantaged social group within this community, and why an ICT4D intervention should be aimed at the ERW.

In section 5.2, the Mafarafara ICT4D case study was presented. An account was provided of the project preparation as well as the research visits and technical visits to the community in the period of April 2013 to October 2016. The events since 2016 that fall outside of the case study were also briefly sketched.

Section 5.5 presents the story of how an ICT platform was installed, and how it became a meaningful contribution to the lives of the ERW who participated in the study. The unexpected challenges that were encountered are reported, such as the position of the local ICT champions, and the research team member who was afterwards blamed for interviewing ERW at their houses. Surprising benefits of the ICT platform to the ERW were also surfaced, such as the popularity of the games, and the fact that the women believed the use of the ICT platform exercised their fingers and helped with their arthritis.

In Chapter 6 that follows, the case study data are analysed by applying structuration theory (*cf.* Figure 6.2) as well as mapping the results to the participatory design thinking process steps, illustrated in the initial co-creation design framework (*cf.* section 4.5).

6.1 INTRODUCTION

This chapter presents an analysis of the qualitative data that were collected on the Mafarafara case study throughout the duration of the project. Its point of departure is the following research question:

- **SRQ3:** How does the social interplay amongst the different role players influence the refinement of an appropriate ICT platform?

The above question is addressed by using Giddens' structuration theory as a lens with which to analyse the social dynamics surrounding and influencing the development of the ICT platform. In doing so, the findings of the application of structuration theory to analyse the case study data also contribute to the following research question:

- **SRQ4:** What role does the combination of the social interplay between all role players and the design process have on the ICT platform, as well as on the co-creation design framework?

These questions relate to Phase 2 of the study, as indicated in Figure 6.1:
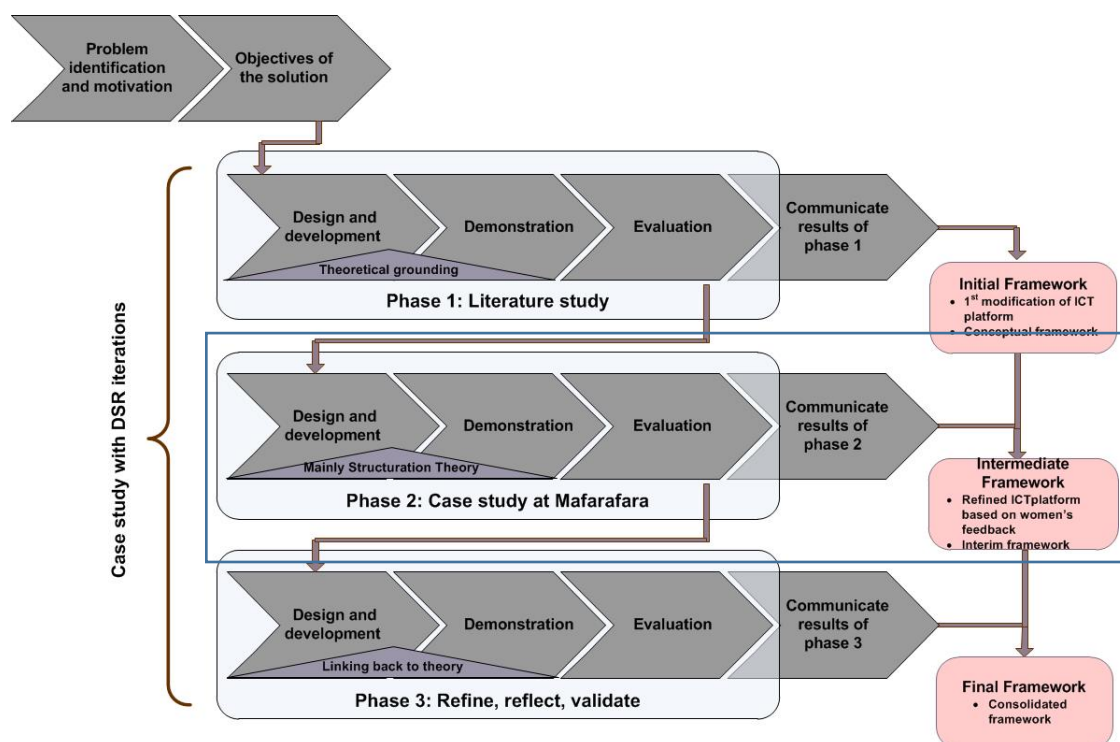
Figure 6-1: Focus on Phase two of the Peffers *et al.* (2007) process

To further answer SRQ4 above, the case study is analysed in terms of the design activities that took place through participation of the ERW and the CSIR project team.

The use of structuration theory assists in bringing to the fore the social implications for a co-creation design approach that is appropriate when co-creating an ICT platform with elderly rural women (ERW) in South Africa. The analysis of the design activities shows how the co-creation process practically played out, which has implications for the co-creation design framework.

Following the analysis of the case study, it is shown how the findings of the case study relates to the components of the co-creation design framework that were identified in Chapters 3 and 4.

6.2 APPLICATION OF STRUCTURATION THEORY

Structuration theory is used as a theoretical lens because of its focus on social processes. It allows for representing the dynamic nature of these processes, and can hence be applied to investigate how the social dynamics in the Mafarafara project influenced the development of the ICT platform.

Structuration theory was introduced in Chapter 2 (*cf.* section 2.6.1), and the case study context as well as site visits were presented in Chapter 5. In the sections that follow, the empirical data collected during the case study are analysed by means of Giddens' dimensions of the duality of structure. These were presented in Chapter 2, and are repeated here for the convenience of the reader:

Structuration process	SIGNIFICATION	DOMINATION	LEGITIMATION
Structure element	Interpretive rules	Resources (authoritative and allocative)	Normative rules
	↕	↕	↕
Modality	Interpretive scheme	Facility	Norm
	↕	↕	↕
Interaction	Communication	Power	Sanction

Figure 6-2: Dimensions of the duality of structure

In the sections that follow, each site visit will be revisited by considering the social structuration processes that occurred as signification (understanding and sense-making),

domination (processes of empowerment and acting out of social power) and legitimation (processes involving social values and norms). According to Giddens, (Giddens, 1984) the dimensions of the duality of structure are not separate but interdependent, and are only presented separately for purpose of analysis. It has been applied to the case study in this manner.

6.2.1 Summary of project according to site visits

As discussed in Chapter 5, section 5.5.6, the nature of the visits over the duration of the study were as follows:

- Visit 1 (April 2013): scoping, consent and fact finding by research team.

- Visit 1a (June 2013): site inspection by the technical team.

- Visit 2 (Aug 2013): ICT platform installation and training; continued assessment of situation.

- Visit 3 (Nov 2013): Assessment of ICT platform use and information needs

- Visit 3a (Feb 2014): technical visit to upgrade solar panels and ICT platform information base.

- Visit 4 (April 2014): Assessment of ICT platform use and information needs.

- Visit 5 (Aug 2014): Assessment of ICT platform use and information needs.

- Visit 5a (Feb 2015): ICT platform removed for upgrades.

- Visit 6 (April 2015): ICT platform re-installed, along with a new printer and bar chairs. Continuous assessment.

- Visit 7 (Oct 2016): Assessment of storm damage to building that houses the ICT platform, and project assessment.

- Between visits: telephone communication between CSIR team and Mma C as required, for updates/requests.

Between the research site visits (1-7), short technical visits (visit 1a and 3a) were made for a site inspection as well as upgrading of the solar panels and the platform information base. Later in the project, the ICT platform was removed for more comprehensive upgrades (visit 5a).

6.2.2 Social structuration account of co-creation process

A social structuration account of the co-creation process that occurred between the CSIR research team and the ERW of Mafarafara, when an ICT platform was installed and its functionality refined, is outlined in this section. It will demonstrated how the social structuration processes influenced the design and implementation of the artefact, and how the installation and continued use of the ICT platform in turn affected the social structure.

The site visit summary in section 5.5.6 serves as context for the analysis below.

6.2.2.1   Before the first site visit:

Table 6-1: Social structuration informing the first site visit

Activity	Signification	Domination	Legitimation
ICT platform prior development and testing in similar sites		Allocative resource: ICT platform technology for rural setting (sturdy, solar powered, only requires shelter from elements) See sections 4.3 and 4.4 for details	
Research on appropriate community for a project with ERW	Mafarafara community identified from previous visits to the area		Mma C identified as contact person (community leader, educated, experience with aid projects, member of target user group = ERW) and project negotiated
Preparation work	Information on ICT platform sent to Mma C to read		
			Agreement in principle on ICT platform project with ERW

From the activities preceding the first site, as visit shown in Table 6.1, it can be seen that there were pre-existing social structures that informed the project, as well as structures that were put in place as preparation for the study. The ICT platform entered the project with a history of design and adaptation that were informed by other, similar rural African settings. The CSIR team did prior research on ERW and their needs, and a search for a suitable case setting led them to Mafarafara. Mma C was assisted with sense-making about the project by means of prior conversations and reading. Mma C was also responsible for the initial sanctioning of the project with the ERW in Mafarafara.

6.2.2.2 Site visit 1:

Table 6-2: Social structuration during site visit 1

Activity	Signification	Domination	Legitimation
Arrival at Mafarafara			Mma C receives and hosts CSIR group (mutual sanctioning)
	Mma C declares that she is not clear on purpose of visit		
Day 2: Visit to chief			Obtain chief's blessing on project (normative requirement of traditional culture)
First meeting with ERW	Introductions made		
	ERW struggle to understand what ICT platform will be like. An attempt is made to answer sense-making questions asked by ERW		CSIR team explain ethical consent process (normative requirement of research community). Informed consent forms signed
Day 3: Visit to crop fields	CSIR team taken to see crop fields for themselves	Crop fields: community's allocative resource. Only partially usable due to lack of irrigation	
Second meeting with ERW	Information gathered on women's livelihoods, previous exposure to technology and information needs related to farming		Ethics clearance process with new attendees. ERW conditionally accept the project
Technical site inspection visit	Assessment of physical site to prepare for technology installation (ICT platform and solar panels)		

From the social structuration account of the first visit, it can be seen that particular normative practices were adhered to before commencing with research activities. Mutual sense-making had to take place to prepare both groups (ERW and research team) to better understand each other, and to inform further interaction and the installation that was to follow.

6.2.2.3 Site visit 2:

Table 6-3: Social structuration during site visit 2

Activity	Signification	Domination	Legitimation
Day 1: Installation of ICT platform		ICT platform installed (allocative resource) The information pre-loaded on ICT platform	Women helped with installation, thereby taking ownership of infrastructure

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Activity	Signification	Domination	Legitimation
		(authoritative resource) was according to information needs expressed during first visit. It also contained content found useful on previous projects, such as games and a numeracy programme	
Enjoying shared meal			Sharing of food as communal social practice
Day 2: Visit to chief			Report to chief (normative practice) and update him on ICT platform project
Briefing with ERW			Informed consent revisited with all attendees. It was made clear that everyone who wanted to participate was welcome (value of inclusiveness).
Light lunch provided by CSIR	Sense-making: CSIR learned that the lunch that they brought was not substantive enough; they did not realise that it was the people's main meal		
Commencement of user training	Attendees taught how to log in, open their own folders and access information on farming. Two young local men were trained at the onset, and they facilitated further training.	Women hesitant to participate, as they did not believe they were capable. Mma C had to motivate them	
Day 3: Training continues	Sense-making: CSIR did not realise it was pension pay day; very few attendees		
Day 4: Training continues	While training was in progress, small group interviews were held to find out details about participants' livelihoods, farming problems experienced and information needs		New arrivals were briefed and ethical clearance obtained
		First modification to system (allocative resource): font size increased as some ERW had difficulty with eyesight	

During site visit 2, the ICT platform was installed and training commenced. From the social structuration account of site visit 2 in Table 6.3, it can be seen that a number of normative practices were repeated, namely to gain permission from the chief, the following of research ethical practices, and sharing of food. The sense-making that was done by the research team and technician during the previous visit informed how the ICT platform was installed and what content was loaded. The training of the ERW (as a structure of signification) was facilitated by the two local young men that were fast learners and who could teach the ERW in their own language.

6.2.2.4 Site visit 3:

Table 6-4: Social structuration during site visit 3

Activity	Signification	Domination	Legitimation
Day 1and 2: Observations and interviews	Research team learned about ERW's use of ICT platform		Participants reminded of ethical process and informed consent
	ERW reported that they learned valuable things about crop and livestock farming from the ICT platform	ICT platform has been appropriated as a resource through regular visits and use by ERW	Women helped each other to use ICT platform (community's value of inclusiveness)
	ERW requested more agriculture content in Sepedi		
CSIR team brought food to share			The enactment of the value of sharing was highly appreciated
CSIR team visits Agriculture Office	Officer claims no knowledge about projects at Mafarafara	CSIR team asserted themselves (authoritative resource) to request assistance with irrigation for ERW	CSIR team gets referred to other officers not present, who were apparently sanctioned to assist

The main activities during site visit 3 were to assess how the ICT platform was used since the installation and training three months earlier, and to enquire about further information needs, now that the women were familiar with the current information base on the ICT platform. The research team also made a visit to the Agriculture Office situated in a neighbouring town, to negotiate farming and irrigation assistance on behalf of the Mafarafara women.

The social structuration account in Table 6.4 shows a repetition of normative practices concerning research ethics as well as a culture of sharing. Mutual sense-making continued: the CSIR team learned more about the women's livelihoods and needs

(information related as well as other needs), and the ERW learned by means of the ICT platform.

6.2.2.5 Site visit 4:

Table 6-5: Social structuration during site visit 4

Activity	Signification	Domination	Legitimation
Upon arrival, ERW express concern about change in CSIR team composition	CSIR learns that they need to keep the same team		It is clear that the women want consistency and that they value relationships developed during visits
Basic food items (vegetables and porridge meal) delivered on arrival			Within the local culture of sharing, the food was highly appreciated and cooked and shared over two days
Visit to chief's house			Respect paid to traditional leader
Visit to crop garden			Women were working jointly – one had to contribute to be accepted
Role of two local champions interrogated	ERW confused about future role of the two young men they nominated to assist them	Two men got involved hoping to get money (allocative resource)	The two men had an unstated expectation that they will get paid, even though this was not part of the agreement
Assessment of ICT platform use and further information needs	Additional information requested on health and farming	Participating ERW felt proud and 'capacitated', being able to log in and find information or play games	Their use of the ICT platform was sanctioned by their family and community, who could see that the women benefited from it
Second visit to Agriculture Office	CSIR team located appropriate officials and invited them to Mararafara to see for themselves	As with first visit, CSIR team had to use their social power to locate and convince officials	Visiting officials sanctioned ERW's request for assistance as legitimate

During site visit 4, several structuration processes were evident, as can be seen in Table 6.5. One of the challenges encountered by the CSIR team was to deal with the uncertainty around the role of the two local ICT champions and the unstated expectation that they would be paid. From a structuration perspective, the situation could be seen as a mismatch in normative rules between the CSIR and the local community, leading to social tension.

A highlight was that the in-depth individual interviews conducted with 11 ERW who regularly used the ICT platform showed an overwhelmingly positive response as to

what the ICT platform meant to them. They were proud of being able to log in and use the system – this was a major accomplishment for them, since they did not believe that they would be able to do it, given their age and lack of education. The interviewer learned that the women not only felt 'capacitated', but that regular visits to use the ICT platform also gave them a sense of purpose, since most of them were retired. This result also supports socio-technical systems theory (*cf.* section 2.6.4), which indicates that, if technology is implemented, it can have an influence on changing the attitude towards the use of a technical system; this, in return, affects social processes and norms. The use of the ICT platform became a regular social practice to the participating ERW. It made them feel socially empowered, not just because of the knowledge gained, but also because of their capability to use it.

6.2.2.6 Site visit 5:

Table 6-6: Social structuration during site visit 5

Activity	Signification	Domination	Legitimation
Debriefing: Unhappiness expressed about home interviews during visit 4			The CSIR male researcher was afterwards accused of breaking a social norm by interviewing the women privately at their homes
Further feedback interviews	To most participants, the use of the ICT platform has become a regular social ritual that gave meaning to their daily existence	ERW more confident in using the ICT platform. Their ability to use it has boosted their self-esteem	
ERW made aware that they will have to take over maintenance of the ICT platform	While ERW confirm this, they are not clear how they will do it.		

Site visit 5, of which the structuration processes are summarised in Table 6.6, was another follow-up visit to find out how the ERW were experiencing and using the ICT platform, and what further improvements or modifications were required. During the interviews, the issue of the male researcher doing home interviews during the previous site visit was raised as a concern. This came as a surprise to the research team, as the home visits were suggested by the women themselves.

The use of the ICT platform seemed to have become more entrenched in the daily lives of the participants, and hence a regular social practice. The women's descriptions of their daily activities showed that they visit the community centre on a daily basis, where they take turns to work on the ICT platform and do craft activities such as weaving and sewing. This result also addresses the theory of diffusion of technology (*cf.* section 2.6.3), which highlights the importance of adoption and how the use of an innovation can affect users to learn more. The ERW did gain more knowledge as they used and adopted the ICT platform.

Throughout the day, the women assisted each other with tasks, including the use of the ICT platform. These results from both site visits 4 and 5 are supported by literature, where it is indicated that users gain knowledge and *learn* (Kijima *et al.*, 2012) if they *collaborate*. They will curate, which means they will be *encouraged* to co-develop and be or *feel empowered*, as they will gain new knowledge and skills that previously did not exist; they will see the value of their inputs and will be motivated to interact with one another. Other benefits are *networking* to expand their social network (social integrative benefits) and enhance a sense of belongingness. Furthermore, the more *entertaining and interesting the content* of the co-creation platform, the greater the willingness to discuss and cooperate (Suryana *et al.*, 2017).

