

**Towards a framework to guide the development of ICT4D:  
A South African Perspective**

**by**

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## ABSTRACT

Information and Communication Technologies for Development (ICT4sD) has the capability of facilitating the flow of knowledge which offers developing countries opportunities to enhance systems that may assist in poverty alleviation and other developmental initiatives. Even though ICTs4D hold the potential of harnessing ICTs for social development, there still exists a significant percentage of ICT4D that fail to deliver the results they were developed for. Many ICT4D projects have made no difference and some have even caused harm in the communities they have been implemented.

To determine how ICTs can be harnessed to serve as a catalyst and not as a hindrance for social transformation, one needs to consider the literature surrounding the topic of ICT4D. There is, however, an overall lack in the consistency of theory surrounding the process of development of ICT4D, and a lack of empirical evidence of appropriate methods regarding the development of ICT4D.

To address this lack of evidence this study explores the best practices for the development of ICT4D in developing countries, specifically in South Africa (SA). The findings are used to develop a framework to guide the formation of ICT4D specifically within the Analysis and Design phases of development.

An iterative seven-step process, by Jabareen (2011), the Conceptual Framework Analysis (CFA) process, was adopted to develop the ICT4D framework. These steps and thus the formation of the framework was accomplished within two overarching research phases, 1) a theoretical study and 2) an empirical study.

The study is situated within three fields of literature, namely 1) Information System Development, 2) Human Development and 3) Information Communication Technologies for Development. The theoretical study investigated these three fields to understand the functioning of ICT4D from the perspective of all three of these fields and to develop a theoretical base of knowledge within each field. The exploration of these three fields formed part of the overview literature study and the Systematic Literature Review. The findings resulted in various analytical, design and functional concepts that were integrated to develop the preliminary Analytical and Design Framework.

The empirical study followed by adopting a mixed methodology approach, comprising of two stages: 1) qualitative semi-structured interviews and (2) a quantitative framework-ranking exercise. The findings within this phase were applied to the framework to provide improvements and validation to develop the final framework.

A positive response resulted from the empirical study and the framework was validated as needed, reliable, relevant and useful within the ICT4D domain. Even though the validity of the framework was established, further study is required to map the issues that may arise through implementation, and to confirm the usefulness thereof in real life situations.

Since not one coherent approach exists for developing ICTs4D, but a combination of frameworks and tools are needed, the final framework is a contribution to the available tools and approaches that can be used to provide a guide to develop ICT4D within the Analysis and Design phases.

# OPSOMMING

Inligting- en Kommunikasietegnologieë vir Ontwikkeling (ICT4sD) het die vermoë om kennisvloei deur alle sektore binne 'n gemeenskap te fasiliteer. Hierdie vermoë om kennisvloei te vergemaklik, bied aan ontwikkelende lande ruim geleentheid om stelsels te verbeter wat kan bydra tot armoedeverligting en ander ontwikkelingsinisiatiewe. Alhoewel ICTs4D die potensiaal bied om IKT's vir sosiale ontwikkeling te benut, bestaan daar steeds 'n beduidende persentasie van ICT4D wat nie die resultate lewer waarvoor hulle ontwikkel is nie. Baie ICT4D-projekte het geen verskil gemaak nie en sommige het selfs skade veroorsaak in die gemeenskappe waarin hulle geïmplementeer is.

Om te bepaal hoe IKT's aangewend kan word om as katalisator te dien en nie as 'n belemmering vir sosiale transformasie nie, moet 'n mens die literatuur rondom die onderwerp ICT4D oorweeg. Daar is egter 'n algehele gebrek aan die konsekwentheid van die teorie rondom die proses van ontwikkeling van ICT4D en 'n gebrek aan empiriese bewyse van toepaslike metodes aangaande die ontwikkeling van ICT4D.

Om hierdie gebrek aan bewyse aan te spreek, ondersoek hierdie studie die beste praktyke vir die ontwikkeling van ICT4D in ontwikkelende lande en spesifiek Suid-Afrika (SA). Die bevindings word gebruik om 'n raamwerk te ontwikkel om die ontwikkeling van ICT4D spesifiek binne die Ontleding- en Ontwerpfases van ontwikkeling te lei.

'n Iteratiewe sewe-stap proses deur Jabareen (2011), 'n Konseptuele Raamwerk Analise (CFA), is aanvaar om die ICT4D-raamwerk te ontwikkel. Hierdie stappe en dus die vorming van die raamwerk is bereik binne twee oorkoepelende navorsingsfases: 1) 'n teoretiese studie en 2) 'n empiriese studie. Die studie geskied binne drie literatuurvelde, naamlik 1) Inligtingstelselontwikkeling, 2) Menslike Ontwikkeling en 3) Inligtingskommunikasie Tegnologieë vir Ontwikkeling. Die teoretiese studie het hierdie drie velde ondersoek om die funksionering van ICT4D te verstaan vanuit die oogpunt van al drie hierdie velde en om 'n teoretiese basis van kennis binne elke veld te ontwikkel. Die verkenning van hierdie drie velde het deel gevorm van die oorsigliteratuurstudie en die sistematiese literatuuroorsig. Die bevindings het gelei tot verskeie analitiese, ontwerp- en funksionele konsepte wat geïntegreer is om die voorlopige Analitiese en Ontwerpraamwerk te ontwikkel.

Die empiriese studie gevolg deur 'n gemengde metodologie benadering bestaan uit twee fases: 1) kwalitatiewe semi-gestruktureerde onderhoude en (2) 'n kwantitatiewe raamwerk-posisie oefening. Die bevindings binne hierdie fase is toegepas op die raamwerk om verbeteringe en validering te bied om die finale raamwerk te ontwikkel.

Die empiriese studie het gelei tot 'n positiewe reaksie en die raamwerk is waar nodig, betroubaar, relevant en nuttig in die ICT4D-domein gevalideer. Alhoewel die geldigheid van die raamwerk

vasgestel is, is verdere studie nodig om die probleme wat binne die implementering mag voorkom, neer te pen en om die bruikbaarheid daarvan binne werklike situasies te bevestig.

Aangesien daar nie 'n logiese benadering tot die ontwikkeling van ICTs4D bestaan nie, maar 'n kombinasie van raamwerke en gereedskap nodig is, is die finale raamwerk 'n bydrae tot die beskikbare gereedskap en benaderings wat gebruik kan word om leiding te gee om IK4D te ontwikkel binne die Analise- en Ontwerpfases.

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# LIST OF ACRONYMS

ACE	ACE Framework
ANT	Actor Network Theory
AT	Appropriate Technology
BOK	Body of Knowledge
CCD	Capable and convivial design
CCD	Citizen-centric Capacity Development
CFA	A Conceptual Framework Analysis
CTSP	Community Technology Skills programme
FESC	The Faculty Ethics Screening Committee
FW-A	Framework Aims
FW-C	Framework Challenges
FW-T	Frameworks Work Type
GUI	Graphical user interface
ICT	Information Communication Technology
ICTE	Information Communication Technology for Education
ICT4D	Information Communication Technology for Development
IS	Information System
ISD	Information System Development
PD	Participatory Design
RAD	Rapid Application Development
RICT-CEF	Rural ICT Comprehensive Evaluation Framework
RICTP-PAF	Rural ICT Project Process Assessment Framework
SDGs	Sustainable Development Goals
SDLC	System Development Life Cycle
SLF	Sustainable Livelihoods Framework
UNDP	The United Nations Development Programme

# CHAPTER 1- INTRODUCTION

Chapter 1 forms the introduction to the thesis, which serves to familiarise the reader with the topic of Information Communication Technology for Development (ICT4D) and provides an overview of the research layout. Section 1.1 starts with the background information of the subject. This subsection introduces the reader to the concepts surrounding ICT4D and highlights the potential benefits and challenges associated with implementing and developing ICT4D. Section 1.2, the Problem Statement, then follows and establishes the problem which the thesis aims to solve. In the following section, Section 1.3, the aim and objectives of the study are discussed. The aim is derived from the information gathered to establish the problem statement and the objectives specify the actions that need to be taken to accomplish the aim. The next section, Section 1.4 discusses the delimitations in order to highlight the boundaries set out for the study. Section 1.5 then states the possible limitations that exist in achieving the aims. Section 1.6 discusses the ethical implications of the study and finally the chapter is concluded by Section 1.7, the research strategy, which highlights proposed plan of action for this study.

## 1.1 Background

ICTs provide access to information through telecommunications and includes any electronic device that will store, retrieve, manipulate, transmit or receive information in a digital format (Zuppo, 2012). Mobile phones, wireless networks, personal televisions and industrial robots are examples of just a few of these devices. Moreover, ICTs make it easier and more effective to communicate over distance and time, through applications such as instant messaging, video calls and voice over IP (Christensson, 2010).

Not only do ICTs provide users with communication capabilities, but according to Castells & Nations (1999), access to ICTs is a requirement for social and economic development. The World Bank (1998:9) states that ICTs facilitate the attainment and absorption of knowledge, therefore offering developing countries extraordinary opportunities to improve educational systems, policy formation and policy execution. Potentially, they also offer the poor a wider range of employment opportunities. Heeks (1999) points out that ICTs could serve as a valuable instrument in promoting sustainable human development. The literature surrounding the connection between ICTs and social development, has increased vastly in recent years, and the specific ICTs used for the purpose of social development have become known as Information Communication Technology for Development (ICT4D) (Kleine, 2010a; Gigler, 2011).

According to Bhatnagar (2000), ICTs4D (Information Communication Technologies for Development) are specific ICTs which:

- Offer support in the decision-making process of public administrators for enhancement of developmental programmes,

- Improve public and other services to citizens, and/or
- Allow empowerment of citizens by creating access to knowledge and information.

An example of an ICT4D in SA, is the MomConnect project. In 2014 the Minister of Health set out to address maternal healthcare issues in SA. This was in response to the Millennium Development Goals (MDGs) which were established by the United Nations. A task team was set up to develop a solution to minimise preventable maternal and infant deaths (Waldman and Stevens, 2015; van der Merwe, 2018). The task team approached stakeholders within the SA mHealth landscape which have expertise in utilising digital technology to address pressing health challenges (United Nations Foundation, 2015). Together they developed a national strategy to reach pregnant women, and thus the MomConnect project was born (Waldman and Stevens, 2015).

The MomConnect programme is a service that utilises digital technology (SMS) to provide pregnant women and women with infants, with stage-based health information and postnatal support. This programme also improves service quality of clinics, by enabling women to pose pressing questions and to rate their local clinic service (United Nations Foundation, 2015). According to Leon et al. (2012) this programme provided a platform for research and disease surveillance, improved supervision at local clinics, improved planning and development of service delivery, provided a tool for decision-making in clinical services, encouraged health and prevention of disease, and provided education to mothers via health professionals.

More recently, the study of ICTs4D has increased, due to projects such as MomConnect, and thus the global belief in the transformation potential of ICTs has grown (Heeks, 1999). Many institutions use ICTs to provide the marginalised a chance at increased participation in decision-making processes, as well as offering transparency and accountability in governmental policies and other decision-making processes (Majchrzak, Markus and Wareham, 2014).

Eventhough there is potential in harnessing ICTs for social development, there still exists a significant percentage of ICTs4D implementations that fail to achieve their intended results (Butcher, 1998; Prakash and De, 2007; Pade and Sewry, 2009). Many ICT4D projects have failed to bring about change and have even caused additional damage within the communities where they have been implemented (Pade and Sewry, 2009). According to Roberts (2015), a leading cause for such failure is the presumption that development is automatically achieved with ICT implementation within ICT4D projects. This is a weak assumption according to Roberts (2015) and Mthoko & Khene (2018), because ICTs serve merely as a facilitator for development rather than being the sole driver for development.

There are also authors who are of the opinion that the growth of ICTs may serve to widen the gap between the rich and the poor, rather than eradicate it. This is due to the fact that ICTs favour mostly those who can afford them and therefore have caused economic and social divide between the rich and the poor. (Ohiagu, 2013) This divide which these ICTs make between the "information-rich and

information-poor” results in a knowledge gap and inevitably leads to marginalisation for those who are information-poor (Dennis and Merrill, 2006).

It is clear in literature that ICTs4D hold the potential to act as catalyst in social development, but reality highlights something different. In reality many ICTs4D have failed at facilitating social development, and many have even served to widen the socio-economic gap between the rich and the poor. It is therefore important study the literature and establish the appropriate steps in the development of ICTs4D. These steps should lead to the development of ICTs4D which can be successfully implemented, facilitating social development rather than hindering it.

Furthermore it was discovered that there exists an overall lack in the consistency of theory regarding the process of development of ICT4D, especially ICTs4D implemented in underdeveloped countries (Avgerou, 2010). Majchrzak, Markus and Wareham (2014) also state that a gap exists in the research concerning the precise nature of ICTs and their social consequences in complex social environments, such as is demonstrated in underdeveloped countries. This is due to the fact that theories among different disciplines have different focal points with respect to ICTs (Avgerou, 2010).

This thesis therefore attempts to gather reliable theoretical uniformity from theoretical and empirical data sources, to gain a deeper understanding of the best design and implementation practices for ICT4D in developing countries – specifically SA. From the exploration of these best design practices the study aims to deliver a framework that will make some progress towards ensuring successful implementation of ICT4D within developing areas.

## **1.2 Problem Statement**

Literature reveals that there exists a significant percentage of ICT4D that fail to deliver the results they were developed for. Many ICT4D projects have made no difference and some have even caused harm in the communities they have been implemented (Butcher, 1998; Prakash and De, 2007; Pade and Sewry, 2009).

There also exists an overall lack in the consistency of theory regarding the process of development of ICT4D, especially ICTs4D implemented in underdeveloped countries (Avgerou, 2010). Furthermore, a gap exists in the research concerning the precise nature of ICTs and their social consequences in complex social environments, such as is demonstrated in underdeveloped countries (Majchrzak, Markus and Wareham, 2014).

The study therefore sets out to explore the development of ICT4D in order to gain a deeper understanding of the best design and implementation practices for ICT4D in developing countries.

## **1.3 Research Aims and Objectives**

The objectives and aims for the research are now discussed in further detail

### **1.3.1 Research Aims**

The final aim of the thesis is established upon the findings discussed above and is summarized as follows:

Apply the knowledge gained through the theoretical study, and empirically investigate the development of ICTs4D to create a framework that will lay the foundation for the requirements for developing ICTs4D in developing countries, specifically in the context of SA.

### **1.3.2 Research Objectives**

Objectives have been identified as a roadmap to attain the aims stipulated above. The objectives are attained through 2 Studies, the Theoretical Study, and the Empirical Study.

The purpose of the Theoretical Study is to develop a conceptual framework for guiding the design and development of an ICT4D in developing country settings. The objectives within the theoretical study include the following

1. Investigate the definition and literature regarding the field of social development by analysing existing theories, tools and frameworks.
2. Evaluate the literature surrounding the definition of ICTs4D in developing countries.
3. Investigate and identify the requirements for the development of ICTs4D in developing countries.
4. Construct a conceptual framework for the development of ICTs4D in developing countries, by using the knowledge obtained through the attainment of the previous objectives.

The purpose of the Empirical Study is to Improve and Validate the Framework. The objectives within the Empirical Study include the following:

5. Empirically test the framework by investigating and identifying the requirements for the development of ICTs4D in SA, by executing in-depth interviews with experts in the ICT4D field
6. Improve the framework based upon the above findings.
7. Validate the framework upon attainment of objective 5

## **1.4 Delimitations of the study**

The framework is intended to serve as a facilitator rather than the complete solution. There is not one coherent approach to developing ICTs4D, but a combination of frameworks and tools are needed in this development process. This framework, therefore, is a contribution to the available tools and approaches that can be used. The framework should therefore be used in unison with

other ICT4D development guides in order to account for the larger scope, in which the problem space is situated.

## 1.5 Limitations of the study

The study's generalisability and depth are constrained by the delimitations to ensure its feasibility. These include:

- The framework developed within this thesis was derived from literature within the social development, Information System Development and ICT4D fields.
- The literature used to define the requirements for the development of ICT4D, focuses on cases from developing countries and South Africa.
- The validation of the framework was determined through application within the South African context, and thus its validation is applicable within the South African context.
- The research will not address all the phases of the Information System Development process. The ICT4D framework only addresses the analysis and design phases of the Information System Development process.
- Only English papers available from the web and SU library were included in this study
- The ICT4D framework is a conceptual framework, therefore additional research regarding the specific environment is required before its implementation.

## 1.6 Ethical Implications of Research

The aim of this thesis is to firstly develop a conceptual ICT4D framework. Creating this framework involved acquiring knowledge from 3 fields, namely, social development, IS and ICT4D. This was accomplished through a theoretical study which consisted of an overview literature study of the 3 fields, and a systematic literature review providing an in-depth perspective of the 3 fields. The first phase of the study involved the development of a framework derived from literature. The literature was retrieved from the web and public libraries. There was no utilization of sensitive content within the first phase and thus no ethical implications exist within the first phase of developing the conceptual framework.

The second phase involved the empirical study, which aimed to validate and improve the theoretical framework. The empirical study involved acquiring knowledge from experts in the field of ICT4D through scheduled interviews. Ethical clearance was obtained from the Division of Research and Development at the University of Stellenbosch, before these interviews were conducted. The Faculty Ethics Screening Committee (FESC) classified the research as low risk, and the formal ethics clearance number received by the researcher is: ING-2018-7540. The interviews were conducted according to the appropriate ethical procedures as agreed in the ethical clearance stipulations. These interviews were purely with professionals and no contact was made with any ICT4D users.

There was no personal or private information disclosed by participants and therefore no foreseen ethical implications expected for the project.

## 1.7 Research Strategy

The research strategy discusses the strategy behind developing the framework. The strategy involved developing the framework by conducting two studies, the Theoretical Study and the Empirical study. These two studies were executed within the 7 phase framework development method proposed by Jabareen (2011). These 7 phases from Jabareen (2011) is explained in the table below.

**Table 1: Jabareen's (2011) 7 phase framework development methodology**

Phase	Objective of phase
Phase 1: Mapping the selected data sources	Identify literature regarding Information Systems for Social Development Applications
Phase 2: Reading and categorizing of the selected data	Categorize important themes regarding the literature and define necessary concepts from these themes
Phase 3: Identifying and naming relationships among concepts	Find connections and interrelationships among concepts
Phase 4: Deconstructing and categorizing the concepts	Concepts are deconstructed, by identifying main attributes, assumptions, characteristics, and role
Phase 5: Integrating concepts	Concepts are updated and integrated to reduce the number of concepts to a practical number that will be used to develop the framework.
Phase 6: Synthesis and resynthesis	This involves iterative synthesis and resynthesis of the concepts to form the framework
Phase 7: Validating the conceptual framework	Validate the conceptual framework through feedback

The first study – the Theoretical Study – used the first 5 phases of the method proposed by Jabareen (2011), to develop the conceptual framework. The second study, undertook the Empirical Study which consists of the final 2 phases of the method proposed by Jabareen (2011) to improve and validate the conceptual framework.