6.2.2.7 Site visit 6:

Table 6-7: Social structuration during site visit 6

Activity	Signification	Domination	Legitimation
Arrival debriefing: request made to keep CSIR team the same	CSIR has to hear a second time that ERW does not like changes in the CSIR team that works with them		
Reinstalling of ICT platform after removal for updates	Women missed the use of the ICT platform while it was gone and are relieved it is back	ICT platform as allocative resource modified in design and content	
Commencement of interviews			Ethical process and informed consent revisited
Composition of participant group studied		The same group of ERW kept participating because of intangible benefits (knowledge gained, sense of belonging, experience of empowerment)	
Rules for new printer/copier discussed			ERW were told that they would have to charge for copier use in order to fund

Activity	Signification	Domination	Legitimation
			paper and toner. One person needed to take responsibility for handling the money.
Wish expressed for improving the ERW's centre		The ERW wished to upgrade and beautify the community centre that houses the ICT platform, despite their limited resources	

During visit 6, the ICT platform was returned and re-installed, following modifications and updates. Upon its return, the ERW all required refreshment training before they were able to use it again. The social impact of the removal of the ICT platform was larger than expected: the women were "sorely missing" it, according to a site visit 6 report.

Among the issues that were surfaced during feedback interviews, it was found that the women dreamed of upgrading their community centre. That would give them and the village more social prominence. Since their resources were limited, these changes would take some time to achieve.

6.2.2.8   Site visit 7:

Table 6-8: Social structuration during site visit 7

Activity	Signification	Domination	Legitimation
Assessment of ICT platform use since previous visit		ICT platform upgrades and printer motivated and boosted the regular user group	
Assessment of storm damage implications	Without the ICT platform their experience of ailments returned	One woman still felt empowered because the ICT platform changed her outlook on life	
Future planning for a new building		Mma C and ERW envisioned a new brick community centre and were soliciting resources to build it	
Future planning for ICT platform		ERW were for first time willing to take ownership for ICT platform's maintenance	

The aim of visit 7 was to assess the situation after a storm damaged the community centre and its thatch roof caved in. While the women were concerned about not having

a community centre and missed using the ICT platform, they still had hope and a shared dream for a new multi-purpose centre.

Before the storm came, they were, as a group, in a better position than ever before. They valued the printer since it gave them a way to provide a service to the community. They renovated the lapa adjacent to the centre and made the site pretty with a rock garden. They were proud to host a wedding there for a village couple.

Their high spirits were not totally crushed by the storm damage, and they were pro-actively, with Mma C's leadership, soliciting support for a new multi-purpose brick building.

6.2.3 Reflection on applying structuration theory to case study data

The application of structuration theory, by means of considering the structures of signification, domination and legitimation, made it clear how the often unstated social structures informed and influenced the outcome of the project. Some of the local norms and ways of working were known to the research team due to their prior experience in ICT4D projects in rural settings. An example of an anticipated local norm, was the obligation of paying respect to the tribal leader. The research group performed this social practice regularly and made sure they had the blessing of the local chief for executing the study.

However, some challenges were experienced by the research team due to a lack of understanding of the local ways. For example, on certain days of the week or month, the ERW were not available for research activities due to regular social activities such as attending funerals and fetching their social welfare pensions.

Unexpected normative challenges that emerged included that of the male researcher who successfully conducted a set of interviews at the ERW's homes and then later was blamed for violating a social norm. Another normative challenge was that an expectation of payment was created when the local ICT champions were trained as assistants to the ERW.

A benefit of applying structuration theory is that it aids in making the social structures and accompanying unstated social challenges explicit, so that they can be better managed and understood.

6.3 DESIGN ACTIVITIES DURING CO-CREATION OF ICT PLATFORM

In this section, the participatory design thinking processes and steps, together with the value co-creation process steps of the initial co-creation framework, are applied to the case study. This addresses the theory for design and action (design thinking; *cf.* section 2.6.2) as well as the diffusion of innovation theory (*cf.* section 2.6.3) and socio-technical systems theory (*cf.* section 2.6.4). The design activities of the two co-creation participant groups, namely the ERW and the CSIR team, are shown in Table 6-9 per site visit:

Table 6-9: Design activities during co-creation of ICT platform

ERW design activities	ERW activities	Site visit #	CSIR team activities	CSIR team design activities
Listen	Mma C agrees to participate Mma C enrols ERW	Prior	Prior learning from rural DD projects Identify need for ERW study Identify Mafarafara site Establish relationship with Mma C	Identify
Listen Evaluate	ERW share contextual information ERW evaluate desirability of project	1	Introduce project Obtain ethical consent	Listen Ideate
		1a	Pre-installation site inspection	Identify
Collaborate Experiment	Help install ICT platform Participate in training Share information on livelihoods	2	Install ICT platform Give training Interview ERW on livelihoods First update of ICT platform	Collaborate Listen
Collaborate Experiment Identify	Assist each other with use Maintain and clean venue Share info on use and further needs	3	Assess use of ICT platform Identify further needs	Evaluate Listen Identify
		3a	Upgrade solar panels Update information base	
Collaborate Experiment Identify	Share use experiences and info on further needs Assist each other with use	4	Evaluate use of ICT platform Identify further needs	Evaluate Listen Identify
Collaborate Experiment Identify	Share use experiences and info on further needs Assist each other with use	5	Evaluate use of ICT platform Identify further needs	Evaluate Listen Identify
		5a	Remove ICT platform for maintenance and updates	
Collaborate Experiment Define	Share enthusiasm for returned ICT platform Use updated ICT platform and give feedback Plan to upgrade Community centre and lapa	6	Re-install ICT platform Install new printer	Evaluate
Collaborate	Share plans and activities towards new building	7	Assess storm damage Arrange temporary safekeeping of ICT platform	Listen Identify
	Progression with new building	After		

The following can be noted from Table 6.9:

From site visits 3 to 5, there is a lot of repetition of activities: continued use of the ICT platform on the ERW's side, and continued evaluation and further needs assessment on the CSIR's side. As time progressed and the ERW became familiar with the ICT platform, they could provide more informed inputs related to further needs.

The CSIR team installed existing technology that was refined in the process. As such, their design activities consisted mainly of evaluating use, listening to the users and identifying further needs. Because it was an existing product, not much ideation needed to happen.

The ERW's main activities consisted of trying out the technology that was totally new to them, thus they were experimenting. They did so throughout the project in a collaborative manner, assisting each other to use the ICT platform. Their use of the ICT platform became integrated with their other collaborative activities at the community centre, such as sewing and weaving. Their continued use of the ICT platform enabled them to better identify additional needs related to the information base and use of the ICT platform.

6.4 BENEFITS THAT ERW DERIVED FROM REFINING THE ICT PLATFORM

The benefits that the participating ERW experienced from the use of the ICT platform are summarised below, substantiated by evidence from site visit reports or quotes from interviews performed during site visits. While individual interviews and/or focus group discussions were held during each site visit, some sets of individual interviews had more pertinent questions about the use and the value of the ICT platform. In particular, the interviews that were conducted during site visits 4 and 5 were most valuable in compiling the list of benefits.

6.4.1 Technology user literacy:

6.4.1.1 Ability to log in and perform basic tasks (typing, searching, opening files)

"I can log in and out, get into my file" (Mma ST, visit 4).
"I use my password and can open it these days. [K] taught me" (Mma LM, visit 5).

"She could go in and out of the computer without any help" (Interview notes: Mma LK, visit 4).

6.4.2 Skills development (rudimentary)

6.4.2.1 Learning through numeracy game

"The games have up-skilled her in doing additions and subtractions and as a result of this, she was excited to tell me she could now use her ATM card… [it] has enabled her to do her own exchanges at the bank" (Interview notes: Mma MM, visit 4).

6.4.2.2 Overcome illiteracy by typing own name

"She proudly said that she could type her name and surname, something that previously she couldn't confidently do" (Interview notes: Mma FN, visit 4).
"I can now sign my name when asked to do so. That is development." (Mma ST, visit 4).

6.4.3 Information as a resource:

6.4.3.1 Information on farming (crop and livestock)

"…in the fields, there are diseases of plants and cattle, goats and chicken. She found out about them and what vaccines to use." (Notes of interview with Mma MM, visit 4).
"She has [searched] for most of the information that has assisted them in agriculture in the fields, cattle, goats and chickens" (Notes of interview with Mma C, visit 4).

6.4.3.2 Health information

"They also found out information about medicinal properties of certain herbs and were intrigued by the African potato they saw in the DD" (Lungi, site visit 3 report).
"They have also benefitted from information on health" (Notes of interview with Mma C, visit 4).
"…she has found out which medication to use for different ailments. She proudly told me that the chemists would ask her where she gets all the knowledge about the various medications and she tells them that she gets it from the DD provided by the CSIR" (Notes of interview with Mma C, visit 5).

6.4.4 Place to store personal information

"…she has also stored her family's photos in her file" (Notes of interview with Mma FN, visit 4).

"My personal file has my ID and place of residence" (Mma LK, visit 5).

6.4.5 Means of exercise

6.4.5.1 Moving between computer screens

"They maintained that moving from one computer to the next was also one form of exercise." (Lungi's site visit 6 report).

6.4.5.2 Exercising fingers (helping with arthritis)

"What was significant though was just how all mentioned that their ailments like for example, arthritis, were now bothering them because they were no longer exercising their fingers" (Lungi's site visit 6 report, notes on focus group question on the impact of removing the ICT platform for upgrades).

6.4.6 Entertainment

6.4.6.1 Playing games (main attraction to many)

"I'm able to play games and entertain myself (Mma LK, visit 4).

"I still use the DD and enjoy playing games" (Mma LK, visit 5).

6.4.6.2 Watching a video

"She enjoyed… watching pictures [on the DD], which she called television" (Notes of interview with Mma RM, visit 4).

"I watch the video that's what I like the most" (Mma EM, visit 5).

6.4.7 Intangible benefits

6.4.7.1 Escape from reality: Taking away stress

"It reduces our stress" (Mma MM, visit 4)..

"The DD has been helpful in releasing our stress" (Mma LM, visit 5).

"They have been able to work together as a team and play games on the DD. This has helped them to think less about their problems.… Being preoccupied with the DD has reduced her stress levels" (Notes of interview with Mma JG, visit 4).

6.4.7.2   Confidence in using technology

"She mentioned the fact that playing games on the DD boosted her confidence to use it" (Notes of interview with Mma RM, visit 4).

"She was confident of her skills in starting and shutting the computer" (Notes of interview with Mma C, visit 4).

6.4.7.3   Sense of purpose

"Socially, it has helped her and the women to have a purpose in life" (Notes of interview with Mma C, visit 4).

6.4.7.4   Empowerment/development

"I know things I didn't know before. I've been empowered" (Mma LM, visit 4).

"The DD has brought us a lot of good. We see the light, it has opened our eyes, and we see progress" (Mma AM, visit 4).

Mma RM "noted that the DD has brought them a lot of good in terms of capacitating them" (Notes of interview with Mma RM, visit 4).

"She just would like to thank the CSIR for this gift. It has contributed to their development" (Notes of interview with Mma LM, visit 4).

"Before the DD, the women were not enlightened but now there's an awareness of so many things that they are able to access from the computer" (Notes of interview with Mma ST, visit 4).

6.4.8   Discussion of benefits experienced

From the above comments, it is clear that most of the participating ERW consistently reported similar benefits. It needs to be stated that individual interviews often happened in private, so that it was not a case of women overhearing and repeating each other. In particular, the site visit 4 interviews, which formed a significant part of the evidence, were held in the privacy of the participants' own homes.

Multiple members of the CSIR research team, all of whom submitted independent site visit reports, conducted interviews. Hence, the data were gathered and compiled from multiple sources.

6.4.8.1   Unexpected findings

The women's feedback on the benefits of the ICT platform held some surprises.

The first one was the pride that especially the illiterate ERW took in being able to type their name (their login username was their own name). The illiterate ERW could not use the ICT platform extensively, but they could perform some tasks such as playing games and watching videos. One of them reported that the training on the ICT platform enabled her to use an ATM for the first time in her life; previously she always required someone else to do her ATM banking for her. Activities such as these were a major accomplishment for some of the ERW who believed they were too old to learn, and would never be able to use computers because of being illiterate.

A second surprise was the pleasure they derived from playing games, many of which were educational. They did not only enjoy the games, but believed that the games took away their stress as it made them forget about their worries. This is a major benefit to people who are in survivalist mode and who are regularly stressing about the next meal and other basic livelihood concerns.

There was the unexpected benefit of exercising their bodies and fingers when moving between screens and having to type on the keyboard.

Lastly, it became clear from the interview data and site visit reports that regular visits to the community centre to use the ICT platform gave especially the retired women a sense of purpose.

The unexpected benefits were in a sense unique to the ERW: as a group they had high levels of illiteracy, a number of survivalist stresses and concerns, the retired person's loss of sense of purpose to their life, and age-related ailments such as arthritis. Hence, the ICT platform project could be said to benefit the ERW in a unique manner, due to their unique composition but also due to the success of the project, without which they would not have adopted and regularly used the ICT platform.

6.5 LINKING CASE STUDY RESULTS WITH COMPONENTS INFORMING CO-CREATION DESIGN FRAMEWORK

In section 4.5 the initial co-creation framework (*cf.* Table 4.3 and Figure 4.13) identified specific components from literature and also indicated how these components were supported by the already developed DD project (since 2002). Note that the DD in Mafarafara is referred to as the ICT platform. The following Table 6.10 indicates (in the third column), how the findings from the data analysis (Chapter 6) supports the

components of the initial co-creation design framework. The results from the data analysis are mapped to the identified components to indicate how these assisted the researcher to improve the initial framework.

Table 6-10: Data analysis informing initial framework to become intermediate framework

Component name from initial framework (section 4.5)	ICT platform support for component (Section 4.5)	Data analysis results improving the initial framework and informing the intermediate co-creation design framework components
Socio cultural Socio-technical Needs & Requirements of ICT and ERW Empowerment Minimize isolation Values, structures, traditions, agency and structure	Co-created and co-designed based on needs and requirements of the various communities (resource deprived and rural) Vandal proof Use ICT Champions from community to do support and maintenance User create own account and profile Acknowledge social structures as well as agency	Signification: socio-cultural mutual understanding and sense-making. ERW had to make sense of new technology, and CSIR had to learn and accommodate the local way of doing things Domination: how authoritative resources (Mma C) as well as allocative resources or the lack thereof influenced the outcome of the project Legitimation: in practice, how refinement of ICT platform was informed by the norms and values, stated and unstated, of the ERW community as well as the CSIR team
Participation Co-creation Collaboration (models, process, steps) Community centric, in context	Very popular, especially amongst the youth Apply unassisted learning, minimal invasive education and peer learning Provide feedback on improvements to CSIR team Evolution since 2002	Importance of relationships for ERW Continuity of CSIR research team visiting them ICT Champions assisting them to use the ICT platform Social space – safe, sharing, supporting one another They weave baskets and sew and socialise (share information) while waiting Produce products for socio-economic development (knitting, weaving, and agricultural items) ERW are their own community in a specific rural context
Sustainability Measure impact/effect Benefits (value-in-use, value-in-context, value-in-exchange)	Monitoring and evaluation was done in 2014-2015 on success of the intervention. Evidence was found of value-in-use and value-in-context as well as value-in-exchange. Useful for school projects Educational games very popular	Benefits as discussed in section 6.4 above: user literacy, skills development, information as a resource, place to store personal information (create own profile), means of exercise, entertainment, intangible value, for example, empowerment, destressing, sense of purpose for ERW Using the ICT platform became part of their daily routine

Component name from initial framework (section 4.5)	ICT platform support for component (Section 4.5)	Data analysis results improving the initial framework and informing the intermediate co-creation design framework components
Scalability Longitudinal Infrastructure and content	In existence since 2002 Over 300 units distributed in South Africa Units also in Australia, Uganda, Solomon islands, Lesotho & Ethiopia	Upgrade the ICT platform with relevant content (agriculture and health). User experience of the interfaces of the ICT platform was enhanced. Chairs were added and the screen font was enlarged for readability purposes. The ICT platform is a longitudinal study (2013 – ongoing)
Education and Literacy Access	Purpose of platform is to influence skills and literacy gains Open source content and organised information and content on platform Open Access Leads to human capital development	Enjoyment of using the ICT platform for entertainment (educational games) add to gaining more skills (use ATM better). The illiterate ERW could eventually write their own names based on regularly using the ICT platform. Assisted one another to use the machine.
Policies and Frameworks Regulatory	Influence policy on skills and literacy Support National Development Plan	A holistic approach to any ICT4D project is to acknowledge other needs and connect the community to the right channels (e.g., the agricultural office in the Limpopo Province was alerted to assist the community to get access to water). The results can inform DST and DRDLR to improve their policies regarding the use of ICTs with ERW in agriculture

The data emanating from the application of structuration theory in Chapter 6 (and some evidence relating to theories for design and action, diffusion of innovation and socio-technical systems theory) supported the identified components found in the initial framework. It provided evidence through the co-creation and refinement of the ICT platform with the ERW and the CSIR team. These findings did not alter the initial framework, but enhanced theory relating to co-creation. In the next section, changes for improving the co-creation design framework (based on the empirical data) will be provided.

6.5.1 Other insights from data analysis informing the intermediate co-creation design framework

As can be seen from Table 6-9, the design activities were not applied in a linear fashion (as per the design process steps indicated in the initial co-creation framework). The

reasons were that the ICT platform was already part of an existing DD project (since 2002), and did not require design. In practise, the co-creation occurred through the application of the design thinking and value co-creation process steps (listen, identify, ideate, collaborate, evaluate and experiment) by the ERW and the CSIR team as needed. These steps were not iteratively repeated as they are explained in Figure 4.13, but were applied as reflected in Table 6.9. The implication of the way that design thinking was applied during co-creation will be incorporated in the intermediate co-creation design framework.

The application of structuration theory, as the main theory informing the data analysis, contributed to eliciting the influence of the social structures (signification, domination and legitimisation) on the co-creation design process. This is highlighted under section 6.2.3. The application of structuration theory did not lead to any changes to the intermediate co-creation design framework, as it was useful as applied. The theory added value in that unexpected findings emerged from its application, which highlighted value-in-context and value-in-use (Ranjan & Read, 2016).

The data analysis allowed for visualisation of the initial framework to be adapted to indicate the change in applying the participatory design thinking process steps, as shown in Figure 6-3.
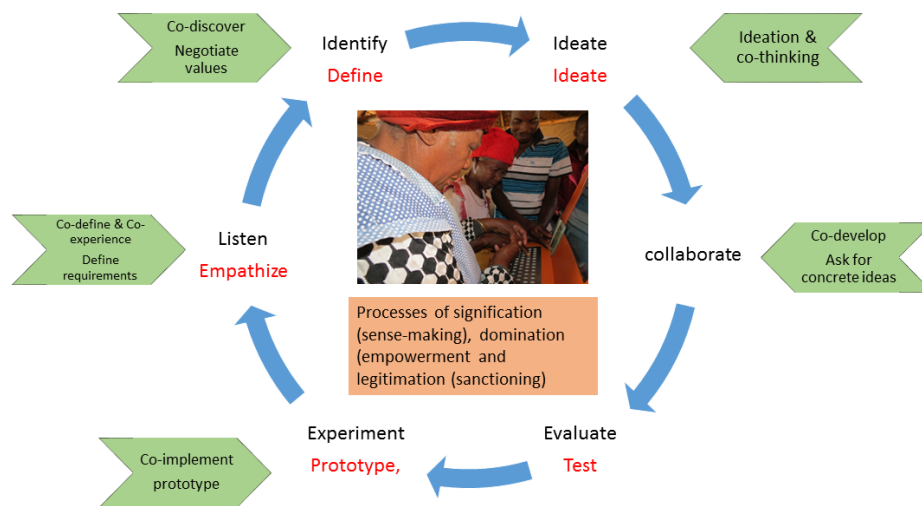
Figure 6-3: Adapted co-creation design process based on data analysis

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6.6 SUMMARY

Chapter 6 provided the results from the data analysis and indicated the design activities that formed part of the co-creation process. It was found that the ERW derived various benefits as a result of refining the ICT platform. The benefits included the improvement of the ERW's literacy skills, and the use of the health and agricultural information on the ICT platform to increase their knowledge and grow crops more effectively. The ICT platform was viewed by the ERW as a place to store their personal information, a means of exercise and a means of entertainment. They indicated that the educational games on the ICT platform allowed them to escape their own realities and this they enjoyed a lot. Some unexpected benefits were also reported. The ICT platform provided the ERW with a sense of purpose, relieved their stress and empowered them as ERW in their community. In addition, their confidence to use technology increased, as could be seen in the example of the woman who started using an ATM without assistance because of her exposure to the ICT platform.

This chapter further shows how the results of the data analysis were mapped to the initial framework in order to develop the intermediate framework. It was indicated through a figure how the co-creation design process steps were altered based on the findings from this chapter. Chapter 7 will provide the intermediate framework as well as the final framework (after experts reviewed and validated the intermediate framework).

CHAPTER 7: EVALUATING THE ARTEFACT TO BECOME THE FINAL FRAMEWORK

7.1 INTRODUCTION

Chapter 6 concluded with the data analysis results and explained how the initial framework components were mapped to the results. The main finding in Chapter 6 was that the participatory design thinking and value co-creation process steps cannot function in a linear way as originally indicated (Figure 4.13). The reason for this is that both the ERW and the CSIR research team altered the way in which these steps were applied, based on needs requirements and various alterations to the ICT platform during each site visit.

This chapter provides the information on the intermediate framework as well as its evaluation (*cf.* Chapter 2; section 2.5.2). It addresses the fourth sub-research question:

- **SRQ4:** What role does the combination of the social interplay between all role players and the design process have on the ICT platform, as well as on the co-creation design framework?

The chapter focuses on Phase 3: Refine, reflect and validate, of the development of the co-creation design framework, as outlined in Figure 7.1:
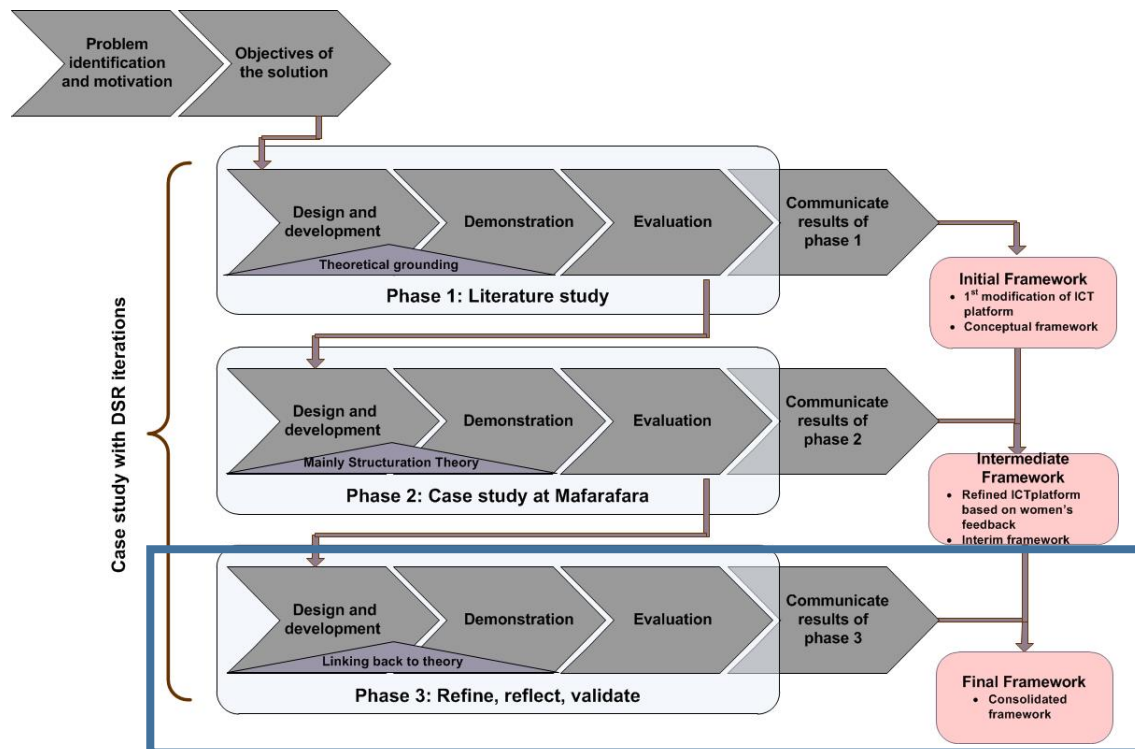
Figure 7-1: Addressing phase 3 of the DSRM process model of Peffers *et al.* (2007)

7.2 THE INTERMEDIATE CO-CREATION DESIGN FRAMEWORK

As was indicated in Chapter 6, the intermediate co-creation framework was improved through the feedback obtained from the ERW during the seven site visits as well as through technical improvements based on the needs and requirements of the ERW. The ERW's feedback was used to refine the ICT platform in Phase 2 (case study in Mafarafara). At the end of Chapter 4, the initial co-creation design framework was presented (section 4.5) following the literature studies of Chapters 3 and 4 (Phase 1 of the research process). It was summarised in Table 4.3 and visually in Figure 4.13. These summaries will now be provided again, so as to indicate how Chapters 5 and 6 (Phase 2 of the research process) have culminated in combining the components identified in the initial framework with the data analysis. The analysis of the data from the case study (ERW in Mafarafara) was predominantly influenced by structuration theory (Giddens, 1984), while the development of the framework was also influenced by the theory for design and action (such as design thinking) and socio-technical systems theory (*cf.* section 2.6).

Table 4.3 indicated that the following components (depicted in Table 7.1) are essential to develop the initial co-creation design framework.

Table 7-1: Components of the initial co-creation design framework

Component name	Chapter 3 Component	Chapter 4 Component	ICT platform support for component
Socio cultural Socio-technical Needs and Requirements of ICT and ERW Empower Minimize isolation Values, structures, traditions, agency and structure	2 (isolation and socio-cultural traditions), 7 (social values) 4 (agency and structure) 5 (ICT meeting needs and requirements) 3 (empowerment of ERW)	2 (ICT4D is a socio-technical activity) 9 ICT4D acknowledge social structures) 5 (Contribution of ICT4D to empower, bring economic, political and socio-economic development) 4 (Active participation, community centric) 8 (ICT4D affect whole system)	Co-created and co-designed based on needs and requirements of the various communities (resource deprived and rural) Vandal proof Use ICT Champions from the community to do support and maintenance User create own account and profile Acknowledge social structures as well as agency
Participation Co-creation Collaboration	11 (Participatory design process) 12 (Models of co-creation)	4 (Active participation, design approach, community centric)	Very popular, especially amongst the youth Apply unassisted learning, minimal invasive education and peer learning

Component name	Chapter 3 Component	Chapter 4 Component	ICT platform support for component
(models, process, steps) Community centric, in context	10 (Design process of co-creation) 8 (Collaboration/collab orative innovation in context that are community focused)		Provide feedback on improvements to CSIR team Evolution since 2002
Sustainability Measure impact/effect Benefits (value-in-use, value-in-context, value-in-exchange)	9 (Benefits of co-creation)	6 (sustainability of ICT4D projects) 3 (Measure effect/impact of ICT4D and Monitoring and evaluation)	Monitoring and evaluation was done in 2014-2015 on success of the intervention. Evidence was found of value-in-use and value-in-context as well as value-in-exchange. Useful for school projects Educational games very popular
Scalability Longitudinal Infrastructure and content	6 (Infrastructure and content)	10 (Scalability of ICT4D)	In existence since 2002 Over 300 units distributed in South Africa Units also in Australia, Uganda, Solomon islands, Lesotho & Ethiopia
Education and literacy Access	1 (Education and literacy levels and skills of ERW)	7 (Access to technology is not only about availability)	Purpose of platform is to influence skills and literacy gains Open source content and organised information and content on platform Open Access Leads to human capital development
Policies and frameworks Regulatory	1 (Education and literacy levels and skills of ERW)	1 (Nature of ICT4D) 11 (Acknowledge policies and regulatory frameworks)	Influence policy on skills and literacy Support National Development Plan

These components were then visualised to provide Figure 4.13 (depicted in Figure 7.2):
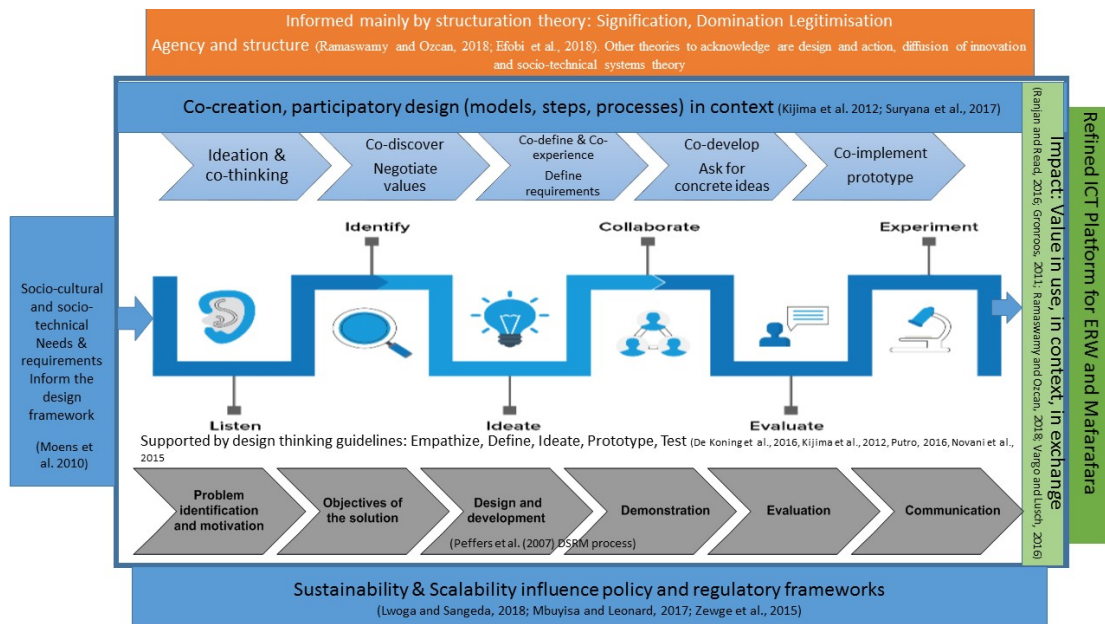
Figure 7-2: Visualised initial co-creation framework

The main results were provided in Table 6.10, based on the empirical evidence (case study in Mafarafara where the ERW and the community refined the ICT platform with the CSIR team) and the application of structuration theory (to indicate the influence of the social interplay between role players on the refinement of the ICT platform). Based on the mapping of the components to the data analysis results, it was found that the same components still apply, but that the way in which the participatory design thinking and value co-creation process steps were applied were altered, as is indicated in Table 7.2.

Table 7-2: The different participatory design and value co-creation processes and steps followed by ERW compared to the CSIR team

ERW design activities	ERW activities	Site visit #	CSIR team activities	CSIR team design activities
Listen	Mma C agrees to participate Mma C enrols ERW	Prior	Prior learning from rural DD projects Identify need for ERW study Identify Mafarafara site Establish relationship with Mma C	Identify
Listen Evaluate	ERW share contextual information ERW evaluate desirability of project	1	Introduce project Obtain ethical consent	Listen Ideate
		1a	Pre-installation site inspection	Identify

ERW design activities	ERW activities	Site visit #	CSIR team activities	CSIR team design activities
Collaborate Experiment	Help install ICT platform Participate in training Share information on livelihoods	2	Install ICT platform Give training Interview ERW on livelihoods First update of ICT platform	Collaborate Listen
Collaborate Experiment Identify	Assist each other with use Maintain and clean venue Share info on use and further needs	3	Assess use of ICT platform Identify further needs	Evaluate Listen Identify
		3a	Upgrade solar panels Update information base	
Collaborate Experiment Identify	Share use experiences and info on further needs Assist each other with use	4	Evaluate use of ICT platform Identify further needs	Evaluate Listen Identify
Collaborate Experiment Identify	Share use experiences and info on further needs Assist each other with use	5	Evaluate use of ICT platform Identify further needs	Evaluate Listen Identify
		5a	Remove ICT platform for maintenance and updates	
Collaborate Experiment	Share enthusiasm for returned ICT platform Use updated ICT platform and give feedback	6	Re-install ICT platform Install new printer	Evaluate
Collaborate	Share plans and activities towards new building	7	Assess storm damage Arrange temporary safekeeping of ICT platform	Listen Identify
	Progression with new building	After		

It is evident that the process steps were applied differently at each site visit, especially between the CSIR research team and the ERW. Based on this finding, the co-creation design framework has to be adapted to accommodate this change. The resulting intermediate framework is now visualised in Figure 7.3.
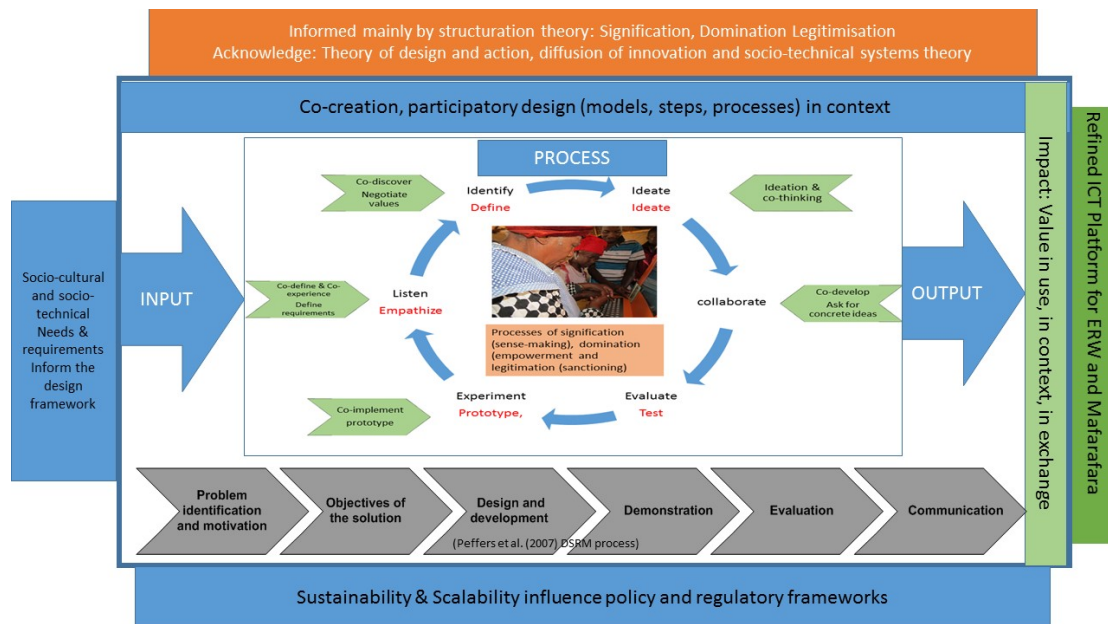
Figure 7-3: The intermediate co-creation design framework

This visualised intermediate co-creation design framework was subsequently evaluated and validated by means of expert reviews.

7.3 EXPERT REVIEWS

In Chapter 2, an approach to the evaluation of the product of this research was defined (see section 2.5.3), based on an integration of the work on artefact evaluation in Design Science Research by Prat *et al.* (2014) and Venable *et al.* (2016). As indicated by Meyer (2018), 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, Henningsson, Hrastinski & Keller, 2011)."

With expert reviews, one can evaluate the usefulness of an artefact and not include an end user (Carlsson *et al.*, 2011). Expert reviews constitute an accepted method to "gather meaning, experiences and insights from (domain) experts" (Iivari, 2007:12). Experts "are more adept at assessing possibilities, judging problems, and proposing solutions" (Chen, Khoo & Yan, 2003:5; Chen, 1995).

The derived approach was translated into an evaluation strategy as described by Hevner *et al.* (2004). The focus of the evaluation of the co-creation design framework is on its utility. 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 development of the expert review instrument is outlined in the next section.

7.3.1 Expert review focus

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 co-creation design framework) is outlined. Gregor and Hevner (2013) identify four criteria for the evaluation of an artefact:

Validity indicates if the intended goal was achieved or not and if the artefact will do as was expected;

Utility focus more on how useful the artefact is and also the value it will have.

While quality and efficiency are listed but not explicitly defined, but one can assume that the focus is on how efficient the artefact will be and also what the quality of it will be to the intended users.