The Theoretical Study involved discovering the requirements for the development of ICTs4D in developing countries. Identifying these requirements formed part of the process of developing a conceptual framework for the development of ICT4D.

The Empirical Study was completed by performing in-depth interviews to firstly improve and then to validate the framework.

## CHAPTER 2- METHODOLOGY

In order to execute successful research, it is crucial that one chooses the appropriate research method (Cho and Lee, 2014). The methodology used in this thesis was carefully developed by studying different methods in literature used to achieve aims and objectives similar to that of the current project. The methodology explains the process followed in order to answer the research questions and to attain the objectives specified in Chapter 1. This Chapter also discusses the reasoning behind the project's methodology which was used to ultimately develop a framework that can guide the development ICT4D in South Africa.

Section 2.1 discusses the research approach chosen for the study and discusses the seven phases associated with the CFA (Conceptual Framework Analysis), the framework developing method proposed by Jabareen (2009). Section 2.2 discusses the structure of the thesis and establishes the overarching phases of the study, used to execute the seven phases of the CFA.

Section 2.3 discusses the process followed to conduct the preliminary overview Literature Study, the first contribution towards the knowledge needed for developing the framework. Section 2.4 discusses the procedures followed to develop the Systematic Literature Review, which forms the second contribution towards the knowledge needed for developing the framework. The Systematic Literature Review builds onto to the preliminary overview Literature Study by following a more in-depth procedure to analyse the literature.

Section 2.5 discusses the methodology used to develop the first iteration of the framework. The knowledge acquired from the preliminary overview literature study and the systematic literature review were used to develop the framework.

Section 2.6 discusses the methods used for the final phase of developing and validating the framework. This phase involved the field work which contributed the final knowledge needed towards developing/refining and validating the framework.

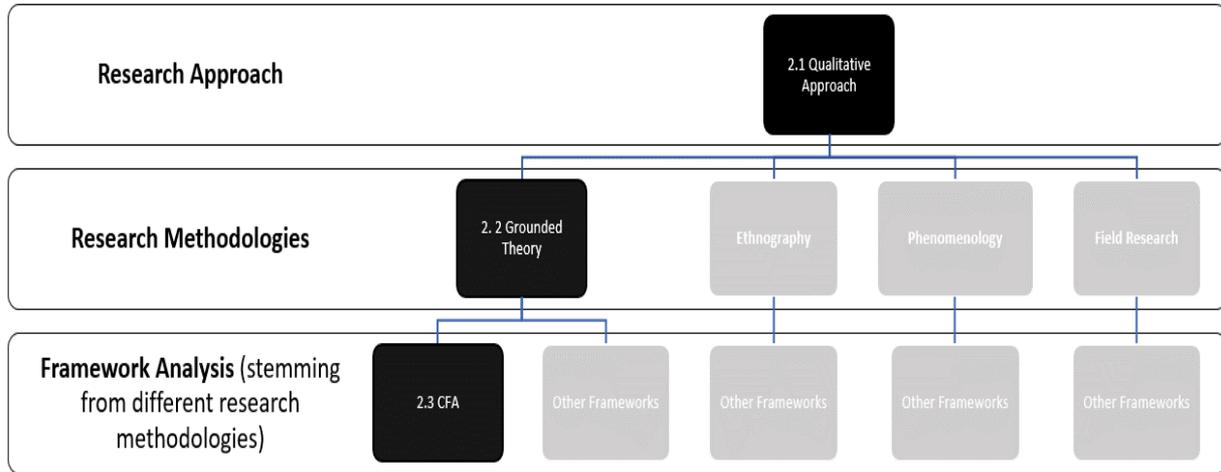
This Chapter therefore clarifies the methods used to conduct an overview Literature Study, the Systematic Literature Review, the integration of concepts to develop the first iteration of the framework and the Field Work, which together contributed to the development of the completed framework.

### 2.1 Research Approach

This section discusses the research approach followed to develop the framework. Section 2.1.1 describes the qualitative nature of the study. Section 2.1.2 follows to discuss the specific qualitative approach, namely the Grounded Theory, used for this study. Section 2.1.3 explores framework developing methodologies rooted in the Grounded Theory, and discusses CFA (Conceptual

Framework Analysis) developed by Jabareen (2009), which was chosen as the framework development methodology for this research.

Figure 2.1 describes the relationship between Qualitative Research, Grounded Theory and Conceptual Framework Analysis



**Figure 2.1: Relationship between Concepts discussed in Methodology literature**

### **2.1.1 Qualitative review**

Grant & Booth (2009) describes the 14 most common review approaches followed in research. These common review approaches include, critical review, literature review, mapping review, meta-analysis, mixed studies review, overview, qualitative systematic review, rapid review, scoping review, state of the art review, systematic review, systematic search and review, systemized review and umbrella review.

The review approach used for this study is qualitative in nature. Qualitative reviews use methods which compare and integrate literature in order to develop an overall understanding of the topic. The review approach is used to either develop an overarching narrative by interpreting a collection of all the literature on a specific phenomenon, or to further develop new theories regarding the phenomenon (Grant and Booth, 2009). Tracy (2013) explains that a qualitative review, as an approach, focuses on context and describes the subject that is being researched. A prominent characteristic of this approach is that it identifies themes or constructs within the body of literature, thereby making sense of the phenomenon under review (Grant and Booth, 2009).

As the objective of this thesis is to create a conceptual framework for the development of ICTs4D, insights into technical as well as social issues are required and thus, a qualitative review approach was chosen. The strengths which this review approach provides to the research are highlighted by Tracy (2013) and Grant & Booth (2009) and are summarised in the bullets below.

- It can support a holistic consideration of the problem, focusing on providing understanding of a continual process and not focusing on merely snapshots of a process.
- It regards context highly and participant perceives meanings of a phenomenon, therefore making it a suitable approach to interpret participants' viewpoints for utilization in social contexts.
- It establishes the chronological order of occurrences of a phenomenon, therefore recording events as well as their consequences, and offers a means of explaining the reasons for the specific chronological ordering.
- It interprets how research can affect reality, and therefore influences the questions we can ask.
- It investigates perceptions of users in order to explore barriers as well as the enablers of the delivery of services.
- It considers various interpretations in literature highlighting those which are theoretically more persuasive, morally appropriate and practically important.

### **2.1.2 Grounded Theory**

The four major qualitative approaches identified by Trochim (2006) include Ethnography, Phenomenology, Field Research and Grounded Theory. For this thesis, the Grounded Theory approach was chosen. This approach was initially developed by Glaser and Strauss in the 1960s and is used to interpret qualitative data (Cho and Lee, 2014). The purpose of the approach is to design a theory about the specific phenomena under review. The name stems from the idea that the development of this theory is grounded and established in observation, and is not merely abstract theorizing (Trochim, 2006).

Grounded theory uses iterative procedures in order to develop conceptually dense theory (Cho and Lee, 2014). This approach is neither static or confining (Trochim, 2006), but involves using open-ended coding to extract data and form new theories (Cho and Lee, 2014). The aim of this approach is to develop core theoretical concepts and to interpret the relationships between the various concepts identified (Trochim, 2006). The main analytical procedure, which this theory employs, are coding (Charmaz, 1996; Groat and Wang, 2013), memo-writing (Charmaz, 1996; Groat and Wang, 2013) and integrative diagrams and sessions (Trochim, 2006).

Coding is the essential connection between data collection extracted for review, and development of theory (Charmaz, 1996). Coding involves grouping different concepts within the body of literature regarding the phenomenon under review. These different concepts which emerge from the literature, are categorized and the different concepts, implications and details are explained and differentiated from other concepts in the literature. The first phase of coding is open and involves searching patterns and themes in the literature, thereby developing initial categories from the broader literature. After this phase, selective coding is executed where categories which have been established within

the open coding, are further explored. These categories undergo further systematic coding to further identify specific themes (Trochim, 2006).

Memo-writing uses the technique of writing memos throughout the iterative process of extracting and analysing the literature through the coding process. These memos are used to form ideas and later theories, as the review develops from beginning to end. The initial memos are open-ended and focus on the broader literature, later becoming more focused on identified core concepts (Trochim, 2006).

Integrative diagrams use graphical representations to assimilate all the concepts identified throughout coding and memo-writing. These graphic representations can use various diagrams such as mind-maps, graphs, or even cartoons, to depict the relationships between the identified concepts (Trochim, 2006).

In summary, Grounded Theory was chosen, based on the following characteristics which were deemed useful for the purposes of this thesis:

- It provides a holistic understanding of the phenomenon under consideration (Cho and Lee, 2014).
- Interpretation of data is not merely a mechanical process, but considers interactions with other social processes too, in the interpretation of the data (Cho and Lee, 2014). This method is therefore also useful for making sense of human behaviour (Glaser and Strauss, 1970).
- This approach provides flexible but robust means of analysing data, which can in turn be used by other researchers for refining and updating (Glaser and Strauss, 1970).
- It has the potential for greater generalizability, therefore various data from different sites and sources can be analysed and compared through this method (Glaser and Strauss, 1970).

### **2.1.3 Conceptual Framework Analysis**

The Framework Method sits within a broad family of analysis methods often termed thematic analysis or qualitative content analysis. These approaches identify commonalities and differences in qualitative data, before focusing on relationships between different parts of the data, thereby seeking to draw descriptive and/or explanatory conclusions clustered around themes

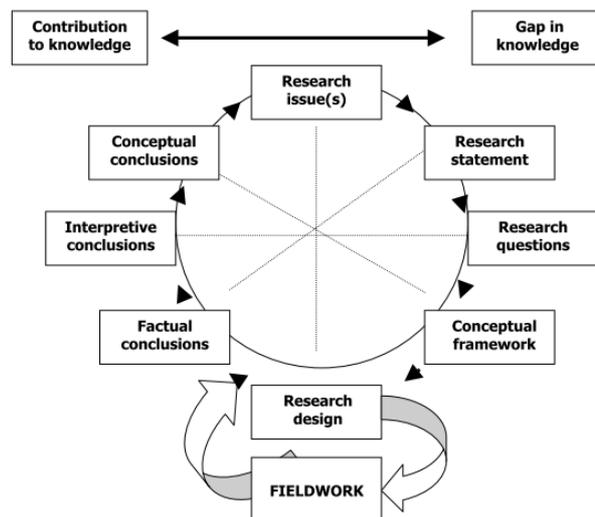
The process of developing a framework is discussed in this section. Section 2.1.3.1 explains how the framework fits into the bigger picture of a research project, and Section 2.1.3.2 describes the chosen framework development methodology, namely Jabareen's Conceptual Framework Analysis (Jabareen, 2009).

#### **2.1.3.1 Conceptual Frameworks within the Research Process**

A conceptual framework is a representation of a specific set of relationships within a research process (Leshem and Trafford, 2007). Jabareen (2009) explains a conceptual framework as a

“network, or ‘a plane’, of interlinked concepts that jointly provide a comprehensive understanding of a phenomenon or phenomena”. A conceptual framework therefore serves as a tool which brings together different concepts within a phenomenon under investigation (Leshem and Trafford, 2007). These concepts are interlinked and together reinforces the meanings and explanations, in order to explain the phenomenon under investigation, and inevitably to develop a framework-specific philosophy (Jabareen, 2009).

Figure 2.2 depicts the overall research process and illustrates where a conceptual framework fits into this process. The diagram indicates that a conceptual framework is part of the research process, which inevitably aims to contribute knowledge towards filling an existing knowledge gap. The final 3 activities depict the 3 different levels of contribution each has to offer. The internal, diagonal connections between the activities, show the causal relationships between different activities. The diagram is the ideal representation of interconnected relationships between research components of a conceptually founded framework (Leshem and Trafford, 2007).



**Figure 2.2: Visualization of research process** (Leshem and Trafford, 2007)

### 2.1.3.2 Jabareen's Conceptual Framework Analysis

For the purpose of this research, the Conceptual Framework Analysis (CFA) was chosen to develop a framework for the development of ICT4D. This framework analysis method was developed by Jabareen (2009). CFA was developed upon the basis of the grounded theory, making it suitable for this research. The advantages of using the CFA as framework development approach, according to Jabareen (2009) are as follows:

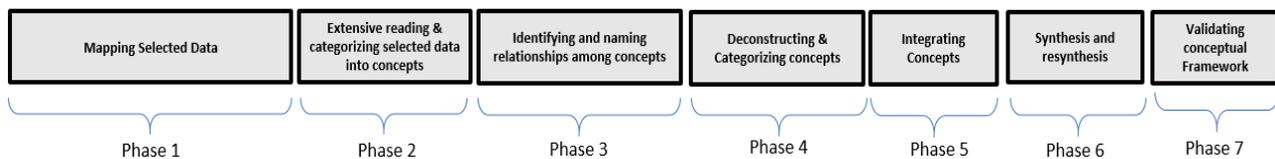
- CFA is flexible as it is constituted of flexible conceptual terms, instead of fixed theoretical variables and causal relations.
- It holds the potential to be altered and modified as the research progresses, and as social phenomena are evolutionary, it makes it applicable in the study of social sciences.

- It provides understanding of the phenomena under review, instead of predicting the phenomena.

The CFA consists of 7 phases, proposed by Jabareen (2009) and are summarized in Table 2.1 and Figure 2.3 below.

**Table 2.1: The 7 phases of CFA by Jabareen (2009)**

Phase	Objective of phase
Phase 1: Mapping the selected data sources	Identify literature regarding Information Systems for Social Development Applications
Phase 2: Reading and categorizing of the selected data	Categorize important themes regarding the literature and define necessary concepts from these themes
Phase 3: Identifying and naming relationships among concepts	Find connections and interrelationships among concepts
Phase 4: Deconstructing and categorizing the concepts	Concepts are deconstructed, by identifying main attributes, assumptions, characteristics, and role
Phase 5: Integrating concepts	Concepts are updated and integrated to reduce the number of concepts to a practical number that will be used to develop the framework.
Phase 6: Synthesis and resynthesis	This involves iterative synthesis and resynthesis of the concepts to form the framework
Phase 7: Validating the conceptual framework	Validate the conceptual framework through feedback

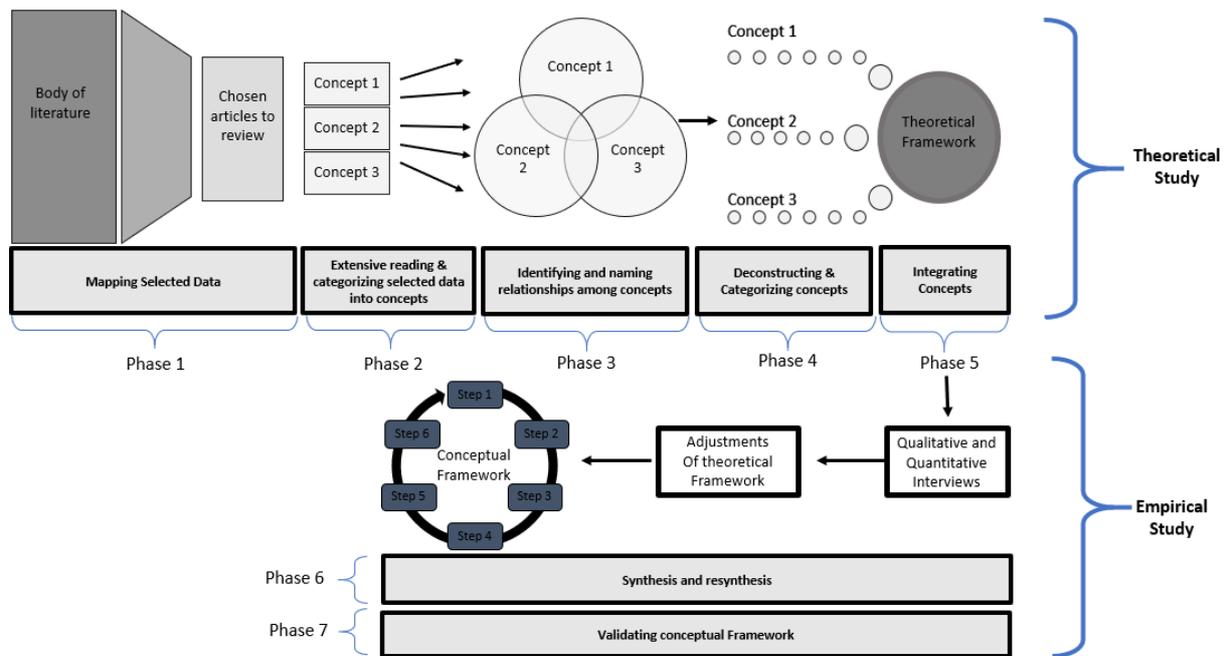


**Figure 2.3: Jabareen's CFA procedure**

Chapter 1.5 provides an explanation of the execution of the 7 phases within the thesis.

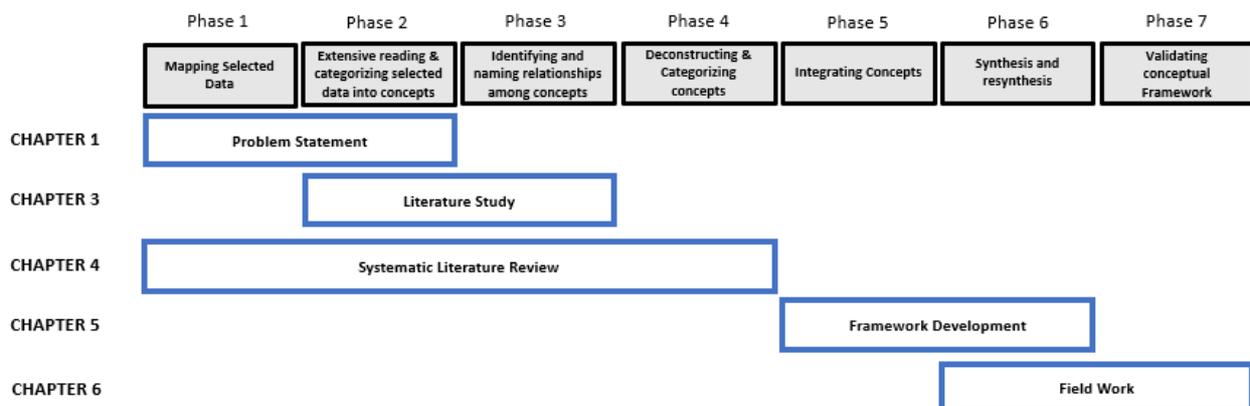
## 2.2 Structure of Thesis and overarching phases

Figure 2.4 below depicts the approach taken to develop the framework by stipulating the overarching activities relating to the different phases within the development of the framework. The figure also depicts the overarching theoretical and empirical parts of the study. The first five phases will involve the theoretical study and the last two phases will form part of the empirical study, to develop and validate the final framework.