7.3.2 The experts identified for this study

Experts were selected from the following areas: ICT4D, academia specialising in DSRM, ethnography, and industry working with rural communities. The reviewers included practitioners and researchers; some of the reviewers function in both of these roles. The selection of experts was based on their accessibility and ability to participate (i.e., convenience sampling was used) (Saunders, Lewis & Thornhill, 2016). Experts were selected that did not have previous exposure to the work, to ensure a non-biased review. Five reviewers completed the evaluation questions on the co-creation design framework. Their fields of expertise and experience are summarised in Table 7.3:

Table 7-3: Details about the expert reviewers

Reviewer	Field of expertise	Role	Years of experience
Reviewer 1	ICT4D	Academic	8
Reviewer 2	Specialist in DSRM	Academic	4
Reviewer 3	Ethnographer	Practitioner	9
Reviewer 4	ICT4D working with women	Academic	3
Reviewer 5	Industry working in rural communities	Practitioner	12

An electronic questionnaire (see Appendix D), facilitated by the SurveyMonkey© web interface (Waclawski, 2012), was distributed to reviewers. They were introduced to the research, and invited to participate, via e-mail. Following their agreement to participate, they were provided with a the link to the survey; the latter provided a brief description of the work, as well as links to a somewhat more detailed description of the various framework elements. The results of the experts are provided in the next section.

7.3.3 *Results from expert reviews*

The results are provided through descriptive statistics and then interpreted to provide a general synthesis of their feedback for each section of the questionnaire (Appendix D).

7.3.3.1 Demographics results

The demographics section of the questionnaire to the expert reviewers only asked information about their years of experience and their gender.

- **Years of experience**

The following graph provides the information on their years of experience:
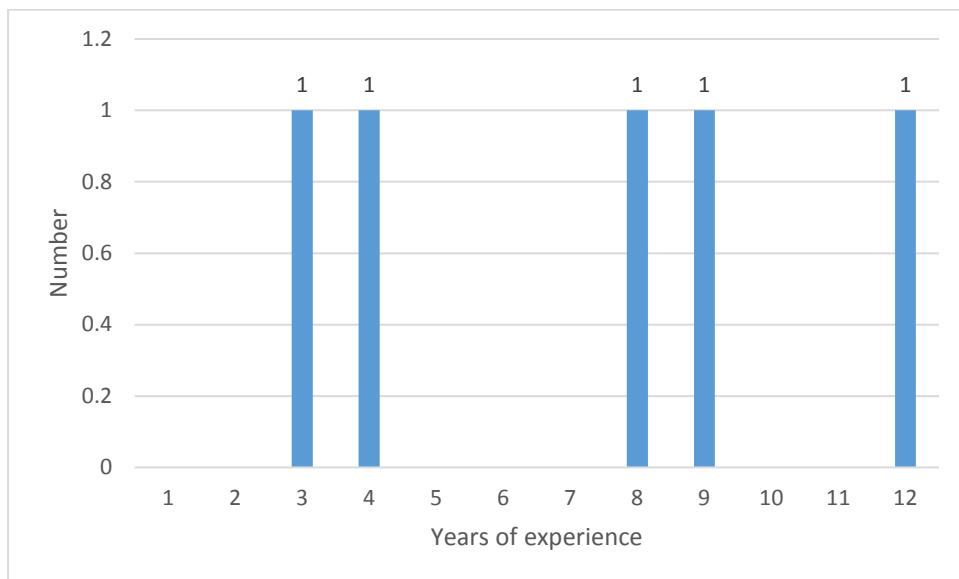
Figure 7-4: Expert reviewers and their years of experience

Two of the experts had between one and five years of experience, two had between six and nine years and one had more than 12 years of experience.

- **Gender**
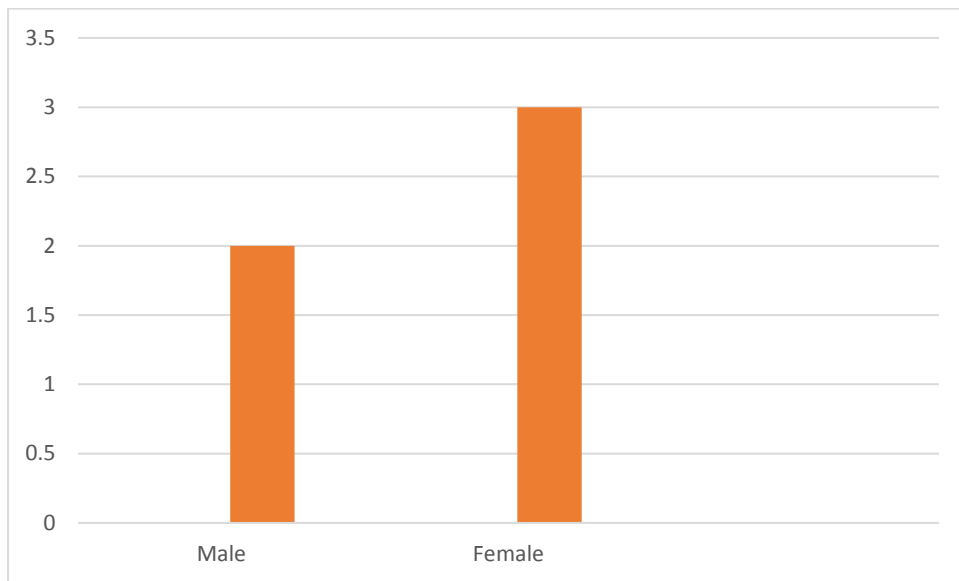
Figure 7-5: The gender of the expert reviewers

There were more females than males who were used as expert reviewers.

7.3.3.2 Various questions relating to specific evaluation criteria of the framework

The following table depict the questions relating to the validity, utility, quality and efficiency of the framework that experts had to provide feedback on:

Table 7-4: Questions relating to the evaluation of the framework

Type of question	Questions
Questions on Validity	How relevant is the framework for the ICT4D research and for those working with ERW in resource constrained environments? Rate the adequacy of the framework for working with ERW in ICT4D contexts.
Questions on Utility	Any omitted elements or components in your opinion?
	Do you expect the application of the framework to produce useful results if used in your context?
Questions on Quality	Is the framework simplistic enough to understand?
Questions on Efficiency	How relevant is each of the components in the Table above? How important (in your opinion) is each of the components?

These questions can also be found in Appendix D.

7.3.3.3 Results from questions on validity

- **How relevant is the framework to ICT4D research and for those working with ERW in resource-constrained environments?**
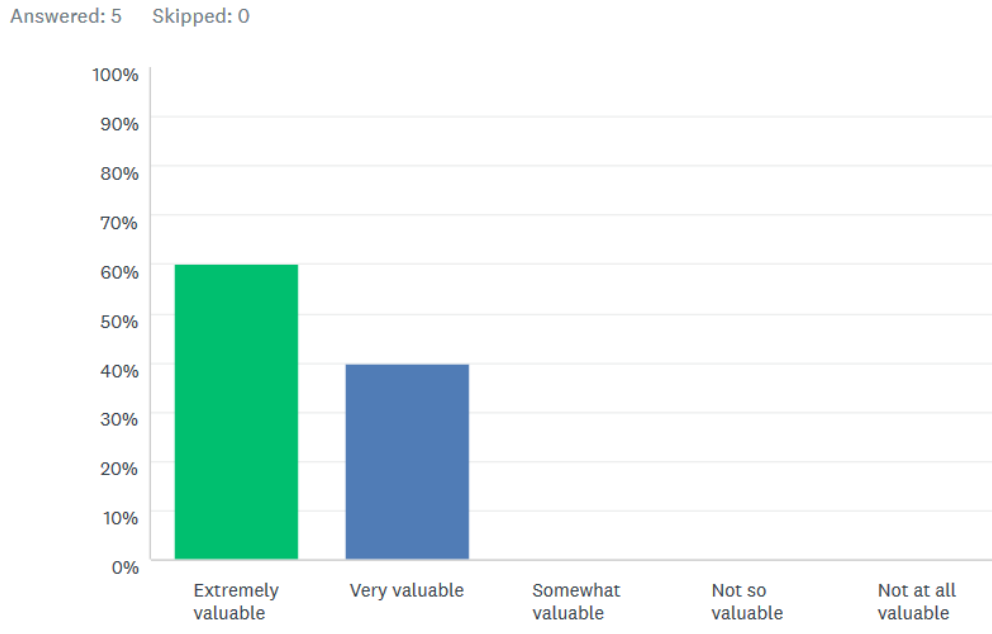
Figure 7-6: Relevance of the framework to ICT4D researchers working with ERW

Figure 7.6 shows that 60% of the expert reviewers indicated that the framework is extremely valuable for ICT4D researchers and those working with ERW in resource-constrained environments, while 40% indicated that it is very valuable.

- **Rate the adequacy of the framework for working with ERW in ICT4D contexts.**
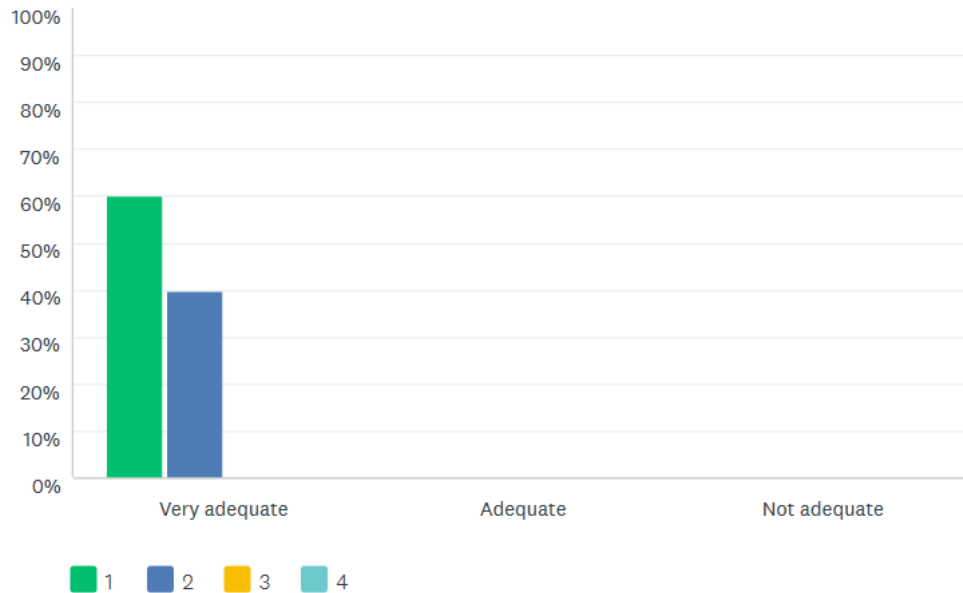
1=extremely adequate, 2=very adequate, 3=adequate and 4=not adequate

Figure 7-7: Adequacy of framework when working with ERW in ICT4D contexts

According to Figure 7.7, 60% of the expert reviewers indicated that the framework is extremely adequate for working with ERW in ICT4D contexts, while 40% indicated that the framework is very adequate. Most of the experts therefore thought that the framework is more than adequate.

Based on these findings, one can deduce that the framework is valid.

7.3.3.4   Results from the questions on utility

- **Any omitted elements or components in your opinion.**
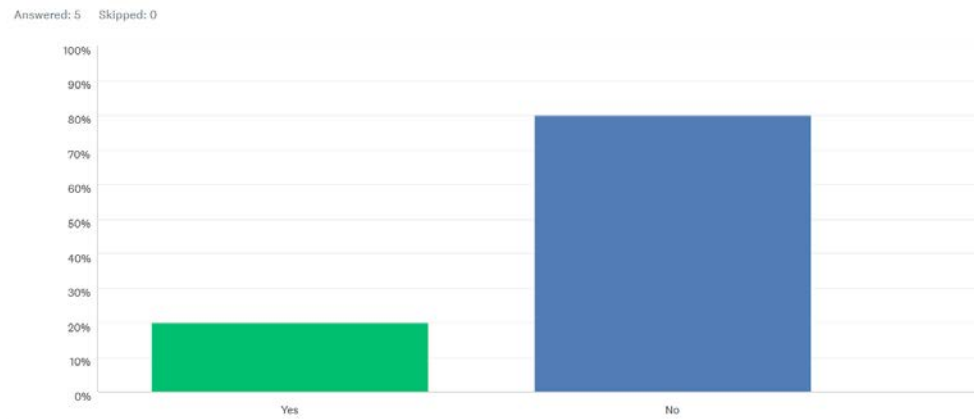
Figure 7-8: Omitted components (if any)

Figure 7.8 shows that 90% of reviewers indicated that there is no component omitted. The one expert who did indicate that there is a component missing did not provide a reason or a suggestion to add another specific component. It can be assumed that this expert might have misinterpreted the question. This is a valuable result, as it provides evidence that the experts found the framework to be complete.

- **Do you expect the application of the framework to produce useful results if used in your context?**
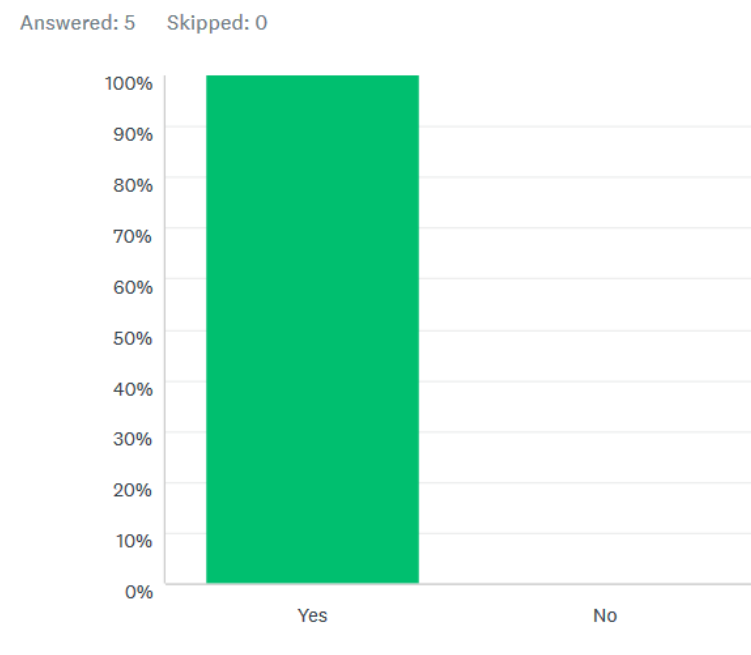
Figure 7-9: Can the framework produce useful results?

From Figure 7.9, it is clear that all of the experts indicated that the co-creation design framework can produce useful results.

Therefore, the framework is useful and has utility in the ICT4D context as well as when working with ERW.

7.3.3.5   Results from the question on quality

- **Is the framework simplistic enough to understand?**
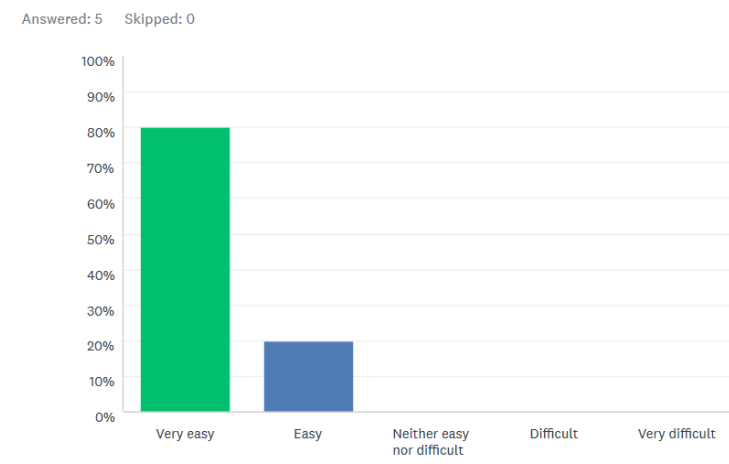
Figure 7-10: Simplicity of framework

Figure 7.10 indicates that 80% of the experts found the framework to be very easy and simplistic, while 20% indicated that it is easy. Therefore, the framework was found to be of high quality.

7.3.3.6 Results from the question on efficiency

- **How relevant is each of the components in the Table?**
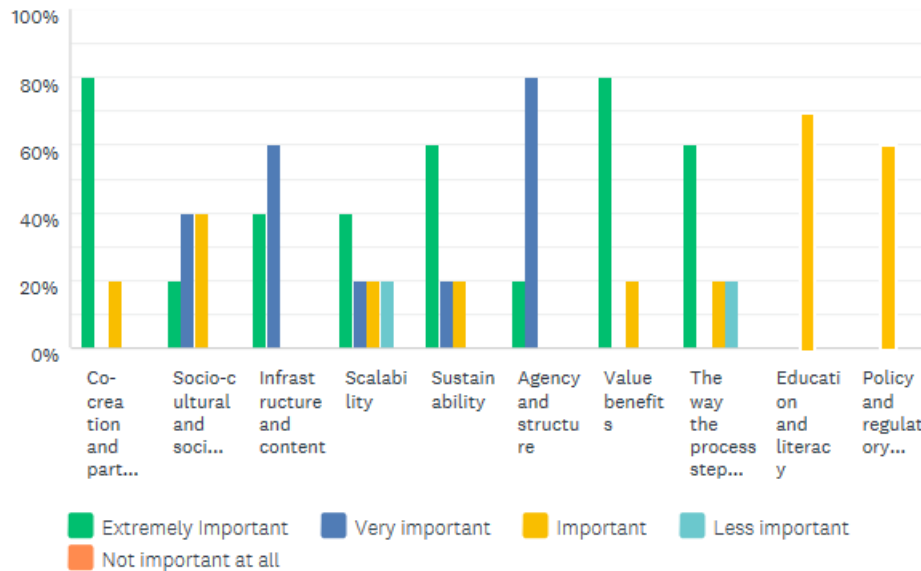
1=least relevant and 4=most relevant

Figure 7-11: Relevancy of the components

Figure 7.11 provides evidence to suggest that 80% of the expert reviewers indicated that sustainability, value benefits, education and literacy and access as well as policy and regulatory frameworks are the most relevant components; 60% indicated that co-creation, infrastructure and content as well as agency and structure are most relevant; and 40% rated that co-creation and participation, infrastructure and content and agency and structure as well as education and access are relevant. The least relevant component was scalability. Therefore, the most relevant components are sustainability, value benefits, infrastructure and content, agency and structure, co-creation and participation followed by the socio-cultural and socio-technical component and lastly scalability.

- **How important (in your opinion) is each of the components?**
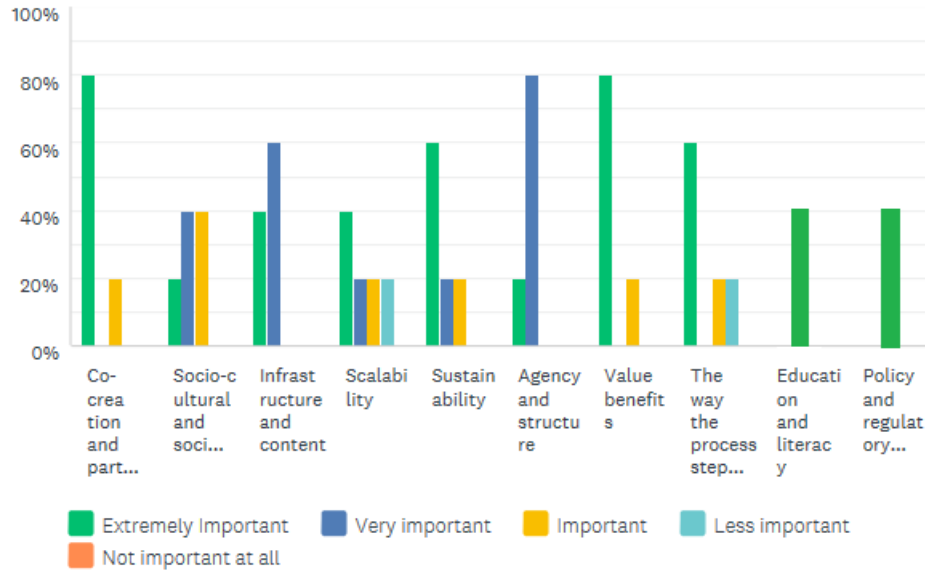
Figure 7-12: Importance of each component

Figure 7.12 indicates that the expert reviewers ranked *co-creation and participation*, as well as *value benefits*, as the most important components (extremely and very important), with a score of 80%. At 60%, the most important components are *infrastructure and content*; *sustainability*; *agency and structure* and *the way the process steps flow*. At 40%, two components were considered as extremely important, namely, *education, literacy and access*, and *policy and regulatory frameworks*. *The way in which the process steps flow* was the only component that got a 20% ranking for less important and important. Scalability was scored at 20% importance, and some ranked sustainability in the same manner. None of the components were found to be not important at all.

Therefore, based on the results from both the questions on efficiency, one can deduce that none of the components were irrelevant or not important, and that the most important and relevant component was the value benefit followed by co-creation and participation, infrastructure and content and agency and structure. Less important was the way the process flows. The framework is therefore efficient.

7.3.3.7 Results on strengths and weaknesses and additional comments

- **Strengths**

Most of the reviewers (90%) indicated that the strengths of the framework lies in the fact that it is "grounded in the recommendations of the latest literature on ICT4D that focuses strongly on the involvement of women in ICT4D projects". A further strength is that the "co-creation processes were combined to be different for ERW compared to the CSIR team that developed and improved the ICT platform to suit the needs of the ERW". The "longitudinal study" is also considered a strength, as short pilot projects often fail. One expert reviewer indicated that "the framework is very valuable in developing countries" and also mentioned the focus and "value of sustainability and scalability". The use of structuration theory also provided depth and "rich data" that proved the relevance of the results in the table provided. The "visualisation is also an added strength as it portrays the adequacy and rigour to the components". Another strength is that the ICT platform content was adapted to suit the needs of the ERW. The benefits that ERW gained from using the ICT platform were also seen as very valuable to add to the theory of ICT4D research. One indicated that the framework is "unique and novel".

- **Weaknesses**

Most of the reviewers (90%) indicated that the framework does not have any obvious weaknesses. One mentioned that provision of implementation guidelines would be an advantage.

- **Additional comments**

Only two expert reviewers provided additional comments:

"In my opinion as ethnographer I think this will assist me when I work with women again in rural areas as I have mostly found that these elderly women (above 65 years) are the ones who are the pillars of the community and if they accept technology the others soon follow suit".

"The co-creation design framework in my opinion is a good combination of process steps and also to see the dynamic in applying these processes during the co-creation was valuable".

"Looking forward to additional implementation".

It is evident from the results of the expert reviewers that they felt that none of the components should be deleted and also that none has to be added.

The ranking of the components according to relevance and importance can be used to number the components in the framework according to most important and relevant.

7.4 THE FINAL CO-CREATION DESIGN FRAMEWORK FOR ERW

If one has to rank the relevance and importance of the components of the co-creation design framework, the table will be adjusted as follows:

Table 7-5: Ranking the components according to relevance and importance (1=most important and 9=least important)

Component name	Most relevant and important
Benefits (value-in-use, value-in-context, value-in-exchange)	1
Participation, Co-creation, Collaboration (models, process, steps), Community centric, in context	2
Infrastructure and content	3
Education, literacy and access	4
Policy and regulatory frameworks	5
Agency and structure that includes needs and requirements of ICT and ERW, empower, minimize isolation, values, structures, traditions	6
Socio cultural, Socio-technical, Education and literacy	7
Sustainability, scalability	8
The way the process steps flow	9

Therefore, the intermediate framework stays the same when it becomes the final framework, as depicted in Figure 7.13.
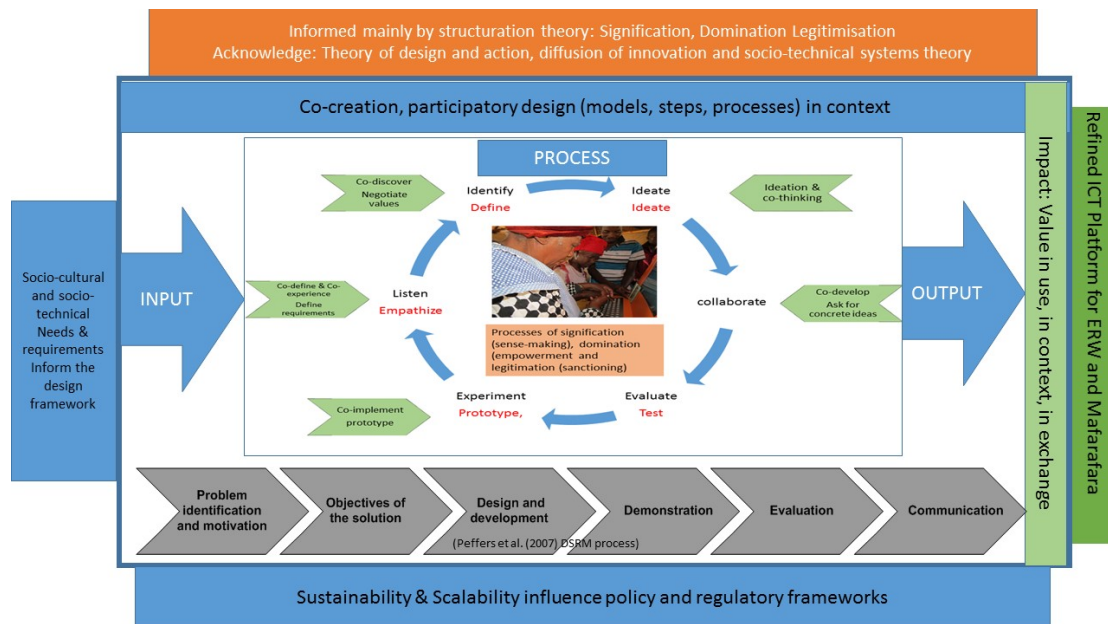
Figure 7-13: Final co-creation design framework

The components in Table 7.4 are not all provided in the visualisation in Figure 7.13, as they are summarised in the blue and orange areas in the figure. In the middle of the framework, one can find the combination of the participatory design and value co-creation process steps. It falls under the process part of the framework. The inputs are provided by the requirements, context and needs in the socio-technical domains, which also include socio-cultural aspects. The outputs are the value and benefits of value in use, value in context and value in exchange that the process has provided when co-creating and refining an ICT platform with ERW in a rural context. The outputs also include this refined ICT platform that was improved based on the inputs and the process. The framework is informed by the theories at the top, and is supported by the sustainability and scalability as well as policy and regulatory frameworks at the bottom. The final framework was found to be relevant, valid, adequate, efficient, and to have quality and utility.

7.5 SUMMARY

This chapter provided a discussion on how the initial co-creation design framework was adapted, based on the case study results, to become the intermediate framework. The expert reviews concluded that none of the framework components should be omitted, neither that another component should be added. Only the ranking of most relevant and most important components were added, and this was found to be valuable. The visualisation of the final co-creation design framework did not change (see Figure 7.13).

Chapter 8 focuses on summarising the research, and on addressing the answers to each research sub-question and the main research question. Contributions, limitations, reflections and the way forward concludes the chapter.

CHAPTER 8: SYNTHESIS OF FINDINGS, DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

8.1 INTRODUCTION

This final chapter reflects on and provides conclusions for investigating the problem, its formulation, the project objectives and the knowledge gained. Key findings are summarised and recommendations are made about the co-creation design framework. The purpose of the study was to develop a co-creation design framework for ERW in Mafarafara (area in Limpopo province of South Africa) that incorporates the implications of the social interplay within the community.

The objectives of the study, as presented in Chapter 1 section 1.4, were firstly to investigate an appropriate design process and frameworks to use when designing and refining an ICT platform with ERW in Mafarafara. The second objective was to conduct a literature study on the challenges faced by ERW in an ICT4D context in order to inform the appropriate design approach and process. This was necessary in order to identify the benefits of using co-creation as a means to refine an ICT platform in the context of the challenges faced by ERW and ICT4D initiatives. Structuration theory was used as a lens to analyse the social interplay between the different role players involved in the co-creation design process of the ICT platform, by analysing qualitative data collected from the ERW during research site visits; this informed the development of the co-creation design framework. The development of the framework was taken through the Peffers *et al.* (2007) design science research process in three phases (Figure 2.6).

8.2 RESEARCH OVERVIEW

The research problem of the study was informed by academic literature on ERW in rural communities in order to understand their plight, as well as by ICT4D research which indicated that the voices of women are not necessarily heard in ICT4D projects. ERW need to be empowered to improve their socio-economic situation in the rural areas where they stay. Women are often regarded as the custodians of their communities, who provide in every day needs; if they can be involved in co-creation of artefacts that improve their quality of lives, then the socio-economic development objective of ICT4D research is achieved. The lack of evidence in the literature of a co-creation design framework that specifically focuses on ERW led to this study and underpins its

rationale. Based on the background, problem statement and rationale for the study, the main research question for the study was formulated as: *What components should the co-creation design framework include when refining an ICT platform with Elderly Rural Women (ERW) in South Africa?* (*cf.* section 1.3).

The following sub-research questions were defined in support of the investigation of the main research question:

- What is an appropriate design process to follow when refining an ICT platform to support ERW in Mafarafara? (Chapter 3;4)
- What challenges related to ERW and ICT4D initiatives need to be considered in the design process? (Chapter 3; 4)
- How does the social interplay amongst the different role players influence the refinement of an appropriate ICT platform? (Chapter 5; 6)
- What role does the combination of the social interplay between all role players and the design process have on the ICT platform as well as the co-creation design framework? (Chapter 6; 7)

During the execution of the research, the artefact (framework) was developed by investigating literature as well as through collecting and analysing data from ERW in Mafarafara (Limpopo Province of South Africa). Experts also evaluated this artefact in order to validate its usefulness (Chapter 7). The following section presents evidence that the research questions were answered by showing where in the study each was addressed and by briefly describing the findings.

8.3 THESIS QUESTIONS ANSWERED

The investigation into the components that constituted a co-creation design framework when refining an ICT platform with ERW in South Africa (main research question), was successfully conducted. Research to address each sub-research question assisted in addressing the main research question by serving as building blocks towards the construction of the co-creation design framework.

8.3.1 First and second sub-research questions answered

Information about addressing the first and second sub-research questions is presented in Table 8.1. It is shown that the literature review led to a clear comprehension of an appropriate design process that should be followed when refining an ICT platform to

support ERW in Mafarafara. The challenges faced by ERW and ICT4D projects were also highlighted in Tables 3.1 and 3.2 in Chapter 3. Furthermore, a synthesis of exemplars of various existing co-creation frameworks found in the literature informed the proposed initial co-creation design framework.

Table 8-1: Sub-research question one and two answered

Topic	Description
Sub-research question 1 and 2: Addressed in: Main findings (outputs):	SRQ 1:An appropriate design process to follow when refining an ICT platform to support ERW in Mafarafara SRQ 2: Challenges related to ERW and ICT4D initiatives for consideration in the design process
	Chapter 2, 3 and 4
	Addressing SRQ1: The methodology chapter (Chapter 2) provided the DSRM process of Peffers *et al.* (2007) was applied to develop the co-creation design framework (Figure 2.6).
	Chapter 3 provided literature on co-creation processes such as listen, identify, ideate, collaborate, evaluate and experiment and that real value lies in process steps such as co-experience, co-definition, co-elevation and co-development that empowers and create belongingness. Co-creation components such as participation, value, improvement of knowledge, agreement, governance and community-focused approaches were identified. Three co-creation models/frameworks were identified to be of significance (Khumalo & Pather, 2018; Ramaswamy & Ozcan, 2018; Durugbo & Pawar, 2014) as the combination of components from these three assisted in building the co-creation design framework from literature.
	Addressing SRQ 2: The literature in Chapter 3 indicated that ERW have to face challenges related to illiteracy, power struggles between genders, cultural attitudes are not respected, access to resources, where women have less power, time constraints as they have to walk far, training and capacity building is not focused on needs of women, recognising women as knowledge producers. Chapter 4 focused on challenges of ICT4D projects that fail because needs of communities are not supported, the usefulness of the ICT in context is not recognised, not everyone (especially not women) participate in co-creation, social structures are not acknowledged, women should also be engaged in dialogue on improving ICTs.

8.3.2 *Third sub-research question answered*

During the examination of the second sub-research question, structuration theory was applied to determine how the social interplay among the different role players influence the refinement of an appropriate ICT platform in Mafarafara. Table 8.2 shows that the enquiry into this sub-research question was presented in Chapters 5 and 6.

Table 8-2: Sub-research question 3 answered

Topic	Description
Sub-research question 3: Addressed in: Main findings (outputs):	SRQ 3: The social interplay amongst the different role players influencing the refinement of an appropriate ICT platform.
	Chapters 5 and 6
	A description was given of how the social structuration processes as per structuration theory's dimensions of signification, domination and legitimisation informed the refinement of the ICT platform. The feedback from the ERW was applied to refine it and to base it on their needs in their context to assist them with agricultural activities and to improve the products they sell to improve their socio-economic status. The influences of the theory for design and action together with the theory of diffusion of innovation and the socio-technical systems theory were also provided, where applicable, in Chapter 6.

8.3.3 Fourth sub-research question answered

Addressing the fourth sub-research question of the study involved the activities of demonstration and evaluation of the newly developed co-creation design framework as described in Chapter 7, with implications identified from Chapter 6.

Table 8-3: Sub-research question 4 answered

Topic	Description
Sub-research question 4: Addressed in: Main findings (outputs):	SRQ 4: The role that the combination of the social interplay between all role players and the design process has on the ICT platform as well as on the co-creation design framework.
	Chapters 6 and 7
	This question is answered in Tables 6.10, 7.1, 7.2 and Figure 6.3 and 7.3 where it is indicated that the feedback of the ERW to refine the ICT platform could inform the development and improvement of the theoretical or initial framework in Chapter 4.

8.3.4 Main research question answered

Conclusions drawn from the literature reviews that were conducted to answer the first four sub-research questions informed, and were used, as building blocks in the construction of the co-creation design framework. The final framework is discussed and explained in Chapter 7 (*cf.* Figure 7.13). Feedback from the expert reviews was incorporated to provide the final framework.

Table 8-4: Main research question answered

Topic	Description
Main question: Addressed in: Main findings (outputs):	The components of the co-creation design framework when refining an ICT platform with Elderly Rural Women (ERW) in South Africa
	Chapters 3 to 7
	The components indicated in the initial framework (Table 4.3), as identified from literature, were repeated in Table 7.1: • Socio cultural, Socio-technical, Needs and requirements of ICT and ERW • Agency and structure, Empowerment, Minimize isolation, Values, structures, traditions, • Participation, Co-creation, Collaboration, (models, process, steps), Community centric, in context • Sustainability, Measure impact/effect • Benefits (value-in-use, value-in-context, value-in-exchange) • Scalability, Longitudinal • Infrastructure and content • Education and Literacy, Access • Policies and Frameworks, Regulatory The components were visualised in the initial framework in Figures 4.13 and 7.2). The components did not change in either the intermediate framework or the final framework. The only adaptation was made in the visualisation of the intermediate and final framework related to the flow of the process steps. A co-creation design framework should include the components that are provided in bullet form in Table 8.4, and should also allow for participatory design and value-co-creation with design thinking processes and steps to differ between the co-creators and the developers. Figure 7.13 provides the visualisation of all the important components, and also indicates the value benefit during the output stage. The process is in the middle, and the inputs are the context and the socio-cultural and socio-technical issues thereof. The whole framework was developed by applying the DSRM process of Peffers *et al.* (2007).

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

8.4   SUMMARY OF THE RESEARCH DESIGN

The design science research process (DSRP) model (Figure 2.5 and 2.6) for producing and presenting information systems research, as suggested by Peffers *et al*. (2007, p. 93), underpinned the research process of the study. The research process of the study is illustrated in Figure 8.1 and extensively explicated in Chapter 2 (section 2.5). The

shaded part of Figure 8.1 situates this chapter within the research process of the study. The phases of the research process are briefly described as follows:

Phase 1: The study was introduced, and the background to the study, problem statement, purpose and research questions were presented. This phase relates to the first activity in the DSRP model proposed by Peffers *et al.* (2007), which is: *identification of problem and motivation of relevance*. Chapter 1, 2, 3 and 4 were the outputs of Phase 1. This Phase focused on investigating the literature to determine the components when co-creating with ERW in ICT4D contexts.

Phase 2: The case study and data collection during seven site visits to Mafarafara were part of this phase. It also included the data analysis outlined in Chapter 6. The findings were mapped with the participatory design processes, as well as with those components from the value co-creation process, and it was evident that the ERW applied these process steps differently compared to the CSIR research team (developers) during the refinement of the ICT platform. This finding informed the revision of the initial co-creation design framework to become the intermediate co-creation design framework.