**Figure 2.4: Approach taken towards developing the framework. Figure adapted from (Oostuizen, 2018)**

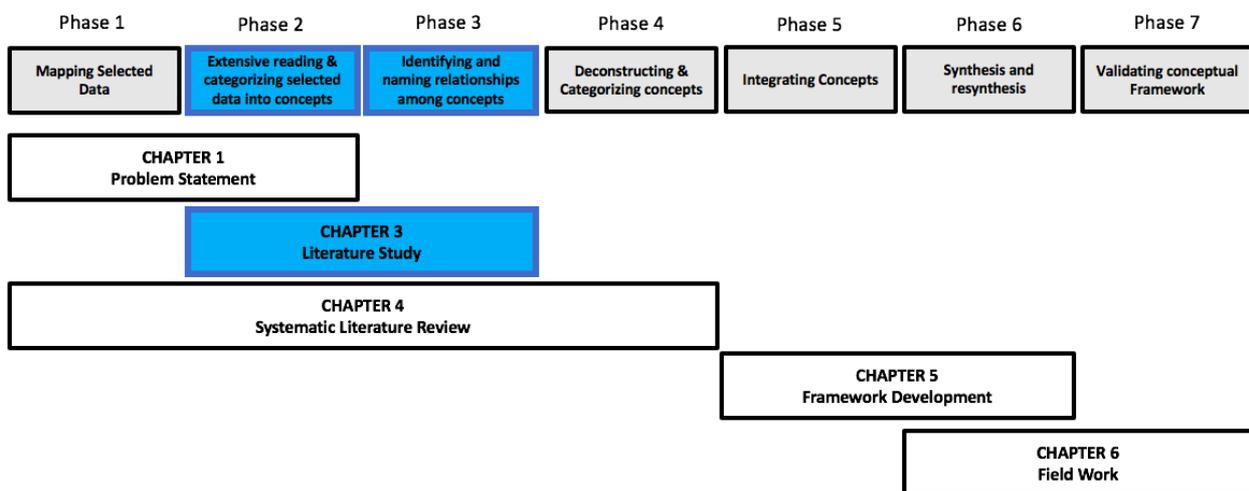
Figure 2.5 depicts the structure of the thesis and highlights the chapter progression within the study. The problem statement forms part of Phase 1 and 2. Chapter 3, the Literature Review, provides an overall view of the literature within the thesis, and forms part of Phase 2 and 3. After the reviewer has a general understanding of the literature, a systematic literature review was performed to identify specific concepts within the literature, and it forms part of Phases 1,2,3 and 4. The knowledge gained from the previous phases were then used to develop the conceptual framework and it forms part of Phase 5 and 6. The reviewer was then engaged in field work where experts provided validation and suggested improvements for the conceptual framework. These improvements were then applied to the conceptual framework to develop the final framework. The field work is discussed in Chapter 6, and it forms part of Phase 6 and 7.



**Figure 2.5 Graphic Representation of Chapters covering each Phase**

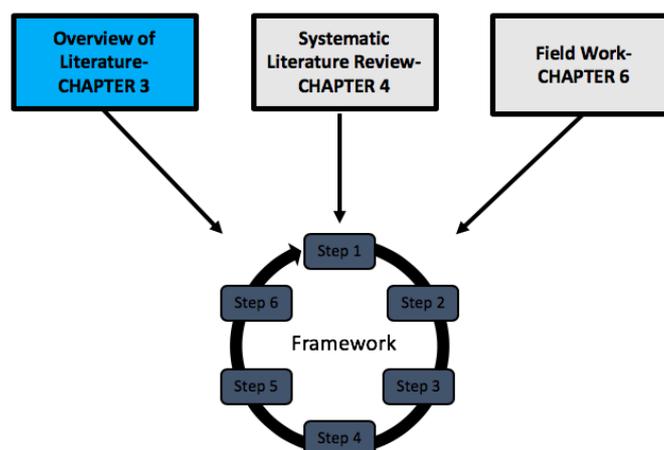
## 2.3 Literature Study

This section discusses the Literature Study. Figure 2.6 provides an overview of the research design structure, and it indicates where in the document each phase, or part thereof, is addressed. The figure also highlights the position of Chapter 3 in the thesis.



**Figure 2.6: Chapter 3 in the thesis**

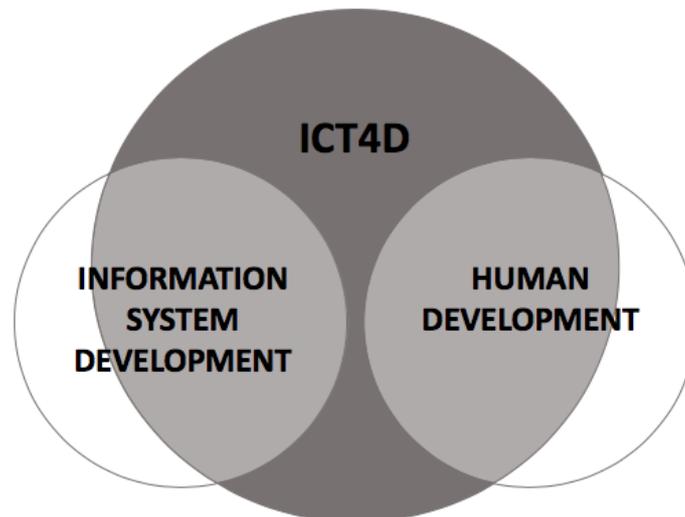
Chapter 3, The Literature Review, is the first contribution towards the knowledge needed for developing the framework. The knowledge acquired from conducting an overview literature study, as well as the systematic literature review and the fieldwork, together contribute to the development of the final framework. Figure 2.7 illustrates the contribution of the overview of the Literature Study to the development of the Framework.



**Figure 2.7: The Literature Studies Contribution towards Developing the Framework**

As depicted in Figure 2.6, Chapter 3 forms part of Phase 2 and 3 of the overall study. This Chapter involves extensive reading and categorizing selected data into concepts (Phase 2) and identifying and naming relationships amongst concepts (Phase 3). These steps are executed to conduct a background study on all the literature that will be researched within the thesis.

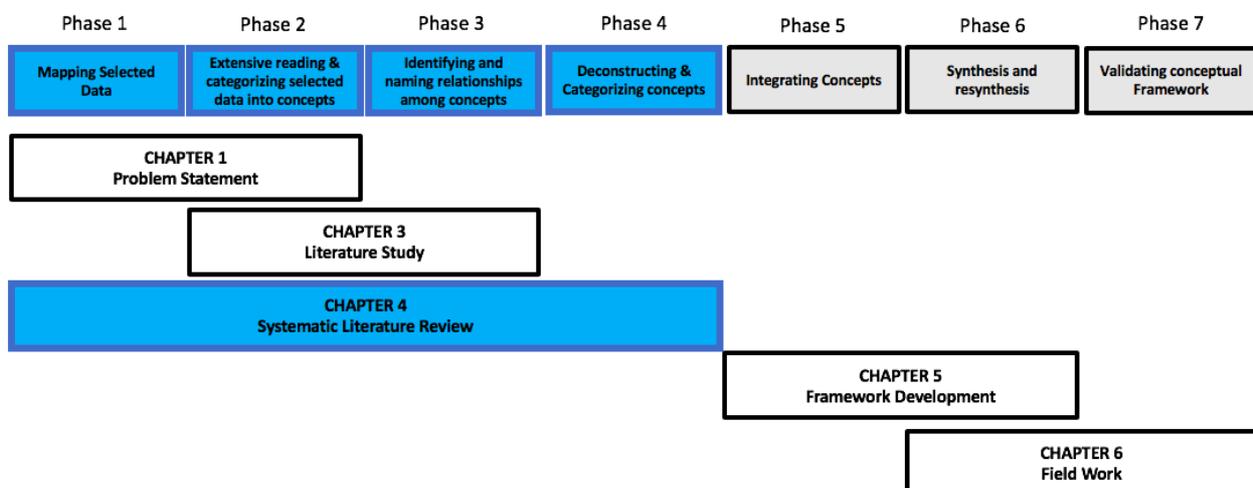
As discussed in Chapter 1, the thesis is an effort towards the development of a framework that will lay the foundation for the requirements for developing ICT4D in developing countries, specifically in the South African context. ICT4D literature incorporates multiple disciplines namely human development and ISD. Literature from these 2 fields were therefore studied as a basis of to develop a better understanding of ICT4D. Figure 2.8 depicts the literature review fields that were explored in order to develop a better understanding of the topic.



*Figure 2.8: Literature Review Fields*

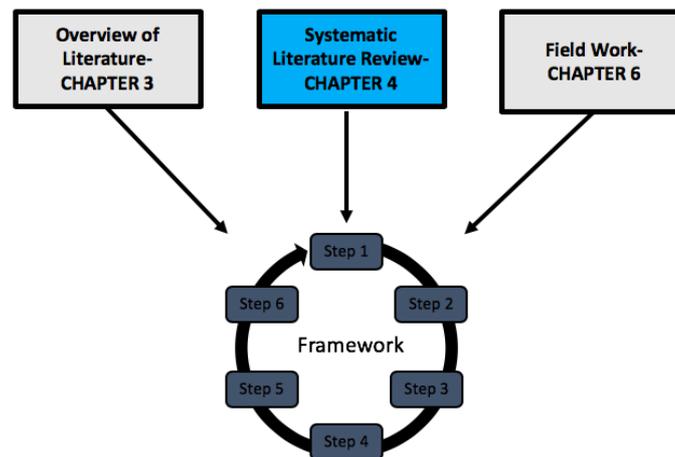
## 2.4 Systematic Literature Review

The Systematic Literature Review forms part of Phase 1: Mapping the selected data, Phase 2: Extensive reading and categorizing the selected data, Phase 3: Identifying and Naming Concepts and Phase 4: Deconstructing and Categorizing Concepts. Figure 2.9 depicts Chapter 4 within the scope of the research.



*Figure 2.9: Chapter 4 in the thesis*

As discussed in the previous section, the Literature Review, was developed as the first contribution of knowledge towards developing the framework. The literature review gave an overview of the theory used to develop the framework. The systematic literature review builds onto to the literature study by following a more in-depth procedure of analysing the literature. The Systematic Literature Review is the second contribution towards the knowledge needed for developing the framework. Figure 2.10 illustrates the contribution of the systematic literature review towards the development of the Framework.



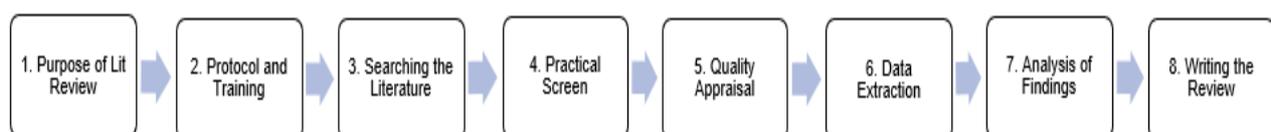
**Figure 2.10: The Systematic Literature Reviews Contribution towards Developing the Framework**

Section 2.4 discusses the methods used to conduct the systematic literature review. Section 2.4.1 introduces the 8 steps process proposed by Okoli & Schabram (2010), which was used to conduct the systematic literature review. Section 2.4.2 and 2.4.3 has a closer look at the procedures involved in these steps and gives an overview of the results obtained by conducting these 8 steps.

### **2.4.1 The 8 step process towards the systematic literature review**

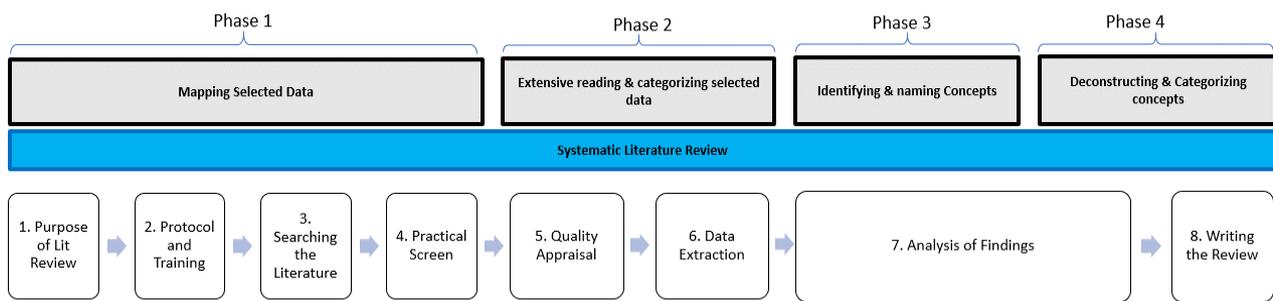
A systematic literature review is one that follows a specific methodology to clearly define the procedures followed in the process of conducting a review. A systematic literature review is comprehensive in its scope and therefore includes all the appropriate literature relating to the study. A systematic literature review can therefore be recreated by other researchers who obtain the same results, if the same defined procedure is followed (Fink, 2005; Okoli and Schabram, 2010).

The guideline presented by Okoli & Schabram (2010) presents an 8-step guideline for a scientifically rigorous literature review. Figure 2.11 shows these 8 essential steps that were followed to conduct the systematic literature review.



**Figure 2.11: Systematic guide to develop a literature review**

Figure 2.12 below demonstrates how these steps correlate with the overarching Systematic Literature Review Phase of the thesis.



**Figure 2.12: Systematic guide to developing the Systematic Literature Review**

### 2.4.2 Step 1-5

Step 1 to 5 involves identifying the applicable literature that will be used to develop the framework. Step 1 of the systematic guide to develop the systematic literature review requires clearly defining the purpose of the literature review, thus stating the purpose and the intended goal of the review (Okoli and Schabram, 2010). This step was covered in the Problem Statement and the Objectives in Chapter 1. Step 2, protocol and training requires clarifying the procedures to accurately and systematically define the means of completing the review (Okoli and Schabram, 2010). This step is covered in this Chapter through the entire explanation of the methodology that was used.

Step 3, 4 and 5 requires identifying all the appropriate literature that will be used to develop the framework. These steps firstly involved searching the literature. This was done by entering specific key words into several search engines. These specific words entered into the search engines are discussed in detail in Chapter 4. The titles retrieved from the search engines then underwent a practical screen to check which comply with a specific including criteria. The documents identified then went through quality appraisal to screen for exclusions. This step requires that the reviewer clearly stipulates the criteria used to determine which studies possess sufficient quality for inclusion and which studies possess insufficient quality for exclusion (Okoli and Schabram, 2010), and is discussed in Chapter 4.

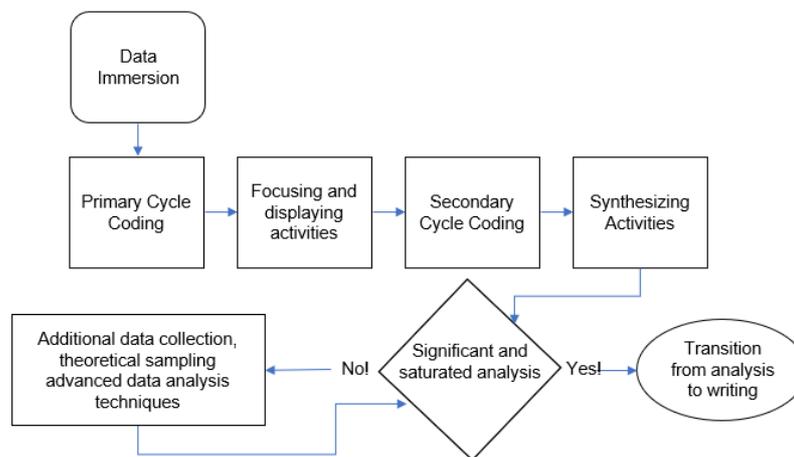
The applicable documents were identified, and later duplicates were deleted. A total of 133 articles were identified in searching the literature and was used to develop the framework.

### 2.4.3 Step 6-8

Step 6 and 7 involves extracting data, organizing the data and making sense of the data so that relevant concepts and their relationships can be identified within the data. Step 6 requires a systematic process to extract the relevant data from the identified articles (Okoli and Schabram, 2010). The data from the 133 articles were extracted according to the research questions posed in the Research Objectives in Chapter 1. Step 7, the analysis of the findings, is embedded within the

data extraction stage and involved an iterative process. As data was being extracted, codes, memos and notes relating to the data were made, compared and organized, so to make comprehensive sense of the literature.

The codes within the literature were developed through primary and secondary cycle coding. The primary cycle coding captured prominent, collective, fundamental or expressive attributes in the literature. During the Primary-cycle coding, the emerging codes identified in the literature were recorded in a systematic code book which served as a chronological map, depicting the creation of the codes and their changes throughout the coding process. The secondary cycle coding went further by grouping and organizing codes into interpretive concepts. The secondary cycle coding therefore involved analysing and developing theories from the primary codes. Figure 2.13 depicts the iterative coding process followed. Qualitative analysis software, Atlas.ti, was used to conduct this coding process.

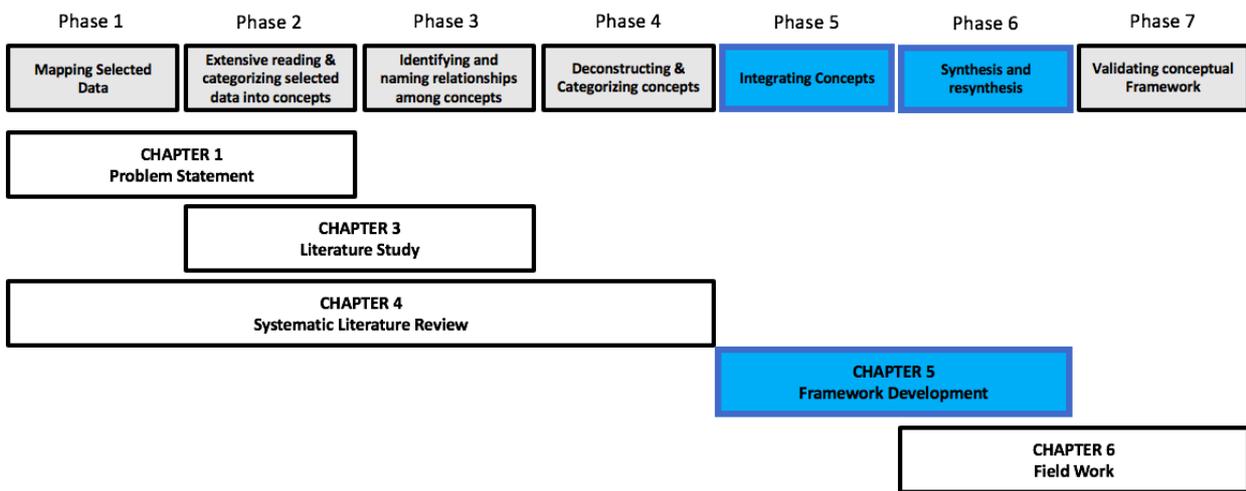


**Figure 2.13: Flow chart depicting the iterative coding process (Tracy, 2013)**

The final step of the systematic guide to developing a systematic literature review involved writing the review. Once all the data was collected for the review, the literature was recorded. Chapter 4 is the comprehensive written document containing the results from the systematic literature review.