Phase 3: Phase 3 corresponds to the second DSRP model activity (Peffers *et al.*, 2007), which is: *evaluation*. Expert reviewers evaluated and validated the artefact, and did not add any new components; they also found the framework to be valuable, useful, efficient and of quality.
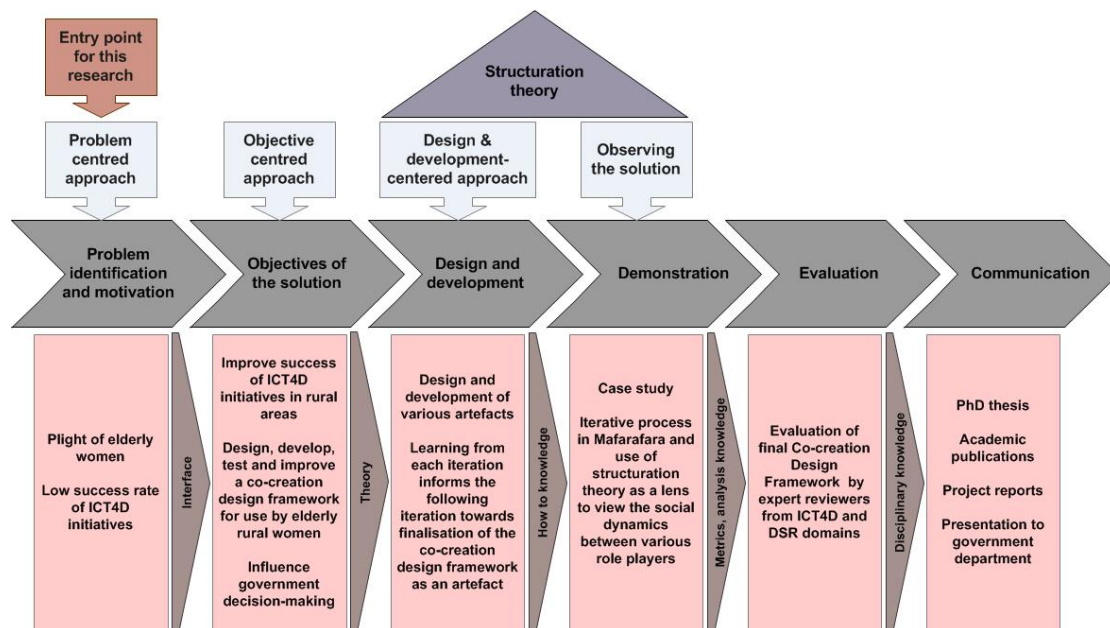
Figure 8-1: Research process as applied in this study

The next section presents a reflection on key findings of the research.

8.5   REFLECTION ON KEY FINDINGS

Extensive literature reviews culminated in the design, development and construction of the co-creation design framework as the required artefact of the study. The application of the developed artefact, in three phases, informed refinements to the artefact.

Key findings were as follows:

- The *initial framework* was informed by the literature study presented in Chapters 3 and 4. The initial framework presented in Table 4.3 and visualised in Figure 4.13 was the first building block towards the construction of the required artefact.

- The methodology, as presented in Chapter 3, was conducted to search for appropriate design approaches, models, steps and frameworks suitable for inclusion in the required artefact. Two co-creation models were found to be suitable (Figure 3.3 and 3.4), and a combination of these two were applied to develop the artefact. It was furthermore found that components from research on ERW and ICT4D, as well as the refinement and evolution of the ICT platform, were necessary to inform the artefact.

- The main finding of the study was that it was possible to design, develop and construct the required artefact, and to provide the components of a co-creation design framework (*cf.* Figure 7.13), which was presented in Chapter 7.

- It was furthermore found that the application of structuration theory in one case study (Mafarafara ERW) provided evidence of other important additions to the initial artefact to become the intermediate artefact (*cf.* Chapter 7).

- Experts reviewed the intermediate framework, after which it became the final framework. They also ranked the relevance and importance of the components in the artefact. This satisfied the requirements of design science research, for *evaluation and validation* of the artefact (*cf.* Chapter 7).

A brief overview of the structure of the thesis and the content of each chapter is presented in the following section.

In Chapter 2 (*cf.* Table 2.7), the following questions were asked that have to be addressed to ensure that all the correct criteria were applied in evaluating and developing the artefact (framework) in this study. These questions will now be addressed below:

- *What is the research question?*

This study has a main research question and four sub-research questions, as was indicated and answered in section 8.3.

- *What is the artefact?*

The artefact in this study is the co-creation design framework that was developed over three phases. The final framework is presented in Figure 7.13.

- *How is the artefact represented?*

It was represented in tables in Chapters 3 and 4, as well as through visualisations in Figures 4.13, 7.2, 7.3and 7.13.

- *What design processes will be used to build the artefact?*

A combination of various design thinking processes, participatory design processes as well as value co-creation processes were applied, as was explained in Figure 4.13.

- *How are the artefact and the design processes grounded by the knowledge base?*

It was grounded by identifying components from literature in Chapters 3 and 4, as well as demonstrating and improving it from data collection and analysis from Chapters 5 and 6, and finally validating it with expert reviews.

- *What, if any, theories support the artefact design and the design process?*

Structuration theory of Giddens (1984) was the main theory that was applied during the data analysis; it was used as a lens to understand the interplay between various stakeholders and participants as agents in the social structure of the Mafarafara community. Theories for design and action (participatory design, design thinking and value co-creation) were also applied to design the artefact during Phase 2. The last theory to recognise as also playing a minor role in Phase 2 was the socio-technical systems theory, where the dynamic between the social system and the technical system in specific contexts is recognised and addressed.

- *What evaluations are performed during the internal design cycles?*

The co-creation design framework (artefact) was evaluated by using an observational method (case study in Mafarafara on refining the ICT platform) as well as a descriptive method (demonstrate utility through expert reviews). The ERW in Mafarafara provided feedback on how their needs could be met by the ICT platform. This allowed for refinement of the ICT platform through their evaluation thereof; the feedback during successive site visits informed the development of the co-creation design framework, to become an intermediate framework. Further evaluation and validation was done on the intermediate framework by means of expert reviews, after which it became the final framework. The expert reviews focused on the four criteria of Hevner (2013), which ask questions on validity, utility, quality and efficiency.

- *What design improvements are identified during each design cycle?*

After Phase 1, the initial framework was developed; it was improved by analysing how ERW refined an ICT platform in a rural community in South Africa. The results of these findings allowed for the intermediate framework to emerge that adapted and combined participatory design, design thinking processes and value co-creation processes based on a South African case study. The intermediate framework was adapted slightly based on feedback from the experts in their evaluation and validation. Only the impact and scalability of the framework were adjusted to become the final framework.

- *How is the artefact introduced into the application environment and how is the artefact field-tested?*

The framework was not introduced in Mafarafara, but the components thereof were improved through the refinement and co-creation of the ICT platform by the ERW in this community.

- *What metrics are used to demonstrate artefact utility and improvement over previous artefacts?*

The expert reviews were applied, and the questions to the experts focused on the four criteria of Hevner (2013) as was already indicated.

- *What new knowledge is added to the knowledge base and in what form (e.g., peer-reviewed literature, meta-artefacts, new theory, new method)?*

As was indicated in section 1.8, the expected contributions will be addressed under section 8.7 below. It includes contributions to theory, methodology and practice.

- *Has the research question been satisfactorily addressed?*

All the research questions were addressed and answered, as was discussed in section 8.3.

One can therefore deduce that this was a successful example of how the DSR methodology can be applied to solve a problem and to add to the body of knowledge in South Africa in order to inform policy on what to consider when technology is deployed specifically catering for ERW in agriculture in rural communities.

8.6 SUMMARY OF CHAPTERS

The content of each chapter is briefly summarised below:

Chapter 1: Scope of research

In Chapter 1, the problem context and the research problem were stated and the study was accordingly motivated. The research questions, objectives, scope of the study, overview of methods, limitations, theoretical and practical significance and ethical considerations of the study were presented.

Chapter 2: Research methodology

In Chapter 2, the research design and methodology used to develop the required artefact were presented. The philosophical paradigm was motivated. The research strategy namely DSRM was explained. Data collection and data analysis methods used in the study were introduced. The relevant theories to be applied were discussed, as well as the ethical considerations.

Chapter 3: Rural women, development and co-creation

The aim of Chapter 3 was to indicate and investigate the situation of ERW in developing contexts, as well as ERW using ICT, and conducting research with ERW. The co-creation with ERW was also investigated in order to decide on an appropriate design process when co-designing an ICT platform with ERW. Chapter 3 concluded with components from literature that would inform the initial framework.

Chapter 4: ICT4D

In Chapter 4, the literature was reviewed to determine the challenges related to ICT4D projects, and in particular the challenges that are faced by ERW in ICT4D projects. It was also necessary to determine how the ICT platform evolved since its inception in 2002, and how it was decided to use it in Mafarafara to co-create with ERW. Chapter 4 ended with presenting the components of the initial co-creation design framework; these were visualised in Figure 4.13.

Chapter 5: Case study: Mafarafara

Chapter 5 set the scene for, and presented the case study. It provided contextual background to Mafarafara, the town in the Limpopo Province of South Africa that was the rural community selected for this study. Details of how the case study was initiated and an overview of the seven site visits were summarised in section 5.4.6.

Chapter 6: Data analysis

The data collected from the site visits to Mafarafara, where the inputs of the ERW assisted in refining the ICT platform, were analysed in this chapter. The intermediate co-creation design framework (artefact) was provided at the end of Chapter 6, based on the results of the case study.

Chapter 7: Evaluating the artefact to become the final framework

In design science research (DSR), it is imperative to evaluate the newly created artefact (Hevner *et al.*, 2004). A sample of experts from various domains were selected, and they evaluated the intermediate artefact in order for it to become the final framework. This final co-creation design framework (*cf.* Figure 7.13) was then discussed and explained.

Chapter 8: Conclusion

Chapter 8 contains a synthesis of the study, which includes a summary of the chapters, an overview of the research process, reflection on the findings, significance and contribution of the research, delineation and assumptions of the study, scientific, methodological and personal reflections and possible topics for future research.

The following section presents the significance and contribution of the research.

8.7 CONTRIBUTION TO KNOWLEDGE

The findings that emerged from the study contribute to the discourse in the ICT4D research domain. The study presents the production of a co-creation design framework (artefact) that can be applied when co-designing and co-creating with ERW by utilising DSR. It was earlier shown that ERW are the most deprived population group in South Africa, and that there is a lack of ICT4D research that focuses on their needs.

The artefact that was developed to support the ERW is novel. Evidence of artefacts designed by using DSR such as constructs, models, methods, instantiations and theories could be found in the literature, but no evidence of a *co-creation design framework* developed using DSR was found. The study contributes to theory for design and action as classified by Gregor (2006), and the developed artefact satisfies the conditions of importance, parsimony and novelty on a micro-level (Weber, 2012). The main theoretical and practical contribution of this research study is the evaluated *co-creation design framework* (artefact), which was evaluated by experts doing research in the ICT4D field namely academia specialising in DSRM, an ethnographer and an industry practitioner working with rural communities.

The knowledge contribution of this research, contributes to knowledge at levels 1 and 2 of the *DSR knowledge contribution framework,* as illustrated in the levels of knowledge contribution proposed by Gregor and Hevner (2013). As suggested by Gregor and Hevner (2013), research artefacts from a specific research project can be categorized at more than one level. The research provides *descriptive* and *prescriptive* knowledge.

At level 1 of the *DSR knowledge contribution framework*, the knowledge contribution of the artefact is the production of an *instantiation*, the *co-creation design framework* output for situated implementation in a specific environment (Figure 2.4).

This research contributes to theory, through its contribution of the *co-creation design framework*, which specifically addresses the refinement of an ICT platform by ERW in a rural environment. The framework contributes new knowledge towards the understanding of problems encountered when co-creating ICT artefacts with ERW, as well as providing a theoretically grounded, evidence-based approach to addressing these problems (Figure 2.7).

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

8.8   LIMITATIONS OF THE STUDY

The study applied the findings of a case study that included ERW from one rural community in Mafarafara, who were part of a longitudinal research project to refine the ICT platform to suit their needs and requirements and to add value to their socio-economic status. The purpose of the study focused only on ERW and did not include feedback from learners or the youth in the community. The data are based on a single case study.

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

8.9   REFLECTIONS ON THE STUDY

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

8.9.1   Scientific reflection

The study was about the development of a framework (artefact) for co-creation with ERW. The prominent philosophical paradigms in IS research are positivism, interpretivism, critical research and more recently pragmatism. An investigation into these paradigms proved that pragmatism would be a suitable paradigm for the development of the required artefact (Chapter 2).

An in-depth study about processes, models and methods in the design science research paradigm directed the execution of the study. The Information Systems Research Framework, as presented by Hevner *et al*. (2004, p. 80), informed the theoretical framework of the study (section 2.4). The process model of the study was informed by the activities described by Peffers *et al*. (2007, p. 93) in the design science research process (DSRP) model. The literature on ERW and ICT4D informed the study and added to the scientific knowledge on these domains.

The information presented in this section provides evidence that the study was based on, and was characterised by, the methods and principles of science. The following section provides a methodological reflection.

8.9.2 *Methodological reflection*

The following questions were answered to reflect on the methodology utilised during the execution of the study:

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

The study was concerned with the design and development of a co-creation design framework (artefact). Methods, procedures and guidelines incorporated in the design science research methodology were utilised for the execution of the study. Design science is concerned with problem solving, which is proactive in the sense that it seeks solutions to problems through creation and/or innovation of IT artefacts including constructs, models, methods and instantiations (March & Smith, 1995; Hevner *et al.*, 2004; Goes, 2014). Design science supports a pragmatist philosophical paradigm, which considers thought as a tool for prediction, problem solving and action. A pragmatist paradigm is concerned with practical application – theories or beliefs are evaluated with the view of how successful they are in practice (Goldkuhl, 2012). Findings from literature reviews, as presented in Chapters 3, 4 and 5, together with reflection and interpretation thereof, contributed to the building process of the artefact. The process model of the study was informed by the design science research process (DSRP), which includes the following activities: identify problem and motivate relevance; define objectives of a solution; design and development of an artefact; demonstration; evaluation; and communication (Peffers *et al.*, 2007, p. 93). The developed artefact was evaluated by experts, which is one of the design science evaluation methods suggested by Hevner *et al*. (2004, p. 86).

Considering the above mentioned, it can be concluded that an appropriate methodology was used to address the research problem.

Were the samples used in the research justifiable?

During the demonstration and evaluation activities of the DSRP model (Peffers *et al.*, 2007, p. 93), which form part of Phase 3 of the process model of the study, a sample of ERW was needed for the demonstration and evaluation of the developed artefact. Experts also evaluated the intermediate framework. A carefully selected sample of ERW whose situation represented the challenges faced by ERW in South Africa was used to demonstrate the applicability of the newly developed artefact. This was done justifiably.

8.9.3 Personal reflection

I strongly believe that the successful completion of the research study relied heavily on the following aspects: firstly, a clearly formulated, stated and focused research problem; secondly, a realistic and detailed study plan with specific objectives linked to specific due dates; and thirdly, motivation, discipline and perseverance. In all these aspects, the guidance and knowledge of my skilled and experienced supervisors was crucial and contributed substantially to the level of my motivation and the success of the study.

I experienced many challenges, of which I believe the biggest were to balance work related demands and personal health with time to work on the study. Even though I am a researcher by profession, I have gained much theoretical knowledge about methodologies, philosophical paradigms, design science research, artefact development and applying structuration theory. Looking back on the study path, it was a very rich, intense and rewarding experience.

8.10 THE WAY FORWARD

This section gives a reflection on generalisability and areas of future academic and practical research.

8.10.1 Generalisability

The co-creation design framework is a framework based on solid, clear, and widely accepted contributions from the field. This framework thus has the potential for generalization as it allows for a larger scope that can provide a basis for application beyond the case of Mafarafara in South Africa. The co-creation design framework therefore has the potential for implementation beyond its immediate source.

The lessons drawn from this dissertation could be useful for decision makers in South Africa and in other similar environments. It could also be useful to support sustainability when working with technology in rural areas. Scalability of ICT projects could benefit from this framework, as ERW are always present in projects in rural areas. The co-creation design framework therefore has the potential to provide relevant input into policy processes in South Africa and in countries with similar social and economic conditions.

8.10.2 Areas for future academic and practical research

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

- Future research could be done to establish the effectiveness of the co-creation design framework by exploring how it can support and benefit other women in practice in similar contexts in other developing countries.

- Guidelines for the implementation of the proposed and final co-creation design framework was suggested by one expert reviewer and can be part of a future study.

- Future research can also involve a refinement of other types of ICTs with all genders, and could include a comparison of findings between male and female participants.

- A continuation of the present longitudinal case study in Mafarafara can investigate the systemic benefits to the community, as a result of focusing on ERW as a user group.

The following section presents concluding remarks about the study.

8.11 SUMMARY

The intention of this study was, firstly, to develop a co-creation design framework (artefact) for ERW when improving and refining an ICT platform in rural areas. A combination of well-established existing theories was used to conduct the study. The co-creation design framework (artefact) was designed and developed by utilising design science research principles, practices and guidelines supported by a pragmatist philosophy.

During the evaluation of the co-creation design framework, qualitative data were collected and analysed where the refinement of the ICT platform with ERW in Mafarafara served as the case being studied by applying structuration theory. The study has demonstrated *"what the components [are] that the co-creation design framework should include when refining an ICT platform with Elderly Rural Women (ERW) in South Africa"* through the developed and empirically evaluated co-creation design framework.

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APPENDIX A: ETHICS APPROVAL

Appendix A-1: UP Ethics Approval

Appendix A-2: CSIR Ethics Approval

**FACULTY OF ECONOMIC AND
MANAGEMENT SCIENCES**

RESEARCH ETHICS COMMITTEE

Tel: +27 12 420-2306
E-mail: anske.grobler@up.ac.za

26 September 2012

Strictly confidential

Dr R Naidoo
Department of Informatics

Dear Professor Lotriet

Project:	*Towards a critical feminist design approach in the co-creation of an ICT platform for a rural development context*
Researcher:	**R Smith**
Student No:	**87462223**
Supervisor:	**Dr R Naidoo**
Department:	**Department of Informatics**

Thank you for the application you submitted to the Committee for Research Ethics, Faculty of Economic and Management Sciences.

I have pleasure in informing you that the Committee formally approved the above study on 26 September 2012. The approval is subject to the candidate abiding by the principles and parameters set out in his application and research proposal in the actual execution of the research.

The approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Codes of Research Ethics of the University of Pretoria if action is taken beyond the approved proposal.

We wish you success with the project.

Sincerely

**PROF AF GROBLER
CHAIR: COMMITTEE FOR RESEARCH ETHICS**

cc:

Members: Prof AF Grobler (Chair); Prof BA Lubbe; Prof HE Brand; Prof CJ Kruger; Prof JH Hall; Prof JH Kirsten; Prof JE Myburgh; Ms K Plant; Prof M Stiglingh; Prof C Thornhill; Prof R van Eyden; Prof SR van Jaarsveld; Prof JJ van Vuuren; Dr M Wiese
Administrative officer: Mr M Deysel

12 September 2012

To whom it may concern

RE: Employee letter for PhD studies of Ms Ronel Smith
Title: Towards a critical feminist design approach in the co-creation of an ICT platform for a rural development context
Faculty: Economic and Management Sciences
Department: Informatics.

Dear Sir/Madam

This is to confirm that CSIR Meraka Institute supports the ethics application as well as the candidate's PhD studies. She is granted permission to do her PhD studies on a current DST funded project (Digital Doorway) in Meraka, CSIR. The studies will add value to the project in the end and provide a better value offering.

The funding will also assist with the mentoring and development of identified students and staff.

I hope you find this in order.

Regards

Prof ME Herselman
Research group leader: Living Labs user methods
Meraka Institute
CSIR
Pretoria
(012) 841-3061
mherselman@csir.co.za

APPENDIX B: INFORMED CONSENT DOCUMENTS

CONSENT FORM TO PARTICIPATE IN RESEARCH

FOROMO YA TUMELELANO YA GO TŠEA KAROLO DIHLODIŠIŠO

Use of the Digital Doorway by middle-aged women responsible for food production in their rural communities

Tšhomišo ya Digital Doorway ke basadi ba mengwaga ya magareng bao ba bjalago dijo mo dinaga magaeng

You are asked to participate in a research study conducted by Prof M Herselman (PhD), R Smith (MBA), and M Rampa (MA, MSc) from the Meraka Institute at the CSIR. You were selected as a possible participant in this study because you are a senior citizen and have the knowledge to produce food for your community.

O kgopelwa go tšea karolo dihlodišišong tša go dirwa ke Prof M. Herselman (PhD), R Smith (MBA), le M Rampa (MA, MSc) gotšwa Sehlogweng sa Meraka go la CSIR. O kgethilwe go ba motšeakarolo mo thutong ye ka gore o magareng ga mengwaga ye masomenne le masometshela le gore o na le tsebo le maikarabelo a go bjala dimela mo setšhabeng.

We will provide you with the necessary information to assist you to understand the study and explain what would be expected of you (participant). Please feel free to ask the researcher to clarify anything that is not clear to you. Participants should note that participation in this research study is voluntary. To participate, it will be required of you to complete a form to give consent that will include your signature, date and initials to verify that you understand and agree to the conditions. This consent form is indicated below (page 6). You have the right to query concerns regarding the study at any time and immediately report any new problems during the study to the researcher.

Re tlile go go fa tshedimošo yeo e nyakegago ka botlalo go go thuša go re o kwišiše dinyakišišo le thlaloso ya seo se nyakegago go tšwa go wena (bjalo ka motšeakarolo). Lokologa go botšiša mohlodišiši a thlalose tšeo o sa di kwišišego. Batšeakarolo ba swanetše go tseba gore ba tšea karolo dinyašišong tše ka boithaopo. Ge o tšea karolo, go tlo hlokega gore o fane ka tumelelano ya go ngwalwa le mosaeno wa gago, tšatši-kgwedi le maina go tiišetsa gore o a kwišiša e bile o dumelelana le mabaka ao a beilwego.

1.	**PURPOSE OF THE RESEARCH**

	LEBAKA LA GO DIRA DIHLODIŠIŠO

We want to know whether you can use the Digital Doorway to get information that will help you to produce better food for your community.
Re nyaka go tseba gore o kgona go šomiša motšhene wa go bitšwa Digital Doorway go hwetša tshedimošo ya gore o kgone go bjala dimela tše kaone mo setšhabeng

2.	**PROCEDURES FOR CONSENT**

	MAGATO A TUMELELANO

If you volunteer to participate in this study, we would ask you to do the following things:
Ge eba o ithaopa go tšea karolo dinyakišišong tše, re tla go kgopela gore o dire tše di latelago:

**2.1	Give us permission to spend up to five days at a time in the community to understand how you produce the food and what information you need to do it better.**
	Re fe tumelelano ya go fetša matšatši a mahlano mo motseng gore re kgone go kwišiša gore naa dimela tša gago o di bjala bjang le gore o hloka tshedimošo goba thušo e feng gore o be kaone ka go bjala.

**2.2	Answer a few questions such as:**
	Araba dipotšišo tše mmalwa go tshwana le:

- Please tell us what information you will need to help you produce more food for your community?
- Re botše gore o hloka tshedimošo e feng gore o kgone go bjala dimela tša go feta tše o di bjalago gona bjale

	.
- Where do you currently get the information you need?
- Tshedimošo yeo o e hlokago gona bjale o e hwetša kae?

- Have you or are you using technology such as cell phones?
- Naa o berekiša tekenology ye bjalo ka sellathekeng?

**2.3	Allow us to record your answers to questions we will ask you.**
	Re dumelle go gatiša ka segatiša mantšu dikarabo tša gago.

**2.4	Allow us to take photographs and make a couple of videos of you using the Digital Doorway**
	Re dumelle go tšea diswantšho le video ya gago ge o šomiša mochene wa Digital Doorway.

2.5 **Help us decide what the DIGITAL DOORWAY must look like to be most useful to you.**

Re thuše ka maele gore naa DIGITAL DOORWAY e tshwanetše e be le eng gore e kgone go go tšwela mohola?

3. **THERE ARE NO POSSIBLE RISKS AND DISCOMFORTS**

KGONAGALO YA DIKOTSIL LE GO SEIKWE GABOTSE TŠEO DIKA HLOLWAGO KE NYAKIŠIŠO YE

4. **POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY**

KHOLEGO GO MOTSEAKAROLO LE/GOBA SETSHABA TŠEO DI BANG GONA

We hope that with your contribution we will be able to adapt the DIGITAL DOORWAY to make it more useful to you specifically. Future versions of the Digital Doorway can also be made better due to your inputs.
Re tshepha gore ka karolo yeo o e tšereng thutong ye re tla kgona go fetola DIGITAL DOORWAY gore e tshwanelane le dinyakwa tša gago. Di DIGITAL DOORWAY tša ka moso di ka diriwa bokaone ka baka la karolo yeo o e tšeago.

5. **PAYMENT FOR PARTICIPATION**

TEFELO YA GO TŠEA KAROLO

Please note that you **will not** be asked to pay to participate in the study nor will you receive any payment.
Tseba gore o ka se hloke go lefa goba go lefelwa go tšea karolo dinyakišišong tše.

6. **CONFIDENTIALITY**

SEPHIRI

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Written notes and reports, electronic transcribed versions of interviews as well as photographs and the voice- and video recordings will be stored securely at the Meraka Institute and destroyed after two years. No personal details (names) will be associated with the data. Confidentiality will be maintained by means of limiting access to your data and only the mentioned researchers will be able to access it.. .
Tshedimošo ye ngwe le ye ngwe yeo e humanwego mabapi le dihlodišišo tše le yeo e ka bapetšwago le wena etlo ba sephiri le gona etlo ntšhiwa ka tumelelo ya gago ka fao molao o nyakago ka gona. Sephiri sa tshedimošo setlo kgonthišiša ke go fokotša phihlelelo ya tshedimošo ya gago ebile ke feela bahlodišiši bao ba ngwadilwego bao bat logo ba le phihlelelo ya tshedimošo. Hlophollo ya ka moka ya tshedimišo e kase bontšhe leina la gago ebile dipampiri tša tshedimošo di tlo bolokelwa bodulong bja go

The audio and video recordings will be kept until the end of 2014 and then erased. The general, summarized, non-personal information in our computer-based database will be available for researchers to access. The database will contain the stories told in audio and written form.

Mantšu ao a tšerwego ka segatiša mantšu a tlo beiwa gofihlela mafelelong a ngwaga wa 2014 mme morago a phumulwa. Tshedimošo ka botlalo ya yeo esego a gago yeo elego ka khomphuteng etlo dirwa gore e fihlelelwe ke bahlodišišo ba bangwe. Tshedimošo e tla be e swere, dikanegelo ka mantšu le ka mokgwa wa go ngwalwa.

 You have a right to listen to the audio (voice) recording we have made of your story and to view the photographs and video recordings.

O na tokelo ya go theeletša digatišwa tšeo re di direlego ka kanegelo ya gago le go bona diswantšho le kgatišo tša video.

No names will be mentioned in any publications.

Gago maina ao a tlogo bolelwa kgathišong.

7.   PARTICIPATION AND WITHDRAWAL

GO TŠEA KAROLO LE GO IKGOGELA MORAGO

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so

O na le kgetho ya go tšea karolo goba aowa mo dinyakišišong tše. Le ge o ithaopa go tšea karolo, o ka ikgogela morago nako ye ngwe le ye ngwe ka ntle le go fa mabaka. O ka no gana go araba ye ngwe ya dipotšišo tšeo di tla bego di botšišwa eupya wa no tšwela pele go ba motšeya karolo mo dinyakišišong tše.

8.   IDENTIFICATION OF RESEARCHERS

BOITSEBIŠO BJA BAHLODIšISI

If you have any questions or concerns about the researchers or the research, please feel free to contact either:

Ge o na le potšišo goba sengwe le sengwe mabapi le banyakišiši le dinyakišišo, o ka ikgokaganya le:

The Principal Researcher
Moetapele wa bahlodišiši:

Prof Marlien Herselman (Tel: 012 841 3081) MHerselman@csir.co.za
CSIR Meraka Institute, Building 43, Meiring Naude Road, Brummeria, Pretoria.

Co-researchers
Bahlodišišimmogo

Mmamakanye Rampa (Tel: 012 841 4432) mrampa@csir.co.za
CSIR Meraka Institute, Building 43, Meiring Naude Road, Brummeria, Pretoria.

Ronel Smith (Tel: 012 841 3104) RSMITH2@csir.co.za
CSIR Meraka Institute, Building 43, Meiring Naude Road, Brummeria, Pretoria.

9.   RIGHTS OF RESEARCH PARTICIPANT
DITOKELO TŠA MO TŠEA KAROLO MO NYAKIŠIŠONG YE

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, contact Dr Sandile Ncanana, the CSIR REC secretariat, [r&d@csir.co.za] at the Research and Development Office.

O ka gogela morago tumelelano ya gago ya go tšea karolo wa ba wa se ša tšwela pele ka go tšea karolo ntle le kotlo e itšego. Go tšea karolo ya gago ka mo tlhodišišong ye ga go phumule maatla a taolo ya semolao, ditokelo goba tšhireletso ya gago ya semolao. Ge o na le potšišo mabapi le ditokelo tša gago bjalo ka motšea karolo e kgokagantšhe le Dr Sandile Ncanana, the CSIR REC secretariat, [r&d@csir.co.za] at the Research and Development Office.

	Signature of research participant **Mosaeno wa motšeakarolo**	
		Please tick box
1	The information above was described to me by [*name of relevant person*] in [*Afrikaans/English/Other*] and I am in command of this language or it was satisfactorily translated to me. *I* was given the opportunity to ask questions and these questions were answered to my satisfaction.	
	Ke hlalošeditšwe ka tshedimošo ye mo godimo [nna motšeakarolo] ke [leina la motho yo a hlalositšego] ka leleme la [Seburo/Sejahlaphi/a mangwe] ebile [nna ke le motšeakarolo] ke tseba leleme leo goba ke kgotsofatšwa ke phetolelo yeo e dirilwego. [nna kele motšeakarolo] ke filwe sebaka sa go botšiša dipotšišo e bile dipotšišo di ile tša arabiwa ka mokgwa wa go nkgotsofatša.	
2	I understand that my participation is voluntary and that I am free to withdraw without giving any reason and without consequences of any kind. I understand that I may also refuse to answer any questions I don't want to answer and still remain in the study.	
	Ke a kwešiša gore ke a ithaopa go tsea karolo le gore nka kgona go tlogela thuthwana ye nako ye nngwe le ye nngwe ntle le go fa mabaka goba ditlamorago tse bohloko goba tse botse. Ke kwešiša gore nka no gana go araba potšio ye nngwe le ye nngwe yeo ke sa nyakeng go e araba ka ba ka dumellwa go tšwela pele ka go tšea karolo	
3	I understand that I will not be asked to pay to participate in the study nor will I receive any payment.	
	Ke a kwešiša gore nka se kgopelwe go patela gore ke tšea karolo thutwaneng ye le go amogela patela ya go tšea karolo.	
4	I consent to the storage and processing of personal data during the time of the study	
	Ke dumelelana le go beiwa le tshepetšo ya tshedimošo nakong ta thuto ye.	
5	I agree to take part in this study by answering questions about myself and the way I produce food for my family and community	
	Ke dumela go tšea karolo thutong ye ka go araba dipotši	
6	I agree to take part in this study by allowing the research team to take photographs and make a couple of videos of me using the Digital Doorway and doing agriculture activities	
	Ke dumela go tšea karolo ka go dumelela sehlopha sa bahlodišiši go ntšea ditshwantsho le di-video tsa ka geke šomiša DD ke tšea karolo mo ditiragalo tša temo.	
7	I hereby consent voluntarily to participate in this study. I have been given a copy of this form.	
	Ke ithaopa go tšea karolo dihlodisong tse. Ke filwe foromo ya go swana le ye.	

_____	_____	_____
Name of Participant	**Signature of participant**	**Date**
Leina la motšeakarolo	**Mosaeno wa motšeakarolo**	**Tšatši-kgwedi**

Verbal consent given:
Tumelelano ya lentswe ka lentswe yeo e filwego

_____	_____	_____
Name of person taking consent	**Signature**	**Date**
Leina la motho wa go tšea tumelelano	**Mosaeno**	**Tšatši-kgwedi**

_____	_____	_____
Witness	**Signature**	**Date**
Hlatse	**Mosaeno**	**Tšatši-kgwedi**

Signature of researcher

Mosaeno wa monyakišiši

I declare that I explained the information given in this document to _____ [*name of the participant]. S*he was encouraged and given ample time to ask me any questions. This conversation was conducted in [*Afrikaans/*English/*Other*] and [*no translator was used/this conversation was translated into _____ by _____*].

Ke netefatša gore ke hlaloseditše _____[leina la motšeakarolo] tshedimošo yeo e lego tokomaneng ye lego. Motšeakarolo o filwe nako ya go ikgotsofatša ka go botšiša dipotšišo. Poledišano ye e dirilwe ka leleme la [Seburu/Sejahlaphi/a mangwe] e bile [gago mofetoledi yoo a šomišitšwego/poledišano e fetoletšwe lelemeng la _____ ke _____].

_____ _____

Signature of Researcher **Date**

Mosaeno wa monyakišiši **Tšatši-kgwedi**

APPENDIX B-2

Tshedimošo go fiwa batšeakarolo pele ba dumela go saena

DD ke khomputhara ya go tlo thuša batho gore ba kwešhišhe gore khomputhara di berekišwa bjang.Lebaka ke gore batho ba tla ithuta go berekiša DD ka ntle le go ya sekolong go ithutela yona. E hlamilwe le go tšwa CSIR ba direle dinaga tšeo gantši motho a ka se bego le khomputara goba a e reka gore e šomiše ke setšhaba. E tiile ebile ga e robege ka boomo. Protšeke ya DD e na le mengwaga e lesome e le gona. Ga bjale go na le DD tše makgolo'a mabedi le lesome (210) tšeo di lego Aforika Borwa le tše masometharotshela (36) kua dinaga mabapi.

Re dirile DD ka morago ba boitemogelo le tsebo ya rena. Re a dumela gore go ka kgonega go fetola ka mokgwa wo e leng ka gona ga bjale ra ba ra thuša le batho go e berekiša bo kaone. Go kaonafatša DD re ka rata go šoma le basadi ba mengwaga ya magareng ga masomenne (40) le masometselahlano(65) bao ba tšweletšago dijo mo nageng ya bona. Re kgethile sehlopa se sa basadi go bereka le sona ka gore ke bona ba bannyane ka palo ya batho bao ba šomišago DD le gona re rata go bona basadi ba thoma go berekiši DD ka bontši. Se a se re gore batho ba bangwe ga ba dumellwa go šomiša DD. Re kgopela fela gore basadi ba ba fiwe sebaka sa go kgotsofatša sa gore ba šomiše DD gore ba kgone go tlo araba potšišo tse mmalwa tšeo re tlo go ba botšiša.

Ge o dumela go tšea karolo re kgopela go etela setšhaba se ga hlano (5) nakong ya thuto/nyakišišo ye. Re kgopela tumelelo ya go dula nageng ye matšatši a mahlano (5) ka ketelo e ngwe le e ngwe. Se se tla re thuša go kwešiša dinyakwa tša lena,go tseba naga ya lena bo kaone le gore naga ya lena e šoma bjang. Ka leeto la rena la mathomo re tla bolela le basadi gore re tsebe gore ba tšweletša bjang dijo, tsa mohuta mang le mathata ao ba kopanang le ona ga bjale le gore ba humana kae tšhedimošo yeo ba e hlokang. Ka ketelo ya bobedi re tlo lokela DD ra ba ra ruta batho go e šomiša. Re tlo e tlogela mo kgwedi tše pedi go le fa sebaka sa go e šomiša. Ka ketelo ya boraro re tlo botšiša basadi ba batšeakarolo gore maitemogelo a bona ke a fe ka go šomiša DD le gore ba re fe maele a gore re ka e kaonafatša bjang. Re tlo tšea DD ra e bušetša morago gore e ye go kaonafatšwa e lokela maele a le batšeakarolo ba re fileng ona. Ka ketelo ya bone, re tlo buša DD yeo e kaonafaditšwego ra ba ra ruta batho gape gore e šomišwa bjang. Re tlo e tlogela gape kgwedi tše pedi gore le e šomiše le kgone go bona gore naa diphetogo di kaonafaditše DD e ntshwa naa. Ka ketelo ya mafelelo re tlo botšiša basadi ba batšeakarolo monagano wa bona ka DD. Ge e le gore diphetogo di šoma gabotse re tla kgona go kaonafatša di DD tše dingwe. DD e tla tlogelwa setšhabeng ge thuto e fedile.