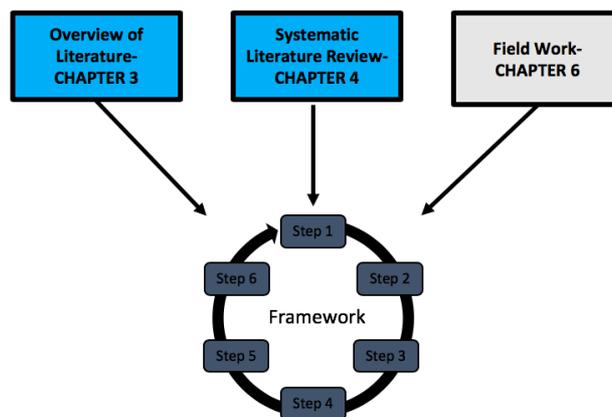
## 2.5 Framework Development

In the Chapter 3 and 4, the major concepts and the relationships amongst each of these concepts were identified to develop a better understanding of ICTs4D, specifically in the South African context. The concepts and their relationships were used to develop the conceptual framework in the Framework Development Chapter. The framework represents the researcher's integration of literature whereby the topic under review can be explained. This section discusses the conceptual framework development process. Figure 2.14 below provides an overview of the research design structure followed, and indicates where in the document each phase, or part thereof, is addressed.



**Figure 2.14: Chapter 5 in the thesis**

The Framework Development is addressed in Chapter 5 and covers Phase 5 and 6 of the research approach. The development of the framework in Chapter 5 thus involved integrating concepts, identified within the Literature Review and the Systematic Literature Review and synthesis and resynthesis of these concepts. The contribution of knowledge used to develop the conceptual framework in Chapter 5, is illustrated in Figure 2.15. The final contribution of knowledge towards the development of the framework is the knowledge acquired through field work which is further elaborated upon in Section 2.6.



**Figure 2.15: The Contribution towards Developing the Conceptual Framework within Chapter 5**

### 2.5.1 Integrating concepts

The previous phases, Phase 2, 3 and 4 of the framework developing approach by Jabareen (2009), involved identifying concept’s within the overall body off literature. Phase 5 which is conducted within the Framework Developing Chapter looks at the concepts identified within those phases and integrates these concepts to reduce the number of concepts to a practical number that will be used to develop the framework. This integration process involved firstly looking at the concepts identified within Chapter 3 and integrating these concepts to develop a structural basis, i.e., a systematic

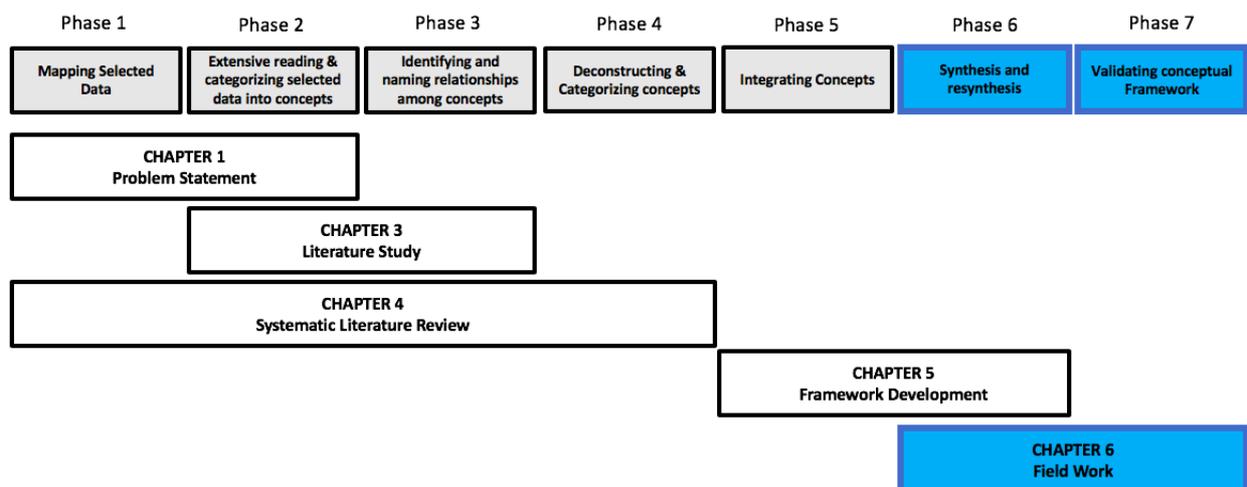
process that is used to build upon and develop the framework. Section 5.1.2 further looks at the concepts identified in Chapter 4, which are three overarching concepts relating to activities used within the development of ICT4D, i.e., analytical, design and functional activities. These activities were then further integrated and systematically arranged upon the framework structure.

## 2.5.2 Synthesis and resynthesis

The integration process resulted in analytical and design activities grouped into their appropriate order of execution that can be used to guide the development of ICTs4D. There however still exists functional activities that needed to be integrated into this structure, but it was discovered that the functional activities did not relate to any of the steps within the structural basis of the framework. The synthesis and resynthesis phase therefore explored the relationships between the, analytical, design and functional activities in order to appropriately incorporate the functional phase into the structure of the framework. The synthesis and resynthesis phase then finally synthesised all the findings from this Chapter to form a cohesive whole which is a systematic process that can be followed to guide the analysis and design of ICT4D, i.e, the conceptual framework.

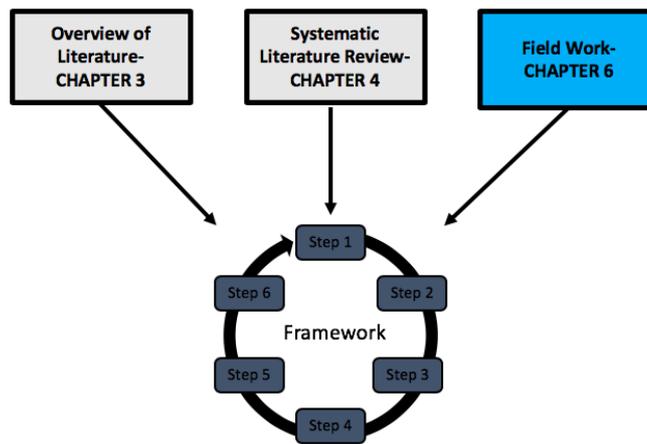
## 2.6 Field Work

This section discusses the Field Work involved in improving and validating the framework. Figure 2.16 provides an overview of the research design structure followed and it indicates where in the document each phase, or part thereof, is addressed. The Field Work forms part of Phase 6 and 7 and is addressed in Chapter 6.



**Figure 2.16: Chapter 6 in the thesis**

The field work contributes the final knowledge needed towards developing the framework. The knowledge input from conducting an overview literature study, the systematic literature review and now the field work, together contribute to the development of the completed framework. Figure 2.17 depicts the knowledge input of the Field Work to develop the framework



**Figure 2.17: Knowledge input used to develop the framework within Chapter 6**

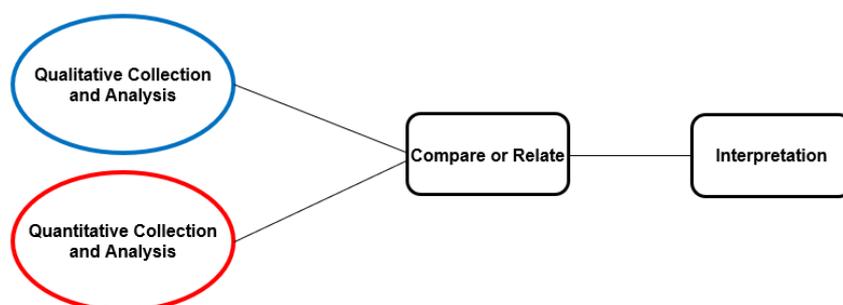
As depicted in Figure 2.16, the field work involves synthesis and resynthesis, i.e. Improving the framework and validation of the framework.

This study adopts a mixed-methods approach for improving and validating the framework. This method is used as it is expected to develop greater understanding of the framework by using a diverse set of collected data.

Section 2.6.1 describes the mixed methods approach used within the fieldwork. The mixed methods approach involves the use of quantitative and qualitative procedures. The study uses interviews with 10 individuals with experience in the field of ICTs4D, to conduct these quantitative and qualitative procedures. Section 2.6.2 provides background theory regarding the use of interviews for qualitative and quantitative analysis. Section 2.6.3 provides an overview of the entire field work process and Section 2.6.4 concludes by giving a summary of Section 2.6.

### **2.6.1 Mixed method approach**

The mixed methods approach uses qualitative and quantitative data collection and analysis methods in parallel. Thus two different types of data are collected, analysed and compared (Kemper, Stringfield and Teddlie, 2003) and finally, interpretations are made regarding these comparisons and relations. This process is illustrated in Figure 2.18.



**Figure 2.18: Mixed method approach**

Interviews were used to conduct the quantitative and qualitative data collection and analysis. These interviews were conducted within two phases. The first phase involved the qualitative analysis and used semi-structured interviews to collect data from 10 individuals with industry experience in the field of ICT4D. The second phase used ranking interviews as a quantitative data collection and analysis method, with the same individuals. These interview procedures are explained in more detail in the following section.

The purpose of using the mixed methods approach according to Greene et al. (1989) for validation purposes, include, triangulation, complementarity, development, initiation and expansion. These five reasons for using the mixed methods approach and their application within this study, is discussed in Table 2.2.

**Table 2.2: Five Reasons for using the Mixed Methods Approach**

Reason for Use	Explanation	Application within Study
Triangulation	Triangulation seeks to find convergence and correspondence of results obtained from different methods (Greene, Caracelli and Graham, 1989).	The qualitative and quantitative research was used in parallel to increase the validity of the construct within the framework by comparing the qualitative results (semi-structured interviews) with quantitative results (ranking interviews) to distinguish if the data corresponds and supports one another.
Complementarity	Complementarity seeks to find explanations, enhancements, illustrations and clarifications from one set of results obtained from a specific method, for results obtained from a different method (Greene, Caracelli and Graham, 1989).	The qualitative interviews together with the quantitative interviews were used to provide clearer interpretation of one another and provide meaningfulness for the results. This was also used to highlight biased methods within the framework.
Development	Development seeks to improve one research method using the results obtained from another (Greene, Caracelli and Graham, 1989).	The open-ended questions within the semi-structured interviews (qualitative data) directed the researcher to use a ranking method (quantitative data) for more decisive data that could be compared more easily.
Initiation	Initiation seeks to increase the scope of the results by utilizing the different perspectives from the different methods to initiate new findings from different methods (Greene, Caracelli and Graham, 1989),	The open-ended questions from the semi-structured interviews were used to initiate further conversation. These topics identified within the qualitative study, generally related to the usefulness and accuracy of the framework as a whole, and thus the ranking method was developed to quantitatively determine the usefulness of and accuracy of each concepts within the framework.
Expansion	Expansion seeks to increase the scope of enquiry used to obtain the results and thus encouraged the use of different enquiry methods for appropriate data collection (Greene, Caracelli and Graham, 1989).	The first phase of the interview process, the semi-structured interviews, focused on the framework under review and its practicality and the need for such a framework. In the second phase the ranking interviews allowed the researcher to expand the

Reason for Use	Explanation	Application within Study
		scope of the study and to question the different concepts within the framework.

## ***2.6.2 Qualitative and quantitative Interviews***

The literature reveals that there exist various interview styles. This includes the structured, semi-structured and unstructured categories of interviews (Oosthuizen, 2016).

Structured interviews are commonly used in quantitative research and often used in survey research. Structured interviews ensure that each interview is presented to all participants without variation in its content and structure. This approach provides a simplistic way to compare answers of participants (Breat, 2009).

The main method used for data collection in qualitative data research, involves using semi-structured interviews. The interviews provide a flexible structure for the outline of the research process and ensure that specific topics are covered. The interviews are very open-ended and allows participants to direct the study through their specific responses. Semi-structured interviews therefore provide a means of covering wider scope than structured interviews (Stuckey, 2013).

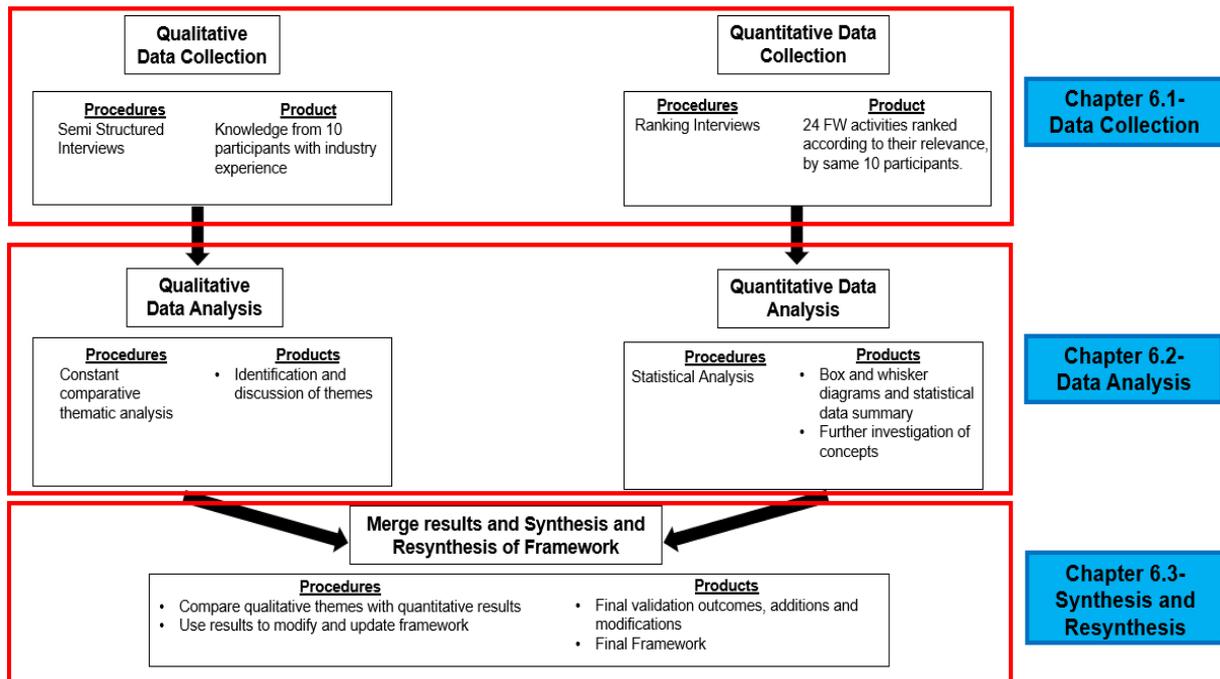
Semi-structured interviews were chosen for the validation process. This method was chosen so that questions could be structured in a way that allowed the discovery of the beliefs and attitudes of the participants towards the usefulness of the ICT4D framework. The semi-structured interviews also allowed participants to express their views spontaneously, as the open-ended question minimized restrictions and influence from the researcher's opinions to their answers. Semi-structured interviews gave the reviewer the ability to be directed by the participants, thus ensuring that a wider scope of topics were covered and that relevant data was captured, minimizing bias by allowing participants to respond and provide information they deemed important and relevant.

The interviews were conducted within two phases. The first phase involved qualitative data collection and analysis and the second phase the quantitative data collection and analysis. The first phase made use of semi-structured, open-ended questions where the participants could provide insight into the validity and usefulness of the framework. The qualitative interviews used ranking questions, in which the participants had to rank the concepts in the framework according to their relevance to the successful development of ICT4D.

## ***2.6.3 Structure of Validation Process***

The mixed method approach used within this study utilised interviews for the qualitative and quantitative data collection and analysis procedures. These procedures were then used to validate and improve the framework. The qualitative and quantitative data collection and analysis along with

the results from these procedures are discussed on Chapter 6. The mixed methods process and the corresponding Sections where each step is addresses is graphically depicted in Figure 2.19.



**Figure 2.19: Fieldwork and corresponding Chapters. Figure adapted from Stenger, Ritter-Gooder, Perry, & Albrecht (2014)**

As depicted Figure 2.19, the fieldwork started with the qualitative and quantitative data collection process. The qualitative data collection involved 10 semi-structured interviews with experts in the ICTs4D field. The quantitative data collection process then followed which involved using ranking interviews conducted with the same participants. The product of these ranking interviews includes 24 concepts that are ranked according to their relevance to the successful development of ICTs4D.

The data from the qualitative analysis were analysed through constant comparative thematic analysis, where themes identified within each semi-structured interview were compared to themes identified in the other interviews. The products from this analysis procedure were identification and discussion of common themes.

The quantitative analysis involved a statistical analysis of the ranking data obtained from the ranking interviews. The quantitative results were then used to identify concepts for further investigation.

The qualitative and quantitative results were then compared and merged, and the results were used for the synthesis and resynthesis (i.e. Improvements) and validation of the framework. The product of the merged results includes final validations, additions and modifications to the framework.

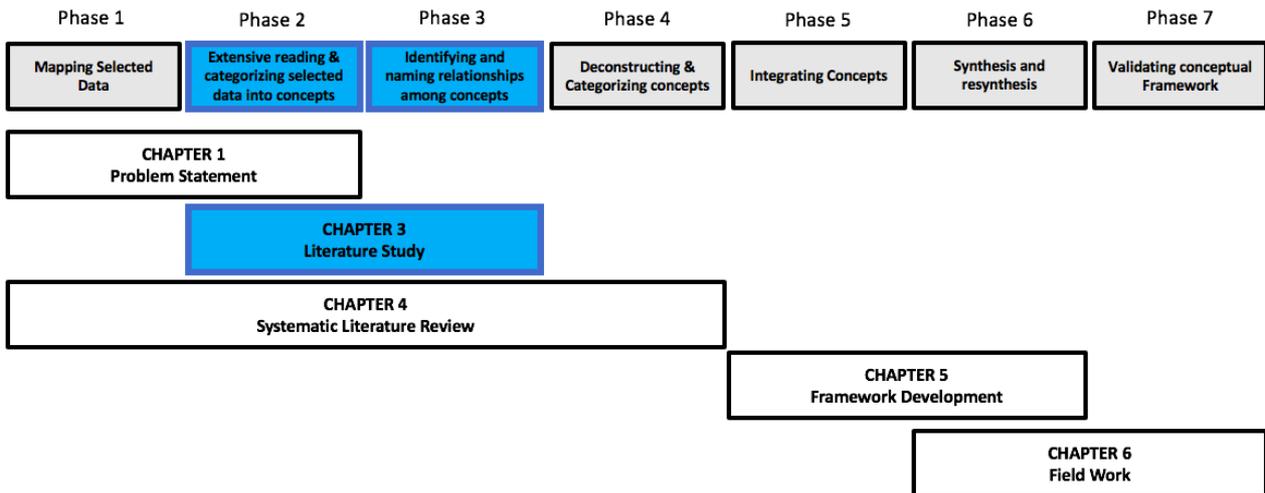
## 2.6.4 Field Work Conclusion

Chapter 2.6 explains the fieldwork process used to improve and validate the framework in Chapter 6. The mixed methods approach was chosen as the appropriate approach to conduct the validation

process. This approach uses qualitative and quantitative data collection and analysis. The results from the qualitative and quantitative procedures are compared and used within the Synthesis and Resynthesis Phase to produce and validate the final framework.

## CHAPTER 3- LITERATURE REVIEW

This section discusses the Literature Review. Figure 3.1 provides an overview of the research design structure followed and indicates where in the document each phase, or part thereof, is addressed. The Literature Review forms part of Phase 2 and 3.

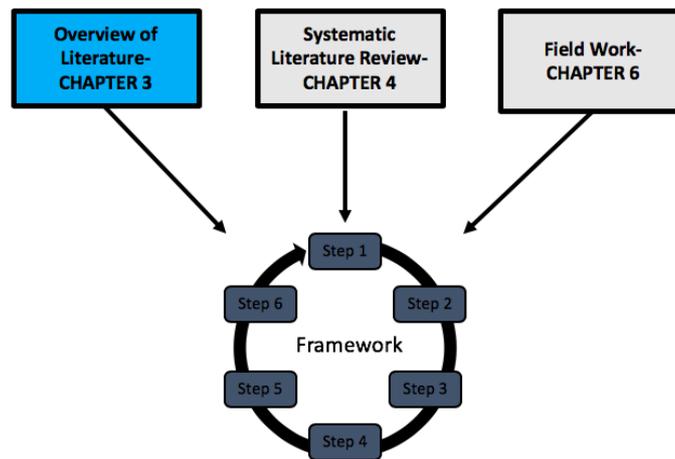


**Figure 3.1: Chapter 3 within the scope of the whole research**

As stated in Chapter 1, the thesis consists of a theoretical study and an empirical study. Chapter 3 forms part of the theoretical study and the key objectives within the theoretical study, which Chapter 3, The Literature Study, aims to attain are:

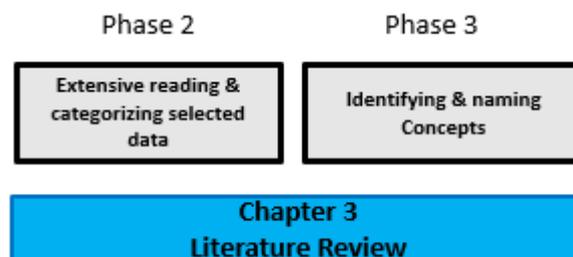
- 1) Investigate the definition and literature regarding the field of social development by analysing existing theories, tools and frameworks.
- 2) Evaluate the literature surrounding the definition of ICTs4D in developing countries.

Chapter 3, The Literature Review, is the first contribution towards the knowledge needed for developing the framework. The knowledge input from conducting and overview literature study, the systematic literature review, and the fieldwork, together contribute to the development of the final framework. Figure 3.2 illustrates the contribution of the overview Literature Study to the development of the Framework.



**Figure 3.2: The Literature Studies Contribution towards Developing the Framework**

The overarching Phases 2 and 3 were executed to perform the literature review. Chapter 3 includes Phase 2 – Extensive reading and categorizing selected data, and Phase 3 – Identifying and Naming concepts.

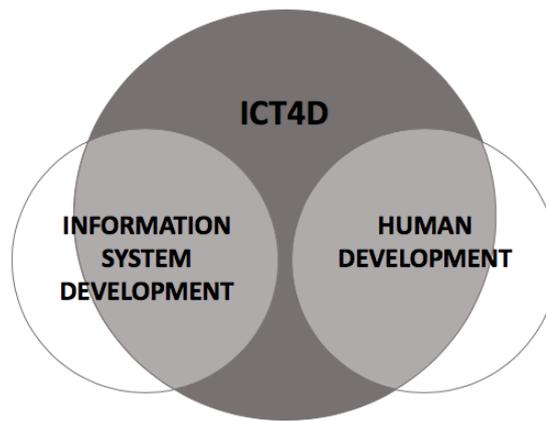


**Figure 3.3: Chapter 3 and its overarching Phases**

According to Jiménez and Yingqin (2018) the literature surrounding ICT4D draws from theories found in Information System Development and Human/Social Development literature. Therefore, the following three fields of literature, were explored within this thesis:

1. Section 3.2 - Information System Development (ISD)
2. Section 3.3 - Human/Social Development
3. Section 3.4 - Information Communication Technology for Development (ICT4D)

Phase 2 and Phase 3 were executed and knowledge was drawn from each sphere to ultimately understand how the literature relates to each other and therefore provide a deeper understanding of ICT4D. Figure 3.4 depicts the overarching fields of literature.



**Figure 3.4: Literature explored in Literature Review**

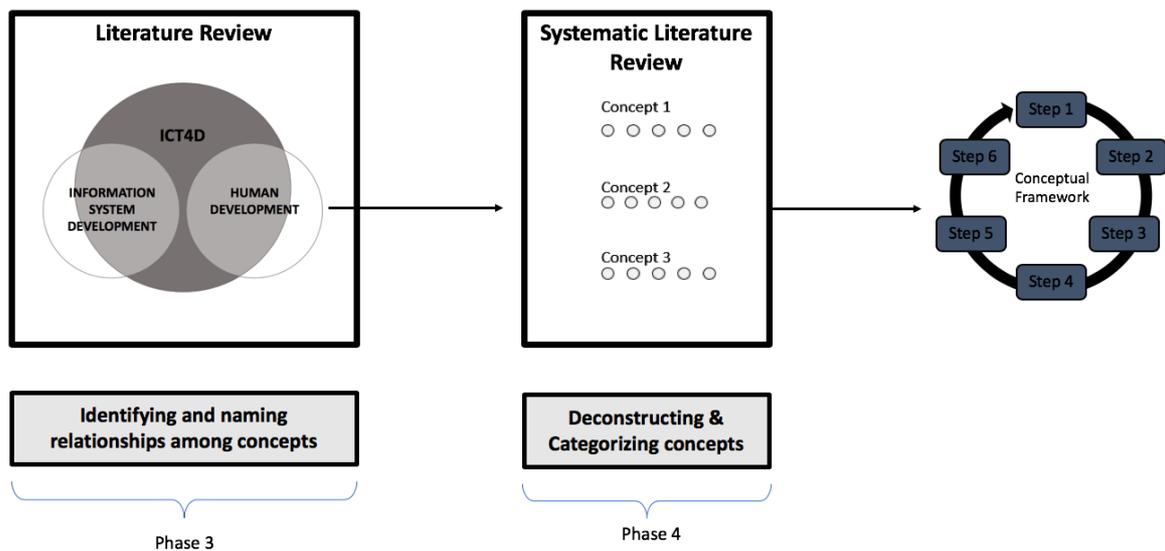
Within each overarching field of literature, the existing definitions and typologies of the subject matter, the distinction between phenomena and dimensions of phenomena, and the existing relevant models and theories, were explored. Section 3.1 introduces the reader to the theory behind conducting a literature review. Section 3.2 starts with taking a closer look at the first field of literature, literature surrounding Information System Development. Section 3.3 follows and explores Human/Social Development Literature. Section 3.4 looks at literature surrounding ICT4D and Section 3.5 concludes with a summary of the findings in Chapter 3

### **3.1 Conducting a Literature Review**

A well-written literature review is used to justify the approach and selection of methods used in a research study and it demonstrates the contribution the study makes to the literature (Hart, 1998). It facilitates theory development, and also reveals research areas that can still be explored (Levy and Ellis, 2006). Levy & Ellis (2006) states that a literature review should

- a) methodologically analyse and synthesize quality literature
- b) lay a foundation for the study
- c) lay a foundation for the correct selection of methodologies and
- d) demonstrate the new contribution the study makes to the overall body of knowledge.

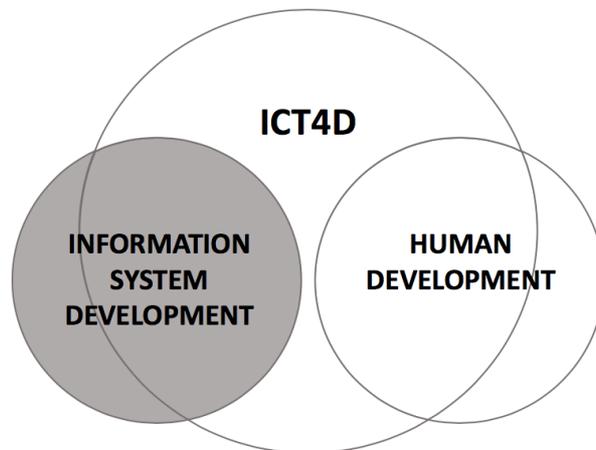
The three overarching concepts, ISD, Human/Social Development and ICT4D were used as inputs. The literature surrounding these fields were processed to deliver outputs that can guide the reviewer towards conducting a Systematic Literature Review that would inevitably stipulate the requirements for the framework. Figure 3.5 below illustrates how the literature review and the systematic literature review were used to create the conceptual framework.



**Figure 3.5: Development of the Conceptual Framework**

### 3.2 Information System Development

Information System Development is the first concept to be reviewed that will contribute towards laying the foundation for creating the framework. Figure 3.6 depicts the literature under review within this section.



**Figure 3.6: Information System Development Literature**

Information Systems are systems with a specific focus on information (Jessup & Valacich, 2008). The study of Information Systems includes the process of collecting, filtering, processing, creating and distributing information, as well as the networks of hardware and software that individuals as well as organizations use to execute the processes involved in a system.

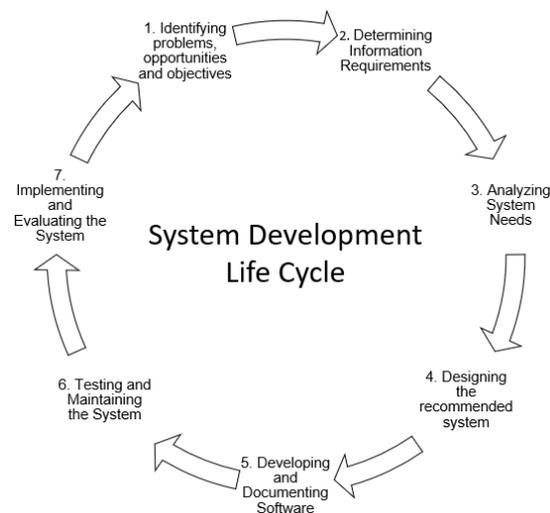
The use of these Information Systems differs according to various system and user requirements, and according to Falkenberg et al. (1998) the three predominant definitions relating to the use of the system are:

1. A technical system implemented with technology related to computer and telecommunications;
2. A social system, such as an organisation with its information needs;
3. A conceptual system which is a construct of one or of both views above.

Section 3.2 explores Information Systems within the following sub-sections. Section 3.2.1 looks at the System Development Life Cycle, the common phases followed for the development of most systems. Section 3.2.2 explores the methodologies used to develop different Information Systems and Section 3.2.3 discusses the means of identifying the different ISD methodologies that will be used to develop different systems.

### 3.2.1 System Development Life Cycle

The System Development Life Cycle (SDLC) Phases describes the common phases followed for the development of most systems, and a wide spectrum of methodologies use the SDLC phases as foundation. The system development life cycle encompasses a cycle of 7 phases to guide developers towards the development of systems (Kendall and Kendall, 2011). Figure 3.7 depicts this life cycle.



**Figure 3.7: System Development Life Cycle adapted from Kendall and Kendall (2011)**

The 7 phases involve the following activities as described by Kendall and Kendall (2011) and is depicted in Table 3.1.

**Table 3.1: Seven Phases of the SDLC described by Kendall and Kendall (2011)**

Phases within SDLC	Description of phase	Activities in this phase include
Phase 1: Identifying problems, opportunities, and objectives.	Opportunities are conditions that can be improved using IS. Stipulating specific objectives is crucial to the relevance and success of the system. Identifying what a specific business or project intends to achieve, will help analysts design a successful and relevant system, through addressing the identified problems and opportunities. The people who are involved in this first phase include users, analysts and system managers coordinating the projects.	<ul style="list-style-type: none"> <li>• Interviewing user management</li> <li>• Summarizing the knowledge that has been attained</li> <li>• Estimating scope of project</li> <li>• Documenting results</li> <li>• Creating a feasibility report which specifies the identified problems and objectives. From the feasibility report a decision needs to be made whether to carry on with the proposed project or to consider another solution.</li> </ul>
Phase 2: Determining Human Information Requirements	This phase is intended for the identification of the requirements which will create an audible, legible and safe system. Analysts identify human information requirements through using different tools and methods. These methods include interactive methods, unobtrusive methods, and all-encompassing methods. These methods identify the capabilities of users, such as their strengths and weaknesses regarding the use of the system.	<p>Interactive methods involve:</p> <ul style="list-style-type: none"> <li>• Sampling</li> <li>• Interviewing and</li> <li>• Investigating hard data and questionnaires.</li> </ul> <p>Unobtrusive methods include:</p> <ul style="list-style-type: none"> <li>• Observing decision makers behaviour and environments.</li> </ul> <p>All-encompassing methods involve:</p> <ul style="list-style-type: none"> <li>• Activities such as prototyping.</li> </ul>
Phase 3: Analysing System Needs	An effort is made to create a new efficient system that satisfies the current needs of the user and has scope for future growth within the organizational constraints. Tools such as data flow diagrams, activity diagrams, or sequence diagrams, are used in this phase to illustrate the sequence of events, resulting in logical, graphical depictions of a system.	<p>The following points highlight typical steps in this phase:</p> <ul style="list-style-type: none"> <li>• Depicting system in structured, graphical form.</li> <li>• Identifying the functional hierarchy showing the functions to be performed by the new system, and their relationship with one another.</li> <li>• Data dictionary development, listing all the items and their specifications used in a system.</li> <li>• Providing a proposal for an efficient system that solves user requirements.</li> </ul>
Phase 4: Designing the Recommended System	This phase is the most critical phase in the development of a system. In the system analysis, a logical and structured system was designed and depicted in graphical form. It is in this phase that the process of converting it into physical form is executed.	<ul style="list-style-type: none"> <li>• Identify the exact system required output.</li> <li>• Identify what the data requirements are for producing the outputs.</li> <li>• Identify what medium will be used to implement the system, as well as the format of files and databases.</li> <li>• Utilize software and formulate process methods to generate the output.</li> <li>• Identify how data will be captured, how inputs will be made, and what interface will be used. The</li> </ul>

Phases within SDLC	Description of phase	Activities in this phase include
		<p>interface connects the user with the system, e.g. keyboard, on-screen menus, graphical user interface (GUI).</p> <ul style="list-style-type: none"> <li>• Determine controls and backup procedures to protect the system and data.</li> </ul>
Phase 5: Developing and Documenting Software	This phase involves the coding of the system into a computer/ programming language – also referred to as the programming phase. Programmers play the key role in this phase. In this stage the processes are transformed into control specifications with the aid of a computer language	<ul style="list-style-type: none"> <li>• Programming</li> <li>• Designing</li> <li>• Coding</li> <li>• Removing any errors in the computer program.</li> </ul>
Phase 6: Testing and Maintaining the System	This phase involves testing the completed programme before relinquishing it to the users. This stage is broken into Programme testing and System testing	<ul style="list-style-type: none"> <li>• Programme testing To identify any errors or any other undesirable occurrences in the operation, for needed error corrections to be made.</li> <li>• System testing Involves using actual data to test the system outputs. A complete system execution is done with actual data, and the output results are analysed. Faults are identified and fixed. The testing procedure is then repeated</li> <li>• Maintenance Carried out regularly throughout the life of the information system. Maintenance, such as program updates, can occur automatically</li> </ul>
Phase 7: Implementation and Evaluating the system	Training users in the operation of the system. Evaluation takes place in this phase, but it is in fact an integral part of the whole SDLC. Evaluation should occur at every stage of the life cycle. Due to new problems that arise, analysts must return to previous stages before they can go onto a next stage. Evaluation throughout the whole lifecycle is therefore crucial, in order to minimize changes in the implementation stage	<ul style="list-style-type: none"> <li>• Training users</li> <li>• Evaluation</li> </ul>

### 3.2.2 Information System Development Methodologies

As stipulated in Section 3.1, one of the 4 requirements, for conducting a literature review is to lay a foundation for the correct selection of methodologies (Levy and Ellis, 2006). Therefore, the literature explores the various existing ISD methodologies that can be used as a foundation platform for the development of the ICT4D framework.

According to De Vries (2004), Information System Development is the process through which Information Systems are conceived, analysed, designed and implemented and an Information

System Development methodology is used to systemise and structure this process. A combination of system development approaches, system development process models, and system development techniques, form part of the definition of Information System Development Methodologies (Huisman and livari, 2006). Gasson (1995) states that an ISD methodology is more than mere methods used for the development of ISs as it is a holistic approach with various elements.

This section analyses these various ISD methodologies. Section 3.2.2.1 explores the differences which exist within the development of the existing methodologies. Section 3.2.2.2 explores the various elements constituting an ISD methodology and Section 3.2.2.3 looks at how these different methodologies are categorised.

### **3.2.2.1 Complexities in the development of ISs**

As an academic discipline, Information Systems in itself is inconsistent, as examination of the subject reveals the lack of agreement regarding the meaning of numerous fundamental concepts within IS (Gray, 2003). This lack of agreement regarding basic concepts, has inhibited communication in this field and thus Banville & Landry (1989) refer to this discipline as fragmented. When referring to information system development, various views regarding the scope of this field are encountered, since various fields and disciplines relate to ISD in different ways. The concepts in the field of IS are interpreted differently by different groups of people and thus many different approaches exist in the development of ISs (Falkenberg *et al.*, 1998). According to Falkenberg *et al.* (1998) the major reasons for these various interpretations of concepts and discrepancies in approaches towards the design of ISs, are the great number of 1) interest groups, 2) conflicting philosophical positions and 3) lack of understanding communication. These reasons for discrepancies in approaches are now discussed in more detail.