APPENDIX C: INTERVIEW GUIDE

Use of the Digital Doorway by middle-aged and elderly women responsible for food production in their rural communities

Qualitative interview guide

Participant ID	
Interview site	
Interview date	
Start time	
Interviewer	
Date of first interview	
Date of second interview	
Date of third interview	

1. Process at all interviews

1. Introduce self and project. Thank participants for their time
2. Consent form: review procedures, confidentiality, voluntary participation, can skip questions or withdraw at any time.
3. Remind participants what the aim of the study is and what will be expected of them.

2. First site visit – determine needs

The aim of this first site visit is to get to know the participants and to determine the current situation with respects to ICT usage and food production. Feedback from the participants will be used to update the content of the Digital Doorway to meet the information needs expressed during the interviews.

Obtain informed consent: administer process according to lessons learnt during pilot as well as per discussions with champion

	Interviewer prompts
Participant information	• Can you tell us something about yourself? (e.g.) • How old are you? • What is your position / work / role in the community? • What languages do you speak and/or write? • How many people are in the community / village?

Exposure to ICT	• Do you listen to the radio? Do you own the radio? If not where do you listen • Do you watch television? Do you own the television? If not where do you watch • Is there a Telkom telephone in the community? • Do you use a cell phone? Does it belong to you? • Have you used computers before? • Do you think computers can make a difference to your community? How
Family's own food production	• How often do you cook a full meal? • What do you typically have for a meal? • Do you grow enough food to be able share with others / sell? • Do you just grow your own food or do the community have a communal garden. If communal production – why? • Who else is helping with the food production?
Problems experienced	• What problems do you encounter with your crops and animals? • Have you ever tried to find information that you couldn't find? • What do you see as the main challenges when producing food for your family or community? • What do you think can be the solution to these problems/challenges?
Food production operational issues	• Where do you get your seed, fertiliser, equipment, food for animals, • How do you know what to grow where and when • Did you get any training • Do you have any advise you can give to somebody just starting to produce their own food: hints or tips – things you've learnt that work well which you found out for yourself.
Process	• Is there anybody else in the community we should talk to? • Are you comfortable with the way we are asking the questions? Is there anything we should change for the process to work better? • Are there any questions you would like to ask?

3. Second site visit – install the Digital Doorway and train the participants

The aim of this second visit is to install the Digital Doorway and to train the participants in its use. No formal interviews will take place. Researchers will engage in general informal conversations with the participants as well as other community members where appropriate, take photos of and video tape the installation process and generally get to know the area better.

4. Third visit – get feedback re changes to DD

Remind participants that participation is voluntary and that they may withdraw at any time. The aim of this visit is to get the participants' feedback on their experience of the DD and what they think should be changed for it to better meet their needs. Explain to the participants that the DD will be removed for a couple of weeks at the end of this visit to, where possible, make the changes they suggested.

		Interviewer prompts
Experience of using the DD (basic)	Own use	• Did you use the DD to get information about agriculture? • Did you use the DD for other purposes? • Did you experience any difficulties? What were they? • When is the best time for you to use the DD? • Can you use the DD at that time? If not why not? What do you think can be done to address the issue? • Do you show other people how to use the DD?

	Other members of community / members of other communities	• Who else used the DD – do you know what for and what they did
		• Did somebody from another community / village ask to use the DD?
		  ▪ How did you feel about that?
		  ▪ What did they use the DD for

Using the DD (advanced)		• Could you put your own information (video, photo) on the DD? If not what was the problem? • Have you tried to use the DD along with another ICT tool (e.g. download information to your cell phone using Bluetooth)? • Do you think there are other things that the DD can be used for (e.g. health information)?

General		• Is the location where the DD is installed suitable for your purposes? If not where do you think we should put it?
		• Tell us what name you would give it to better represent its place in the community
Did the DD make any difference		• Has it made any difference?
		➢ Yes – can you explain how
		➢ No – what can we do
Suggested modifications		• Can we change anything to make the DD suite your requirements better? What?
Process		• Is there anybody else in the community we should talk to?
		• Are there any questions you would like to ask?

We will call you after two weeks to find out if you have thought about something else that we should change on the DD while it is away.

5. Fourth visit – return DD

The aim of the visit is to reinstall the modified DD and to train the participants on the updates. Focus will be on general conversations and taking photos of and video taping the installation process.

Interviewer prompts
Did anybody ask where the DD was?
Did you explain to them why we took it and that it is coming back?
Did the absence of the DD influence you in some way?

6. Fifth visit – final: get feedback on modified DD

The aim of this final site visit is to determine whether the participants feel that the 'new' DD meets their needs more effectively than the original version.

		Interviewer prompts
Experience of using the DD (basic)	Own use	• Did you use the DD to get information about agriculture?
		• Did you use the DD for other purposes?
		• Did you use the DD more or less often than before we made the changes
		• Did you experience any difficulties?
		▪ What were they?

		▪ Is this different from the problems you had before • Do you show other people how to use the DD?

	Other members of community / members of other communities	• Who else used the DD – do you know what for and what they did
		
		• Did somebody from another community / village ask to use the DD?
		
		   ▪ How did you feel about that?
		
		   ▪ What did they use the DD for?
		
		   ▪ Did anybody say something about the changes that was made to the DD

Using the DD (advanced)		• Could you put your own information (video, photo) on the DD? If not what was the problem? • Have you tried to use the DD along with another ICT tool (e.g. download information to your cell phone using Bluetooth)? • Do you think there are other things that the DD can be used for (e.g. health information)?

Redesigned DD		• Did the DD meet your needs better after the changes
		
		   ▪ If yes, please explain how
		
		   ▪ If no, please explain why not
		
		• What role do you think your participation played in the improvement (if any)?
		
		• Did the modified DD make a bigger difference than the original version?
		
		   ➢ Yes – can you explain how

Process		• Is there anybody else in the community we should talk to? • Are there any questions you would like to ask? • If we do a project like this again, can you suggest ways to make the process better • Do you think that you learnt anything by taking part in making changes to the DD?

APPENDIX D: EXPERT SURVEY QUESTIONNAIRE

Survey for expert reviews

Thank you for agreeing to provide your expert opinion on the intermediate
framework. I value your feedback!

The purpose of this study is to:

Develop a co-creation design framework as an artefact. During the development of
the framework, an ICT platform was refined and co-created with ERW in Mafarafara
that incorporates the implications of the social interplay on the co-creation process.

Mafarafara, is a small rural community in South Africa's Limpopo Province.

In order to develop the co-creation design framework Design Science Research
Methodology was applied through three phases as depicted in the figure below:
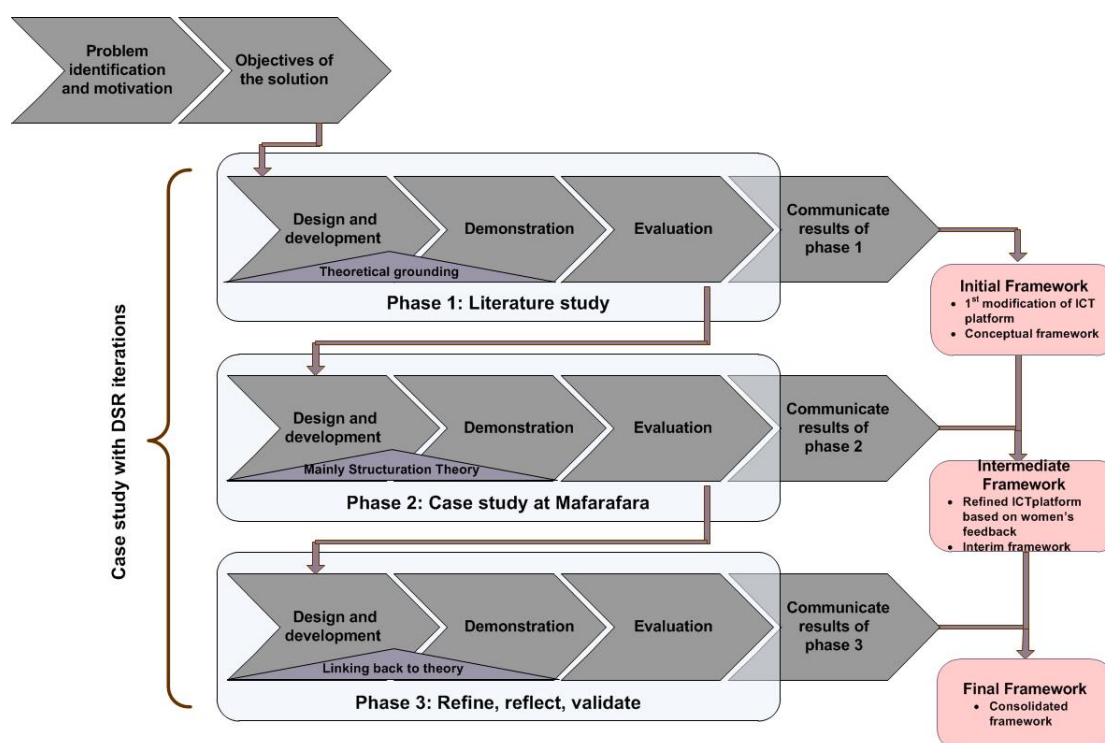
Your inputs will assist the researcher to validate and evaluate the components of the
framework as it was improved and developed through the three pahses. Your
feedback will be part of the last Phase (3).

1. Please indicate your years of experience in your domain (ICT4D researcher,
   Industry implementing projects in rural contexts, specialist in Design Science
   Research Methodology, ICT4D researcher working with women and
   ethnographer working in rural communities)

Years of experience in your domain	Mark with an X
1-5 years	

6-9 years	
More than 10 years	

2. Gender: Mark with an X

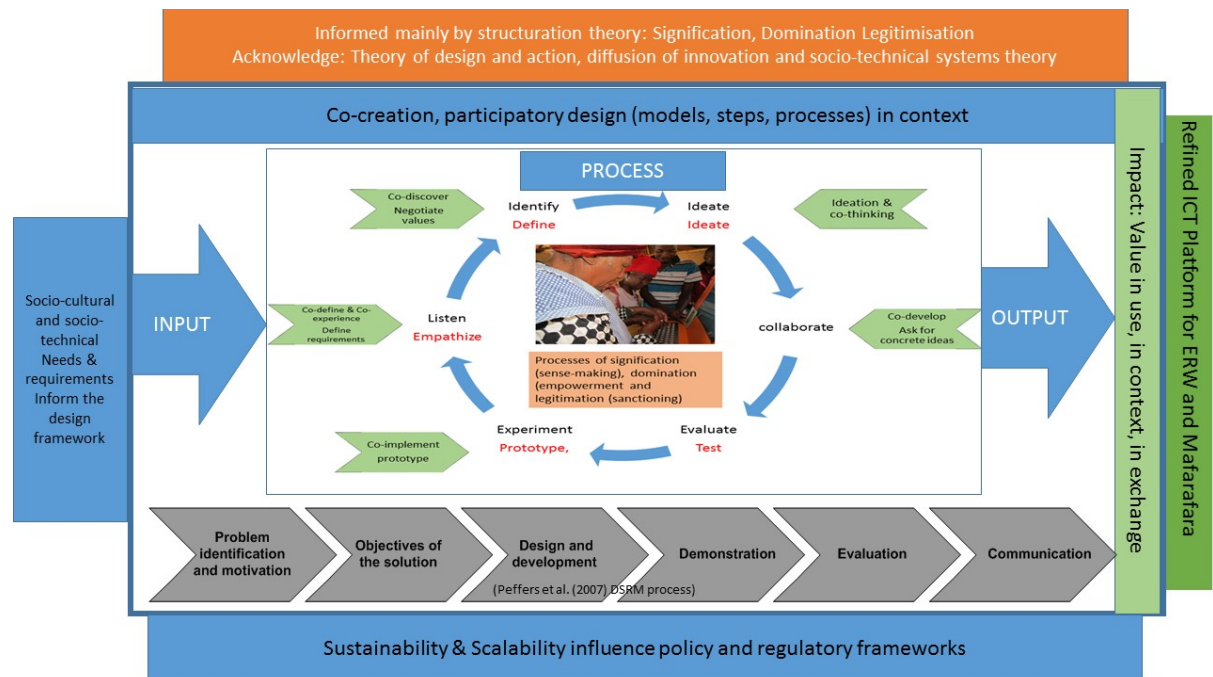| Male	
Female	

3. By answering the questions you provide your consent to take part in this research. Your identity will not be revealed and descriptive statistics with interpretations will be used to provide the results on each question.
4. The following components were identified from literature reviews and confirmed through a case study in a rural community by Elderly Rural Women (ERW):

Component name from initial framework (section 4.5)	ICT Platform support for component (Section 4.5)	Data analysis results improving the initial framework and informing the intermediate co-creation design framework components
Socio cultural Socio-technical Needs & Requirements of ICT and ERW Empowerment Minimize isolation Values, structures, traditions, agency and structure	Co-created and co-designed based on needs and requirements of the various communities (resource deprived and rural) Vandal proof Use ICT Champions from community to do support and maintenance User create own account and profile Acknowledge social structures as well as agency	Signification: socio-cultural mutual understanding and sense-making. ERW had to make sense of new technology, and CSIR had to learn and accommodate the local way of doing things Domination: how authoritative resources (Mma C) as well as allocative resources or the lack thereof influenced the outcome of the project Legitimation: in practice how refinement of ICT Platform was informed by the norms and values, stated and unstated, of the ERW community as well as the CSIR team
Participation Co-creation Collaboration (models, process, steps) Community centric, in context	Very popular amongst the youth especially Apply unassisted learning, minimal invasive education and peer learning Provide feedback on improvements to CSIR team Evolution since 2002	Significance of relationships for ERW Continuity of CSIR research team visiting them ICT Champions assisting them to use the ICT Platform Social space – safe, sharing, supporting one another While waiting they weave baskets and sew and socialise (share information) Produce products for socio-economic development (knitting, weaving, and agricultural items)

Component name from initial framework (section 4.5)	ICT Platform support for component (Section 4.5)	Data analysis results improving the initial framework and informing the intermediate co-creation design framework components
		ERW are their own community in a specific rural context
Sustainability Measure impact/effect Benefits (value-in-use, value-in-context, value-in-exchange)	Monitoring and evaluation was done in 2014-2015 on success of the intervention. Evidence was found of value-in-use and value-in-context as well as value-in-exchange. Useful for school projects Educational games very popular	Benefits as discussed in section 6.4 above: user literacy, skills development, information as a resource, place to store personal information (create own profile), means of exercise, entertainment, intangible value e.g. empowerment, destressing, sense of purpose for ERW Using the ICT Platform became part of their daily routine
Scalability Longitudinal Infrastructure & content	In existence since 2002 Over 300 units distributed in South Africa Units also in Australia, Uganda, Solomon islands, Lesotho & Ethiopia	Upgrade the ICT Platform with relevant content (agricultural and health). User experience of the interfaces of the ICT Platform was enhanced. Chairs were added and the screen font was enlarged for readability purposes. The ICT Platform is a longitudinal study (2013 – ongoing)
Education & Literacy Access	Purpose of platform is to influence skills and literacy gains Open source content and organised information and content on platform Open Access Leads to human capital development	Enjoyment of using the ICT Platform for entertainment (educational games) add to gaining more skills (use ATM better). The illiterate ERW could eventually write their own names based on regularly using the ICT Platform. Assisted one another to use the machine.
Policies & Frameworks Regulatory	Influence policy on skills and literacy Support National Development Plan	A holistic approach to any ICT4D project is to also acknowledge other needs and connect the community to the right channels (e.g. the agricultural office in the Limpopo Province was alerted to assist the community to get access to water). The results can inform DST and DRDLR to improve their policies regarding the use of ICTs with ERW in agriculture

The intermediate framework can be visualised by using the following figure:

Informed mainly by structuration theory: Signification, Domination Legitimisation
Acknowledge: Theory of design and action, diffusion of innovation and socio-technical systems theory

Co-creation, participatory design (models, steps, processes) in context

Refined ICT Platform for ERW and Mafarafara

Impact: Value in use, in context, in exchange

Socio-cultural and socio-technical Needs & requirements Inform the design framework

INPUT

OUTPUT

PROCESS

Identify / Define — Ideate / Ideate

Co-discover Negotiate values — Ideation & co-thinking

Co-define & Co-experience Define requirements — Listen / Empathize

collaborate — Co-develop Ask for concrete ideas

Processes of signification (sense-making), domination (empowerment and legitimation (sanctioning)

Co-implement prototype — Experiment / Prototype, — Evaluate / Test

Problem identification and motivation → Objectives of the solution → Design and development → Demonstration → Evaluation → Communication

(Peffers et al. (2007) DSRM process)

Sustainability & Scalability influence policy and regulatory frameworks

5. Based on your knowledge in your domain please answer the following questions as accurate as possible:

5.1 Questions on Validity

5.1.1 How relevant is the framework for the ICT4D research and for those working with ERW in resource constrained environments?

5.1.2 Rate the adequacy of the framework for working with ERW in ICT4D contexts.

5.2 Questions on Utility

5.2.1 Any omitted elements or components in your opinion?

5.2.2 Do you expect the application of the framework to produce useful results if used in your context?

5.3 Questions on Quality

5.3.2 Is the framework simplistic enough to understand?

5.4 Questions on Efficiency

5.4.1 How relevant is each of the components in the Table above?

5.4.2 How important (in your opinion) is each of the components?

5.5 Strengths and weaknesses of the framework

5.6 Additional comments

Thank you for taking the time to answer these questions