#### 1) Interest Groups

The interest groups can be divided into two groups: the suppliers as well as the users of Information System (IS) products and services. The suppliers form a community that is more united, and they tend to place emphasis on the technology used in ISD. The users tend to support the social view, which serves the interests of users better. There exists a great gap between the technical, formal community, and the community that focuses more on social factors. This is the main cause for misunderstanding regarding the approach and understanding of ISD. (Falkenberg *et al.*, 1998)

#### 2) Philosophical Positions

The different philosophical positions are rarely made clear, but they usually account for many of the discrepancies in fundamental concepts. It is therefore essential to explicitly reflect on each one (Falkenberg *et al.*, 1998). The major philosophical positions include:

- Nominalist

These groups of people view IS as operating through deterministic principles, and they believe a straightforward explanation regarding the operation and requirements of ISs can be given. They form part of a work sector that are usually dominated by machines and formal language of logical and systematic operations and calculations. The study of IS among groups in this field has proven very fruitful, provided no factors outside the domains of hardware, software engineering, formal linguistics, or logic, are considered. The simplifications of this technically focused interest group make it relatively straightforward to identify and use powerful formal ISD methods with effective and successful results. (Falkenberg et al, 1998)

- Objectivists

This group forms part of most of the practical system analysts/designers, who view the existence of the world outside themselves and believe that this reality simply needs to be recorded as an obvious consistent set of concepts. Their surrounding reality, they believe can be expressed through obvious 'entities', 'relationships', 'objects', etc. Formal methods form part of their field of work and these methods are extended by giving the concepts within these methods' symbolic names and numbers. The objectivists view suits limited and small scale, non-contentious subjects (Falkenberg et al, 1998). This position, however, is challenged when system designers and analysts move beyond the boundaries of an engineering organisation and into an environment of conflict. The idea that reality simply needs to be recorded as an obvious consistent set of concepts, does not bear scrutiny in this context (Searle and Willis, 1995).

- Subjectivist and Constructivist

Subjectivists recognise that all conception of reality is purely shaped by private and personal experiences. Constructivists extend this view with their definition of 'inter-subjective reality', where the experiences about reality are shared, to reach agreement regarding categories of concepts and boundaries of individuals (Falkenberg et al, 1998). The constructivist does not validate the objectivist's assumption that reality can be expressed through obvious 'entities', 'relationships', 'objects', etc. Falkenberg et al. (1998) state that these conflicting philosophical assumptions regarding IS, make it crucial to establish the advantages and disadvantages of the various positions, and to deliberately choose one position that is suitable for the development of a specific IS.

### 3) Complexity of Communication

Communication forms an integral part in ISD, and the different communication layers which exist within the development of ISD, is cause for misunderstanding and discrepancy in views regarding the design of ISs. These different communication layers are depicted by a symbolic framework proposed by Stamper (1973), which highlights the semiotic layers of communication within ISs. According to Falkenberg *et al.* (1998), these layers which describe the different communication layers within ISs are;

- 1) the physical layer (physical representation, media, and the extent of contact available);
- 2) the empirical layer (variety and prevarication encountered; syntactical layer (the use of language, structure and logic);
- 3) the semantical layer (meaning and validity of statements);
- 4) the pragmatic layer (intention and consequences behind the expressed statements) and
- 5) the social layer (interests, beliefs and commitments behind expressed statements)

These layers can be grouped into two domains: the technical domain and the social domain. Physical, empirical and syntactical layers make up a domain where technical and formal methods are appropriate for analysis and design, but the layers grouped under social aspects (semantical, pragmatic and social) cannot be adequately analysed and designed by formal methods without modification. Both domains present problems in the development of ISs. The technical layers are usually approached by a confined and limited way of thinking, where the computerised parts of information systems are viewed within formal concepts. The semantical, pragmatic and social domains, however, also create problems when they are approached in the traditional manner, by attempting to develop similarly neat and tidy solutions. (Falkenberg *et al.*, 1998)

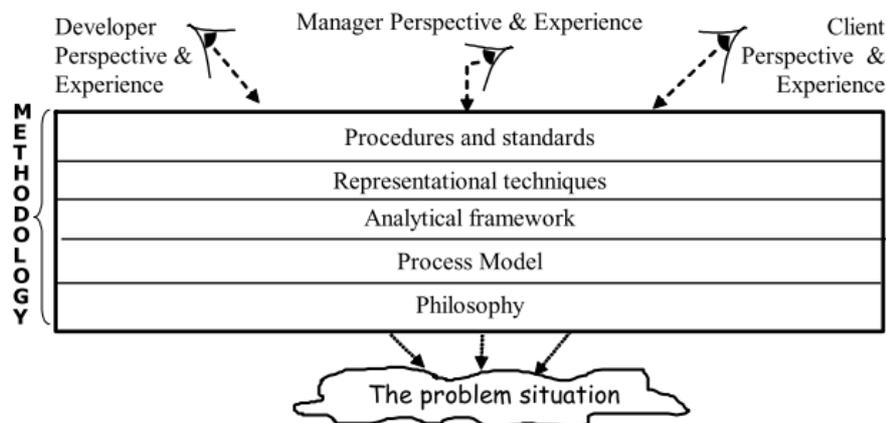
To make sense of all these interpretations and views, the literature review considers the essential elements of ISD methodologies, as well as the existing approaches and methodologies used today.

### **3.2.2.2 Methodology classification elements**

As stated previously, an ISD methodology is more than mere methods towards the development of ISs, as it requires an holistic approach that consists of different elements (Gasson, 1995). Maddison *et al.* (1984) explore these various elements constituting an ISD methodology, and according to them these elements are an assembled group of features that guide developers in the development of information systems. Gasson (1995) sets out to identify these various elements within a holistic methodology and groups them into philosophies, procedures and standards, representational techniques, analytical frameworks, and process models. These elements are referred to as layers and are underlying features that direct and guide the implementation of the methodology. Gasson (1995) describes these layers as follows:

Firstly, within the holistic methodology definition there exists an analytical framework depicting the methodology. This analytical framework can be applied by using a set of tools of analytical methods and techniques. The framework is also built upon a process model, which directs the arrangement and timing of the various activities involved in the development. These development activities are all governed by standards and procedures which determine the expected output of the systems, and thus a holistic view of methodologies considers these predefined standards and expectations. Fundamental to all these elements is a philosophy which rationalises the need for each element,

and it is the glue among team members within the development of the system that safeguards their commitment to one another (Gasson 1995). Figure 3.8 depicts the elements which constitute an holistic ISD methodology. The figure illustrates the structure of comprehending suitable solutions for specific defined problems. It also illustrates how an individual should approach the problem as well as the factors influencing the individual's actions and perceptions regarding the solution to the problem. The perspectives induced by prior experiences, are those firstly conceived by any individual when approaching the problem and methodology. The figure shows how the perspective and actions of the individual are further directed and influenced by the elements within the methodology. These various elements form sequential filters that ultimately influence the individual's perception of context and actions towards development or solving the problem.



**Figure 3.8: The Elements of an ISD Methodology (Gasson 1995)**

These different elements/filters within an ISD methodology are the cause for the different classifications and definitions of ISD methodologies. Thus, the classification of ISD methodologies may differ according to these elements. (Gasson 1995). For example, some authors might categorise ISD methodologies according to philosophies, and others may categorise them according to process models.

### **3.2.2.3 Existing ISD Methodology Classification**

This section reviews existing ISD methodologies and how various authors group these methodologies into 3 classes. Section I. discusses the first class, namely Structured Design. Section II. considers Rapid Application Development and Section III. addresses the third class namely, agile development.

One of the classifications of ISD methodologies, as interpreted by Avison (1989), is the classification of ISD methodologies into seven different approaches. These different methodologies are categorised pertaining to development processes (i.e. the process model filter) and include systems approaches, planning approaches, participative approaches, prototyping approaches, automated approaches, structured approaches and data approaches. They are summarised in the table below.

**Table 3.2: Classification Of IS Development Methodologies By Development Process adapted from Avison (1989)**

Approach	Key elements within approach
Soft Systems Approach	Used to understand badly defined organisational problems Aims to gain a holistic understanding of organisation Uses many perspectives from where to analyse the organisation
Planning Approach	Aligns IS development with strategic business needs
Participative Approaches	Emancipatory organisational change is the basis of IS Development
Prototyping Approach	Based on either one-off cycle or evolutionary design Can be used for emancipatory, technical or experimental purposes
Automated Approach	Basis of IS Development Approach lies on precise definition of technical system, and detailed documentation
Structured Approach	The basis of the system is a well-defined organisational problem The approach aims for the single best way to approach the development (believes there is only one)
Data Approaches	The System Development Approach understands the organisation through an analysis of its use of information

According to Gasson (1995) this classification of ISD methodologies, pertaining to development processes, are not exhaustive as important methodologies such as the traditional approach is missing. A professional literature field that can be approached to provide methodology guidelines and bring some clarity to the various classifications of methodologies, would be the field of software design (Gasson, 1995). This professional field provides more structured guidelines regarding the categorisation of methodologies. Understanding can particularly be derived from one such a piece of professional literature – “System Analysis and Design”, a textbook by Dennis et al. (2015), which sheds light on the categorisation of methodologies. Here Dennis et al. (2015) also categorise methodologies according to their development process. The development process that these methodologies are all structured around, are the phases pertaining to the System Development Life Cycle. Dennis et al. (2015) summarize these methodologies into three different classes pertaining to the sequence of the SDLC:

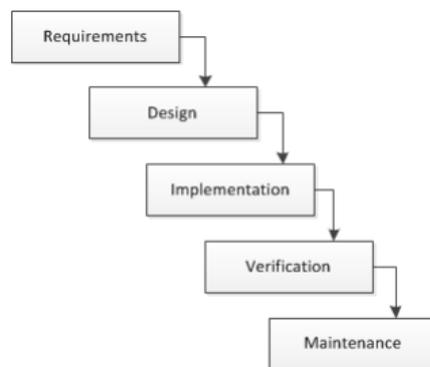
- structured design
- rapid application development and
- agile development.

### 3.2.2.3.1 Structured Design

The first class of systems development methodologies which Dennis et al. (2015) categorise, is structured design. These methodologies form part of formal step-by-step approaches with regard to addressing the SDLC phases. This approach offers logical step-by-step guidelines, with one phase flowing into the next. Structured design became popular in the 1980s as a response to the undisciplined approaches present at that time. The traditional approach using the Waterfall method, is the well-known and an original structured design approach. Other methodologies such as the Parallel Development, also fall under structured methodologies (Dennis, Wixom and Tegarden,

2015). It will be useful to examine the Waterfall Development-Based methodology in greater detail, due to its wide use in organisations today.

The traditional Waterfall model is a linear process starting at problem identification through delivery, to the implementation of the system. The phases start at requirements, and linearly move onto design, implementation, verification and maintenance – in that specific order (Schach, 2007). The Waterfall model is the traditional model, depicting the phases within systems development. The majority of ISD methodologies take on this form, depicted within the traditional Waterfall model (Hitchins, 2017), with variations existing in the sequencing and progression of these steps. Figure 3.9 depicts the linear process of the structured Waterfall model – each step proceeding from one phase to the next.



**Figure 3.9: Waterfall Model Phases**

Table 3.3 summarizes and describes each phase.

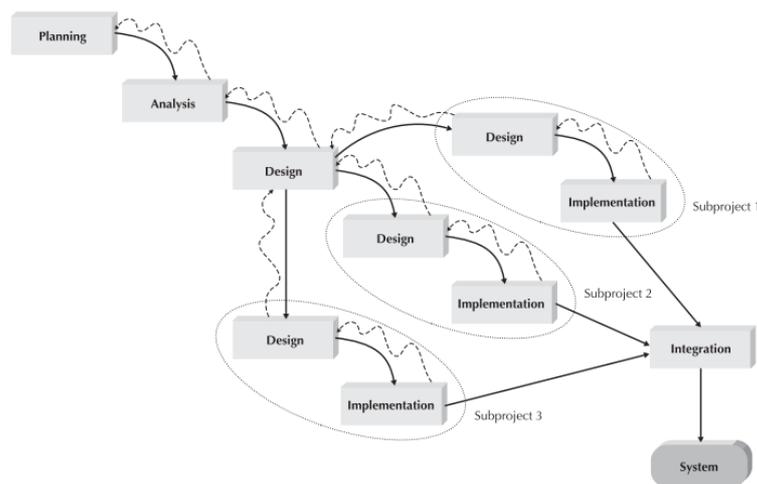
**Table 3.3: Information System Development Waterfall Model**

Phase	Description
Requirement stage	A common understanding of the user needs and system requirements are acquired in the requirements stage (Schach, 2007). In this stage activities such as Identify problems and opportunities; Identify User needs, and Analysing the System, are executed. The System Development Life Cycle, as well as various other ISD methodologies breaks up the requirement stage into these 3 similar steps (Kendall and Kendall, 2011).
Design Stage	The information gathered in the requirement stage is used to design the system. An iterative design process is usually required in order to design the system suitable for the user needs (Wayi and Huisman, 2010).
Implementation and Verification	The developers are very involved in this stage. A sample approach is usually implemented in this stage, where constant tests and feedback from users are given to verify the system and to suggest any improvements. Iterative testing is therefore vital as part of the implementation and verification of the system (Wayi and Huisman, 2010).
Maintenance	After the system has been successfully implemented, maintenance is required to solve any problems within the system or upgrade the system when deemed necessary (Wayi and Huisman, 2010).

### 3.2.2.3.2 Rapid Application Development (RAD)

The next category of methodologies is rapid application development (RAD)-based methodologies. These methodologies arose in the 1990s as a response to the shortcoming of the structured approach. These RAD-based methodologies were developed in an attempt to adjust the phases within the SDLC from the time-consuming linear processes, to a process where portions of the system development are implemented and adjusted iteratively. The system developed from RAD methodologies are developed and released into the hands of users as soon as possible, so that users can provide feedback on the developed system, and adjustments can be made accordingly. The system is then redeveloped and released for further improvements. This occurs until users are satisfied with the system outputs. This iterative revision allows the development of systems that come closer to achieving the objectives specified by user needs. Examples of methodologies which fall under this category are, Phased Development, Prototyping, and Throwing Prototyping. (Dennis, Wixom and Tegarden, 2015)

Figure 3.10 illustrates these continuous releases and adjustment of the system executed in line with the RAD-based methodology approach.



**Figure 3.10: RAD-based Methodology (Dennis et al., 2015)**

### 3.2.2.3.3 Agile Development

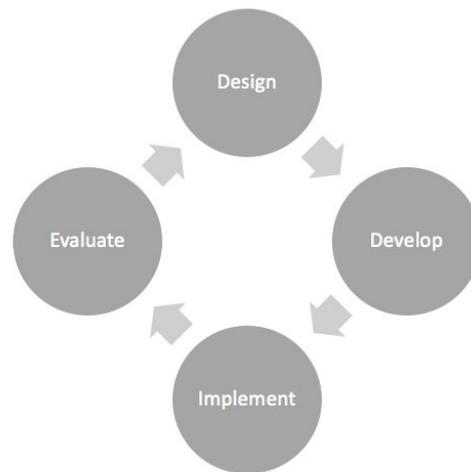
Agile development methodologies form the third category of systems development methodologies, and is a field that is still evolving today (Dennis, Wixom and Tegarden, 2015). The aim of such methodologies is to focus the attention of developers on working software, conditions of the work place, and customers, as well as to distract their attention from detailed documentation and intensive protocol-driven development processes (Final & Engineering, 2014; Kendall & Kendall, 2011; Andoh-Baidoo, 2017). The Agile approach aims to develop systems in shorter delivery periods by following a human-centered approach, which values an individual's interaction and user cooperation throughout the whole process (Nelson, 2002). This process is made possible through minimizing the system design steps, by using shorter life cycles and less tedious and more informal methods. There

is therefore a greater focus on developing and releasing software systems as fast as possible, without the comprehensive identification of system goals and organizational roles by non-technical stakeholders (Gasson, 2003). These rapid methods are ideal for software development, as they give designers the opportunity to continuously alter and improve the system as deemed necessary (Gasson, 2003; Final and Engineering, 2014).

The following 12 characteristics are central to the Agile approach:

- Software is developed and given to user early and continuously throughout the whole process of development, to ensure satisfaction of user (Dennis, Wixom and Tegarden, 2015).
- The change in user requirements are expected and welcomed, irrespective of when these changes occur during the process of development (Dennis, Wixom and Tegarden, 2015).
- Delivering working software frequently to the user.
- Working together with customers is esteemed higher than contract negotiation (Gasson 2003b) (Dennis, Wixom and Tegarden, 2015).
- Individuals participating in the development of the system must be motivated to ensure reliable developers who will deliver and develop working systems (Dennis, Wixom and Tegarden, 2015).
- Individuals and interactions are esteemed higher than processes and tools (Gasson 2003b), and therefore face-to-face communication is seen as the most effective and efficient means of establishing requirements (Dennis, Wixom and Tegarden, 2015).
- The primary measure of progress is working as well as executing software (Dennis, Wixom and Tegarden, 2015) which is esteemed higher than comprehensive documentation (Gasson 2003b).
- Developers should take users into account to ensure that a sustainable pace is followed regarding the work that is invested in the project, thus ensuring that no one burns out. (Dennis, Wixom and Tegarden, 2015)
- There is focus on both technical and design excellence (Dennis, Wixom and Tegarden, 2015).
- Developing with a focus on simplicity and therefore avoiding redundant work and extensive documentation (Dennis, Wixom and Tegarden, 2015).
- Self-organizing of teams is promoted as it is believed to develop the best architectures, requirements, and designs. (Dennis, Wixom and Tegarden, 2015)
- Continual reflection on means to improve the process of development (Dennis, Wixom and Tegarden, 2015).

Figure 3.11 depicts a typical iterative agile design process.



**Figure 3.11: The typical iterative agile design process**

### 3.2.3 Selecting the Appropriate Development Methodology

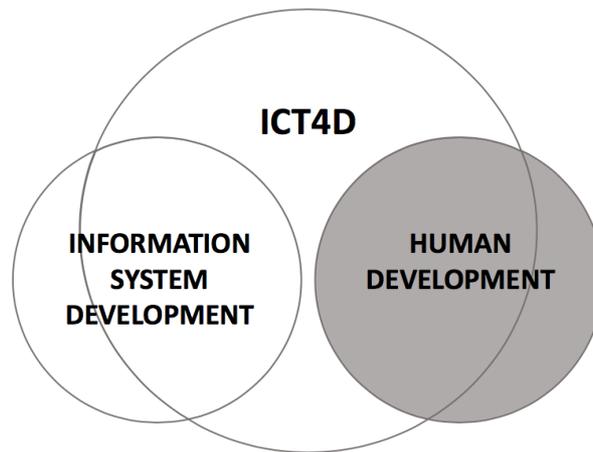
Due to the complexity of Information System Development, the difference between methodologies, and the diverse requirements for solving Information System Development needs, it is important to inspect methodologies in-depth to identify a fitting methodology (Wayi and Huisman, 2010). Deciding upon an appropriate methodology is not simple, as different organisations and businesses have different requirement criteria in their selection processes (Dennis, Wixom and Tegarden, 2015). Dennis et al. (2015) provide a table to guide the selection of appropriate methodologies. Table 3.4 identifies the ability of each methodology type to develop systems with different requirements.

**Table 3.4: Criteria for choosing a methodology adapted from Dennis et al. (2015)**

Ability to Develop Systems	Structured Methodologies	RAD Methodologies	Agile Methodologies
With unclear user requirements	Poor	Good to Excellent	Excellent
With unfamiliar technology	Poor	Poor-Good-Excellent	Good
That are complex	Good	Poor-Good-Excellent	Good
That are reliable	Good	Poor-Good	Excellent
With a short time schedule	Poor-Good	Good-Excellent	Excellent
With schedule visibility	Poor	Good-Excellent	Excellent

## 3.3 Human Development

The second input in the process of conducting the literature study is that of human/social development. Figure 3.12 highlights the focus of this Section.



**Figure 3.12: Human Development literature**

In this section, human development perspectives and the different dimensions of human development (which is henceforth referred to as development) is explored to understand the multidimensional nature of development. The development perspectives and dimensions discussed in this section relate specifically to development in the context of Information and Communication Technology for Development (ICT4D).

Section 3.3.1 discusses the various views regarding human development. Due to human development's multi-faceted nature, there also exist different dimensions in its definition and thus Section 3.3.2 explores these dimensions. Within all these dimensions and views regarding development, there also exist various theories, approaches and frameworks, which conceptualise human development and provide guidelines for human development initiatives. The literature presented in Section 3.3.3 addresses these frameworks, theories and approaches in order to identify the requirements for development.

### **3.3.1 Views Regarding Development**

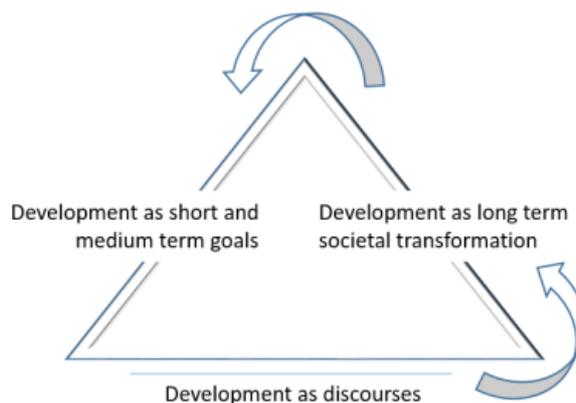
A crucial requirement for the design of effective Information Systems, for the purpose of bringing about human development, is that developers must clearly define what is implied by development (Kleine, 2010b). There exist various views regarding development. A very prominent view, which mostly exists in developed countries, is the Western-centric view (Zheng *et al.*, 2018). Discussions surrounding the Western-centric view of development are mostly centred around economic growth (Prakash and De, 2007; Kleine, 2010b; Andoh-Baidoo, 2017; Singh, Díaz Andrade and Techatassanasoontorn, 2018; Zheng *et al.*, 2018). The Enlightenment Era originally brought about this view associated with material progress, now known as modernity. This view has been criticized for considering material progress without taking into account culture and local practices (Singh, Díaz Andrade and Techatassanasoontorn, 2018). This view of development reasons that poor countries are merely countries with an average low income, and that poverty could be dealt with through economic growth (Prakash and De, 2007).

In the post-Second World War era and over time, these views of development evolved to the understanding that development is very complex and multidisciplinary (Prakash and De, 2007). Studies regarding development have therefore started to consider various disciplines including economics, sociology and political sciences (Mabogunje, 1980). These one-dimensional, economic-centric perspectives, have moved towards holistic perspectives with socio-political aspects that recognize the multidimensional features of human dignity (Andoh-Baidoo, 2017; Singh, Díaz Andrade and Techatassanasoontorn, 2018). The Human-centred design perspective is one such a perspective, which considers human dignity in its design process and which has gradually gained attention (Prakash and De, 2007).

The development approach called the capability approach, originally introduced by the welfare economist Amartya Sen, is another such human-centric approach. Here Sen views poverty as a “deprivation of basic capabilities rather than merely low income” (Sen, 2000). Sen reasons that promoting practical freedoms is the fundamental means of development. He contends that it is these freedoms which equip individuals with capabilities to choose a life which they deem valuable (Sen 2000, Prakash & De 2007).

### 3.3.2 Dimensions of Development

Not only does various views exist regarding development, but due to its multi-faceted nature there also exist different dimensions in its definition (Sumner & Tribe 2008). According to Sumner & Tribe (2008) there are three dimensions of development, each one representing a different line of thought regarding the definition. These reasonings of development form a prism of three interlinked and coexisting dimensions (Zheng *et al.*, 2018).



**Figure 3.13: Dimensions of Development (Zheng *et al.*, 2018)**

Section 3.3.2.1 discusses, Development Perspectives as a discourse, Section 3.3.2.2 explores Development as a Long-Term Societal Transformation, and Section 3.3.2.3 looks at Development as a Short-to-medium term goal.

### **3.3.2.1 *Development perspectives as a discourse***

Development perspectives are established through the discussions and debates of both academics and practitioners of policymaking, institutional arrangements, and allocations of resources. There exists numerous discourses and these vary within the global context.

The Western world view tends to centre around economics (Prakash and De, 2007), whereas other discourses are established through voices of communities and their value systems, such as patriotism, independence, equality and happiness (Zheng *et al.*, 2018).

### **3.3.2.2 *Development as long-term societal transformation***

Development as a long-term societal transformation refers to the type of structures relating to socioeconomics. These structures include rights and legislation regarding property ownership, institutional arrangements of production, and trade and technological infrastructure (Zheng *et al.*, 2018). For example, the arrangement and existence of these structures in the Western world prioritize and promote technological innovation, ownership of private property, and production structures formed by capital, skill and labour division (Díaz Andrade and Urquhart, 2012).

### **3.3.2.3 *Development as a short- to medium-term outcome***

ICT4D literature most often belongs to this dimension of development, as a short- to medium-term outcome. These are usually studies of ICT projects implemented by government or NGOs for developmental purposes. For accurate measurement of the development outcomes of such ICT4D, government and NGOs need to identify the development perspectives that direct the evaluational methods. The economic-centric perspectives tend to push for the evaluation methods which measure economic growth and creation of employment. An example of such an evaluation model is the neoliberal model advanced by the World Bank. On the contrary, perspectives with a more holistic and human-centred view of development, such as Sen's capability approach, tend to push for evaluation of creation of capabilities and other factors of well-being (Zheng *et al.*, 2018).

### **3.3.3 *Identifying the Requirements for Development***

Within all these dimensions and views regarding development, there exist various theories, approaches and frameworks which conceptualise human development and provide guidelines for human development initiatives. The literature explores these frameworks, theories and approaches. These were identified by systematically exploring various ICT4D literature and identifying the human development discourses that are mentioned in the literature. The most common and frequently mentioned human development concepts used in the design of ICT4D were identified, and these findings are summarised in the table below.

The table below lists 9 different frameworks/theories/approaches which will be referred to as arguments. The table summarises their application and purpose together with the elements which constitute these arguments. The elements that were highlighted in the table are those present in the

arguments that are used to analyse human development within a certain context as well as the requirements which the arguments identify as necessary for human development. These arguments are discussed in detail and in Appendix A.

**Table 3.5: Summary of Human Development-based Arguments**

Framework/ Theory/ Approach	Application and purpose	Elements used to analyse Development	Requirements for development
Actor Network Theory (ANT)	ANT can be used in theory to explore development or as a sense-making tool to describe and understand the process of development	<ul style="list-style-type: none"> <li>• Networks</li> <li>• Agents</li> <li>• Relationships present in development</li> <li>• Describe and understand the process of development</li> </ul>	<ul style="list-style-type: none"> <li>• Established within applying the framework (Thapa and Saebø, 2016).</li> </ul>
Capability approach	<ul style="list-style-type: none"> <li>• Conceptualising development (Poveda and Roberts, 2018)</li> <li>• Nine overarching applications: general assessments of human development of countries; assessing small-scale development projects; identifying the poor in developing countries; poverty and well-being assessment in advanced economies; deprivation of disabled people; assessing gender inequalities; debating policies; assessing gender inequalities; functioning and capabilities as concepts in non-normative research. Robeyns (2006)</li> </ul>	<ul style="list-style-type: none"> <li>• Capabilities</li> <li>• Freedom</li> <li>• Critical-agency</li> <li>• Value judgement</li> <li>• Free choice</li> </ul>	<ul style="list-style-type: none"> <li>• Facilitation of the acquisition of capabilities</li> <li>• Expansion of freedoms (Sen, 2000; Grunfeld, 2007)</li> <li>• Critical agency/value judgement (Roberts, 2016). The fundamental capability list by Nussbaum (2001) consists of <ul style="list-style-type: none"> <li>• length and quality of life</li> <li>• health of the body</li> <li>• integrity of the body</li> <li>• senses, imagination and thought</li> <li>• emotions</li> <li>• practical reason</li> <li>• affiliation</li> <li>• living with concern for other species</li> <li>• play</li> <li>• control over one's political and material environment</li> </ul> </li> </ul>
Emancipatory approach	Approach in development endeavors (Hirschheim & Klein 1994)	Not applicable	Emancipate on 3 levels <ul style="list-style-type: none"> <li>• Physical</li> <li>• Legal</li> <li>• Moral</li> <li>• Encourage participation (Vaidya, 2016)</li> </ul>
Critical Theory	Theory that critically observes social phenomena in order to address the factors that might be keeping its agent from emancipation (Krauss, 2016). Theory creates awareness of	Observes social phenomena and context of agents (Krauss, 2016)	<ul style="list-style-type: none"> <li>• to enlighten</li> <li>• to emancipate by freeing its agents from hidden or obvious oppression</li> <li>• to create productivity from knowledge</li> <li>• to reflect rather than objectify</li> </ul>

Framework/ Theory/ Approach	Application and purpose	Elements used to analyse Development	Requirements for development
	agents' circumstances to enable users to determine their own actions for development (Roberts, 2015).		
Millennium Development Goals	At the United Nations Millennium Summit, global leaders come together in an effort to create a more just, prosperous and peaceful world. At these summits, millennium development goals are established and measured (Bates-Earner <i>et al.</i> , 2012)	The progress of the established millennium development goals stated in requirements, are measured in the proceeding summits (Bates-Earner <i>et al.</i> , 2012)	<ul style="list-style-type: none"> <li>• To eradicate extreme poverty and hunger</li> <li>• To achieve universal primary education</li> <li>• To promote gender equality and empower women</li> <li>• To reduce child mortality</li> <li>• To improve maternal health</li> <li>• To combat HIV/AIDS, malaria, and other diseases</li> <li>• To ensure environmental sustainability</li> <li>• To develop a global partnership for development (United Nations, 2015)</li> </ul>
The Sustainable Livelihoods approach	The SL Framework, developed from the SL approach is a tool used to understand the causes of poverty and identify the requirements for poverty elimination (Duncombe, 2006)	<ul style="list-style-type: none"> <li>• contextual analysis of vulnerability</li> <li>• identifying livelihood strengths or assets</li> <li>• identifying levels of analysis according to structures and processes</li> <li>• identifying livelihood strategies and outcomes (Duncombe, 2006)</li> </ul>	<p>Determine livelihood strategies to combine and use assets to overcome limitations Strategies include:</p> <ul style="list-style-type: none"> <li>• Long-term strategies <ul style="list-style-type: none"> <li>○ Processes and activities that enhance long term decision- making capacity of individuals, such as education and skill development (usually provided by governmental programs).</li> <li>○ Broader strategic roles to enhance the long-term rights of the poor in sectors such as health, education and other sectors that promote empowerment.</li> <li>○ Strengthen decision-making</li> <li>○ Strengthen the capacity of infomediaries to assist the poor is therefore strengthened</li> </ul> </li> <li>• Short term strategies <ul style="list-style-type: none"> <li>○ Strengthening the capacity of the poor to make short-term decisions by constructing and expanding socio-cultural resources and providing access to economic networks (Duncombe, 2006).</li> </ul> </li> </ul>
Theory of change	Theory of change (ToC) is the theory describing the means and reason for socio-technical changes which occur in a specific context. ToC therefore provides pathways that will allow	Recognise the competing stakeholders and the role of their context in shaping their practices by identifying <ul style="list-style-type: none"> <li>• Habitus</li> </ul>	Apply framework in specific context to identify requirements for development.

Framework/ Theory/ Approach	Application and purpose	Elements used to analyse Development	Requirements for development
	required change to occur (Zheng <i>et al.</i> , 2018).	<ul style="list-style-type: none"> <li>• Capital</li> <li>• Field (Vaidya, 2016)</li> </ul>	
Theory of Trust	<p>Development endeavours which employ this theory use trust as an emancipatory tool to improve the risk taking abilities of individuals (Vaidya, 2016) (Yamagishi, Kikuchi and Kosugi, 1999)</p> <p>Trust within development initiatives therefore serves as a tool for overcoming social uncertainty by encouraging those under its influence to be inclined to believe in the goodwill and harmless intentions of others (Vaidya, 2016).</p>	Not applicable	<p>Shape abilities to form trust:</p> <ul style="list-style-type: none"> <li>• expectation of benevolence</li> <li>• cultural similarities</li> <li>• optimum communication</li> <li>• expectations of selflessness</li> <li>• individual's ethics</li> </ul>

These arguments, listed in the table above, were studied in detail to identify the requirements for human development in specifically ICT4D settings. These requirements are summarised in Table 3.6 below. For a detailed description of all the arguments listed in the table above, see Appendix A

**Table 3.6: Requirements for Human Development**

<b>Requirement for human development</b>	<b>Author</b>
Facilitating the acquisition of capabilities and livelihoods	(Chambers and Conway, 1992; Sen, 2000; Vaughan, 2011; Bates-Earner <i>et al.</i> , 2012)
Emancipation	(Hirschheim and Klein, 1994; Roberts, 2015; Vaidya, 2016)
Participation	(Byrne and Byrne, 2004; Sanoff, 2006; Hussain, Sanders and Steinert, 2012)
Trust formation	(Gomez & Gould, 2010; Krauss 2013; Vaidya, 2016; Yamagishi et al., 1999)

The following section discusses each of these concepts in further detail.

### **3.3.3.1 Facilitating the acquisition of capabilities and livelihoods**

As mentioned in Section 3.2.2, Capabilities are the functionings of individuals, which enable them to gain access to resources and choices (Alkire, 2002). These capabilities are what create freedoms for individuals and thus constitute development. The expansion of capabilities allows the expansion of freedoms that form the building blocks of development. Some of these freedoms include freedom to participate in political events and access to basic education (Grunfeld, 2007).

The concept of livelihoods is similar to that of capabilities. Chambers & Conway (1992) describes livelihoods “as comprising of capabilities, assets, including both material and social resources, and activities required for a means of living”. Capabilities and livelihoods are therefore required to live a valuable life (Walsham, 2017).

### **3.3.3.2 Emancipation**

Emancipatory principles are argued to be one of the principles that should direct the process of development (Hirschheim & Klein 1994). Ulrich (1983) describes emancipation as liberating, as it influences people from being treated as a means to an end by others who are striving to achieve a certain goal. Emancipation occurs at the physical, legal and moral level, and thus people require emancipation on all 3 levels (Vaidya, 2016). A system development methodology is emancipatory if it attempts to eradicate limitations for the well-being of humans, that are due to physical (which includes natural or technical), psychological, or social conditions or forces (Hirschheim and Klein, 1994).

### **3.3.3.3 Participatory design**

Participation in system development, specifically Information System Development, can facilitate the building of local human capacity by including the voices of the excluded. Participatory design within Information System Development is able to yield empowering results, throughout and after the

system development process (Hussain, Sanders and Steinert, 2012). The participatory approach therefore has the potential to stimulate social development (Morin, García-Sánchez and Pérez-Bernal, 2007).

If the goal of IS development includes social development, the participation process is all the more crucial in the development process (Morin, García-Sánchez and Pérez-Bernal, 2007). Hussain et al. (2012) confirm this by identifying that the main advantage of using participatory design in developing countries, is the opportunity to develop two types of empowering outcomes: products that meet the users' needs, as well as psychological empowerment of the participants.

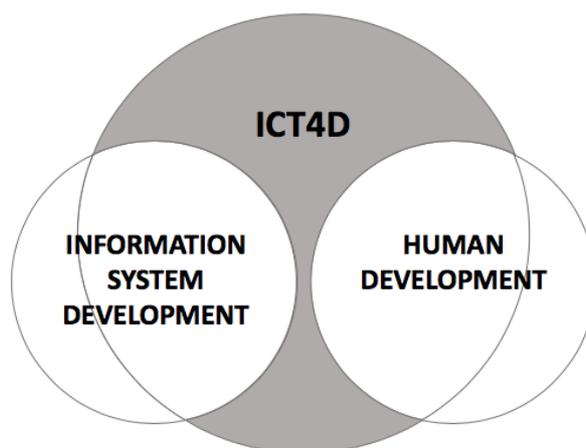
#### **3.3.3.4 Trust formation**

The theory of trust poses trust as an emancipatory tool. Trust can be used to encourage people to explore new opportunities by emancipating them from other commitment relationships that might be hindering their development, and therefore also improving their risk-taking abilities (Vaidya, 2016) (Yamagishi, Kikuchi and Kosugi, 1999). Trust serves as a tool for overcoming social uncertainty by encouraging those under its influence to believe in the goodwill and harmless intentions of others (Vaidya, 2016). Trust therefore, is important where complex situations without easy contractual relation or enforcement exist (Gomez and Gould, 2010).

The theory suggests that the success of many development projects are linked to trust amongst stakeholders (Yamagishi, Kikuchi and Kosugi, 1999). Trust and context are known to influence practices and thus it is a key factor in development projects. (Vaidya, 2016)

### **3.4 ICT4D**

The third input within the process of conducting the literature study is that of ICT4D and is illustrated in Figure 3.14



**Figure 3.14:ICT4D Literature**

Firstly, Section 3.4.1 considers the definition ICTs (Information Communication for Technology). Section 3.4.2 follows by discussing the benefits of using ICTs for development purposes, and Section 3.4.3 has a closer look at the reasons for ICT4D failure.

### **3.4.1 Defining Information and Communication Technologies**

Information technology covers many areas of human activity and is always expanding into new areas. Some widely used Information and Communication Technologies include motion pictures, internet and mobile phones. According to Juneja (2018), Information and Communication Technology can largely be defined as the combination of computer and telecommunication equipment, working together to store, retrieve, and manipulate data. The World Bank (1998) describes ICTs as follows: "Information and communication technologies can be defined as electronic means of capturing, processing, storing, and communicating information. ICTs are based on digital information held as 1s and 0s, and comprise computer hardware, software and networks". Hamelink (1997) defines Information and Communication Technologies as all technologies "that enable the handling of information and facilitate different forms of communication among human actors, between human beings and electronic systems, and among electronic systems".

According to Hamelink (1997), ICTs can be subdivided into 5 categories. A common feature is to be able to digitalize information. These are the 5 categories described by Hamelink (1997):

#### 1. Capturing Technologies

Capturing Technologies include all technologies which capture information and change it into a digital format. These technologies include keyboards, touchscreens, voice identification system, mice and many others.

#### 2. Storage Technologies

Storage technologies include all technologies with the ability to digitally store and recover information. Amongst other devices these include, hard disks, CD-ROMs and smart cards.

#### 3. Processing Technologies

Processing technologies possess the capability to create systems and software required for the performance and applicational use of digital Information Communication Technologies.

#### 4. Communication Technologies

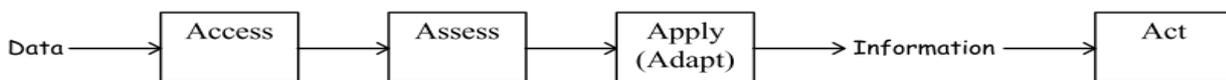
Communication technologies include all technologies which create a means and networks to convey information in digital form, such as modems, cellular mobiles, local area networks, cellular networks, and digital bulletin boards.

#### 5. Display Technologies

Display technologies include a variety of output devices which provide a means of displaying information in digital format, e.g. computer screens, printers, virtual reality helmets, television sets, and digital video discs.

As information forms such a big part of ICTs, one must understand information before you can fully understand ICTs. Information is needed to develop any system or enterprise. The type of information needed to develop, e.g. an enterprise, includes information such as finance, technology, labour and raw materials, market opportunities, demand and supply, and other environmental factors affecting the enterprise. This information is collected through raw data and needs to be converted into usable information (Heeks, 1999).

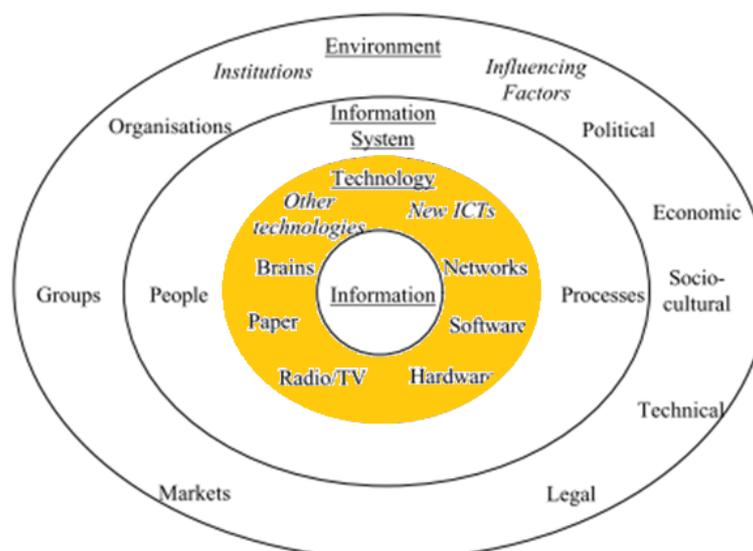
The flow of information from raw data to usable Information is depicted in the information chain diagram



**Figure 3.15: Information Chain (Richard Heeks, 1999)**

For information to be usable, it needs to be accessible, assessable, applied, and then it can be acted upon (Heeks 1999). ICTs are the mechanisms that are used to access, assess, apply and act upon information.

Figure 3.16 shows that Information Communication Technology forms a sub class of IS. The figure systematically depicts Information Systems and highlights the connection between IS and ICT.



**Figure 3.16: Relationship between IS and ICT (Heeks 1999)**

It is widely known that ICTs, if harnessed correctly, can serve as a catalyst for social transformation and human progress (Prakash and De, 2007; Mthoko and Pade-Khene, 2013; Majchrzak, Markus

and Wareham, 2014). The ability of ICTs to facilitate communication and store information, makes them effective tools in the quest for poverty alleviation and rural development. (Pade-khene and Sewry, 2011; Osah, Pade-Khene and Foster, 2014). ICTs, therefore, hold the potential to enhance socio-economic development and the quality of citizens' lives through their potential positive effects on health, education, empowerment, as well as on capability expansion and human rights (Ashraf *et al.*, 2017).

The United Nations Development Programme (UNDP) has recognized the importance of ICT in the quest for poverty alleviation. Currently the majority of the big development organizations utilize ICTs in their development programs, and there is an increase in smaller organizations using ICTs in their development initiatives (van Reijswoud, 2009). Increasing access to ICT through venues such as libraries, schools, and telecentres, has contributed to global development, by providing marginalized communities opportunities to bridge the digital divide by accessing empowering information (Gomez and Gould, 2010).

An example of an ICT4D, is the farmer's Post Radio, which is used to convey market prices to farmers in western Bolivia. Information relating to central market prices of products in the agricultural sector, is collected and processed by The Institute of de Capacitación del Oriente. It is then broadcasted over the farmers' Post Radio, making this information easily accessible to rural farmers who do not have internet access. Farmers use this information to appropriately price their products, to avoid exploitation and thus facilitating their own socio-economic development (Blommestein *et al.*, 2006).

The socio-economic transformational outcomes which ICTs may provide, only depend on how they are employed (Osah, Pade-Khene and Foster, 2014). For ICTs to be effectively used by the community, the access avenues need to be trusted and used (Gomez and Gould, 2010). Research has demonstrated the positive contribution ICTs can have on socio-economic development, but has also highlighted the potential for ICTs to hinder the process of socio-economic development. It is therefore important that ICTs be employed correctly and effectively especially in rural communities (Mthoko and Pade-Khene, 2013). The key aspects for ICT failure will now be explored to identify the requirements and hinderances for ICT4D.

### **3.4.2 Reasons for ICT4D failure**

The literature provides many examples of ICTs being harnessed for social development but yet there is still a significant amount of ICTs4D that fail to attain their objectives and some even serve as a hinderance to social development. Van Reijswoud (2009) therefore argues that a change in perspective and application is required to develop ICTs for sustainable development purposes.

The literature further explores the reasons for failure of ICTs4D, as well as the mistakes made within the design and implementation that can hinder social development, instead of facilitating it. The following literature highlights the mistakes made in failed ICT4D projects

The 8 main reasons for failure identified in the literature are as follows:

1. The difficulties of accounting for unexpected benefits (Pade and Sewry, 2009; Mthoko and Khene, 2018).

Many a time pilot ICT projects have not succeeded in accomplishing initial objectives and goals but have produced unintended benefits. These benefits can easily be overlooked by funders, and therefore these unexpected benefits should be considered in the planning and design phase (Pade and Sewry, 2009; Mthoko and Khene, 2018).

2. Trying to create international or national solutions for local problems (Butcher, 1998; Pade and Sewry, 2009; Krauss, 2016; Mthoko and Khene, 2018).

One of the major stumbling blocks in the design and implementation of ICT4D is that the rural and social context is not taken into account (Butcher, 1998; Pade and Sewry, 2009). Most ICT4D projects require unique solutions that are applicable for the environment in which they are implemented. Western values and assumptions cannot merely be applied to rural contexts, and therefore these ICT4D projects need to take into account the broader social and economic context (Krauss, 2016).

3. The lack of community participation in design, implementation and evaluation (Butcher, 1998; Roberts, 2015; Mthoko and Khene, 2018).

It is often assumed that independent designers and evaluators of ICT systems can effectively design, implement and evaluate ICT4D projects in a community outside of their own. This disregards the opinions of the target audience and results in the community receiving interpretations from stakeholders that are far removed from their context (Pade and Sewry, 2009). Butcher (1998) states that the potential of ICTs to accelerate social development, will never be utilized successfully if the projects are not driven and initiated by community members themselves.

4. Objectives becoming political and risk being subjective (Butcher, 1998; Pade and Sewry, 2009; Roberts, 2015; Krauss, 2016; Mthoko and Khene, 2018).

Often, ICT4D initiatives are restricted by political and subjective perceptions. Implementation and evaluation of such projects are also very difficult where there is political unrest (Pade and Sewry, 2009). The discourses influenced by policies might also prevent meaningful action, and cause ICT4D failure (Butcher, 1998; Krauss, 2016). Experts in the ICT field can be subjective when only applying their knowledge, and they may miss more appropriate methods for the design, implementation and evaluation of ICT4D if they do not allow open and participatory methods

5. Insufficient funding and resources (Pade and Sewry, 2009; Mthoko and Khene, 2018).

Funding is an obstacle in many ICT4D projects and especially so in developing countries, due to limited resources within the communities. The skills, time and effort which are required for these projects, do come at a cost. The fact that the benefits of these projects are not immediate and usually long-term, and often provide little political benefit, makes it difficult to acquire ongoing funding (Pade and Sewry, 2009). Butcher (1998) states that medium- to long-term models of financial sustainability need to be established to prevent project failure.

6. Not considering the time-dependent nature of ICT4D programmes (Pade and Sewry, 2009; Heeks, 2010; Mthoko and Khene, 2018).

ICTs4D are built on human infrastructure and therefore they are very dependent on human factors, which may cause time expectations to be exceeded. Often projects will be evaluated too soon, because evaluators do not take into account the long-term benefits and that the project could be aborted in the pilot phase, since they do not allow benefits to present themselves as time progresses (Pade and Sewry, 2009; Heeks, 2010).

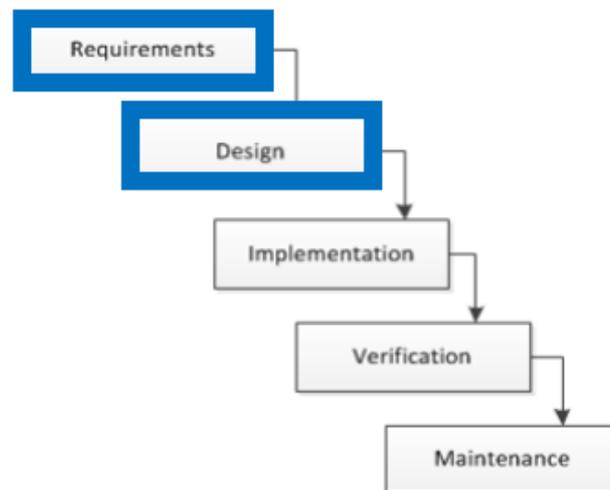
7. Not considering all stakeholders (Pade and Sewry, 2009; Mthoko and Khene, 2018).

Many actors are involved in ICT4D projects and the interests of each need to be considered. Often there will be too much focus on the interest of external stakeholders, such as funders and project managers, and at other times the focus might be too much on the internal stakeholders, such as individuals in the community or the community as a whole. Both these can be problematic for the sustainability of the project, and thus an effort must be made to include all stakeholders (Pade and Sewry, 2009).

8. Unrealistically ambitious objectives (Butcher, 1998; Pade and Sewry, 2009).

Unrealistic objectives can often be seen in the budgets that are available for such projects. The capacity of these budgets to achieve the objectives are just not adequate, and thus failure of the project may occur if unhappy stakeholders are unable to see objectives being met (Butcher, 1998).

As discussed in Chapter 3.1, the development process of Information Systems usually consists of 5 overarching phases: Requirements, Design, Implementation, Verification, and Maintenance (Wayi and Huisman, 2010).



**Figure 3.17: Information System Development Steps (Schach, 2007)**

The 5 stages of Information System Development were studied in the context of ICT4D projects, and through the literature review it was discovered that the most challenging stages in the Information System Design Process are Requirements and Design stages. This is highlighted Figure 3.17. It is in these stages that assumptions regarding local needs and abilities are usually made, which lead to ICT4D failure (Bieber *et al.*, 2007; Bourgeois and Horan, 2007; Donner *et al.*, 2008; Wayi and Huisman, 2010).

The challenges that arise from the requirement and design stages of ICT4D projects, are often due to the failure to ensure extensive ground work, participation and process iteration for the successful implementation of these ICTs (Bieber *et al.* 2007; Wayi & Huisman 2010). These processes are necessary for acquiring the in-depth understanding of the context of the communities in which the ICT4D are implemented (Bieber *et al.* 2007), and to build awareness and acceptance of the ICT4D (Wayi and Huisman, 2010). The challenge in gaining this understanding and building awareness and acceptance, is the high illiteracy rates and other unstable social factors, usually present in developing countries (Wayi and Huisman, 2010). Acquiring access to information relating to community components, such as the local people, government structures, groups, communication, legal constraints, supporting organizations (Bieber *et al.*, 2007), as well as knowledge about IS in rural communities, is limited (Wayi and Huisman, 2010). For any system to be successful, there need to exist an interaction of social and technical pillars of development. This all requires more time for system developers to discover appropriate stakeholders for the system, and to create an understanding of the system amongst the community users (Harrison and Zappen, 2005).

### 3.5 Chapter 3 Conclusion

The study is positioned within three fields of literature, namely 1) Information System Development, 2) Human/Social Development and 3) Information Communication Technologies for Development. These three fields were investigated to understand the functioning of ICT4D from the perspective of

all three of these fields and to develop a theoretical base of knowledge within each field. The exploration of these three fields formed part of the overview literature study in Chapter 3.

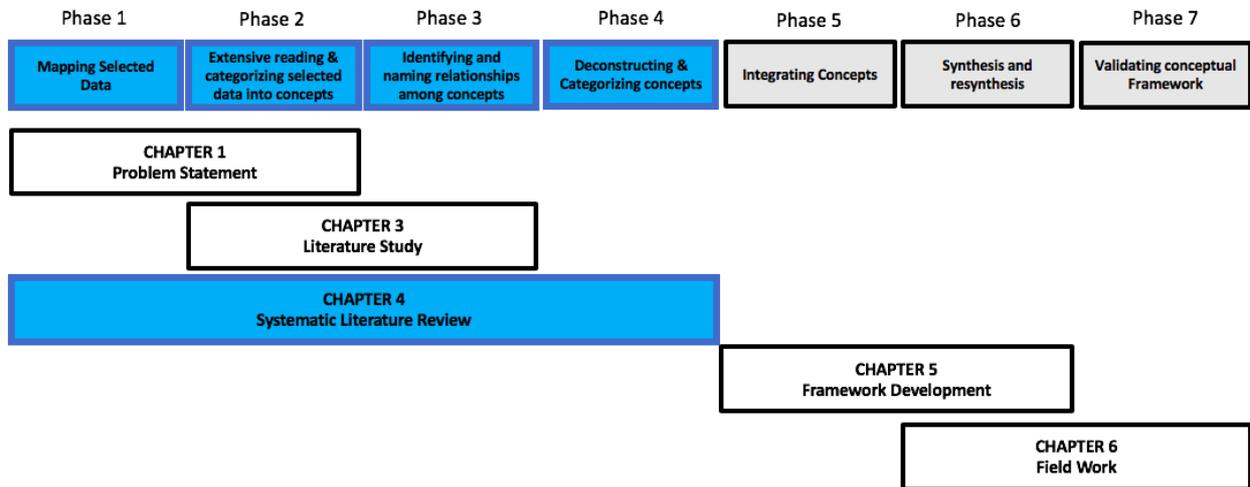
Section 3.1 gives an overview of the procedures involved in conducting a Literature Review. Section 3.2 followed and set out to meet the first objective stipulated in Chapter 1, to Theoretically investigate the definition and literature surrounding the field of Information System Development (ISD) by analysing existing ISD approaches, methodologies and frameworks relating to ICT4D. Section 3.2 therefore contains literature exploring the definition of ISD methodologies, the fundamental concepts within ISD methodologies, the existing ISD methodologies and the most appropriate application for these different methodologies.

Section 3.3 set out to meet the second objective stipulated in Chapter 1 which is to theoretically investigate the definition and literature regarding the field of human development, by analysing existing theories, tools and frameworks relating to this field. Through this literature review the main requirements for human development were identified: facilitation of the acquisition of capabilities and livelihoods, emancipation, participation and facilitation of trust formation.

Section 3.4 set out to meet the third objective stipulated in Chapter 1, which is to evaluate the literature surrounding the definition of ICTs4D in developing countries. Section 3.4 therefore explored the definition of ICT4D and the benefits of using ICT for human development initiatives. The literature in Section 3.4 also highlighted the reasons for failure for most ICT4D projects and highlighted the phases that require the most attention within the development of ICT4D. The findings in Section 3.4 laid the foundation for further exploration of ICT4D and guided the reviewer to further explore the requirements and design stages of IS development in ICT4D. The following chapter will therefore focus on and depict in greater detail the elements that occur in these stages in the development of ICT4D.

## CHAPTER 4- SYSTEMATIC LITERATURE REVIEW

This chapter discusses the Systematic Literature Review. Figure 4.1 provides an overview of the research design structure followed and it indicates where in the document each phase, or part thereof, is addressed. The Systematic Literature Review forms part of, Phase 1,2,3 and 4.

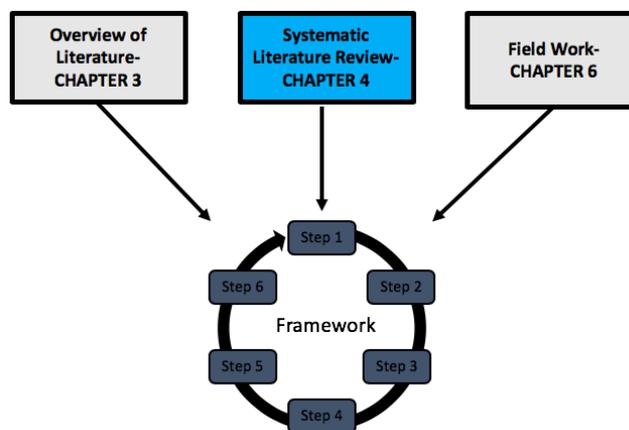


**Figure 4.1: Chapter 4 within the scope of the whole research**

The key objectives as stated in Chapter 1, which Chapter 4, The Systematic Review aims to attain, are:

- 
- 3) Investigate and identify the requirements for the development of ICTs4D in developing counties.
- 

The Systematic Review in Chapter 4 together with the overview of Literature in Chapter 3, and the Field Work in Chapter 6, were used to develop the framework. Figure 4.5 illustrates the knowledge contribution which this chapter makes towards developing the framework.



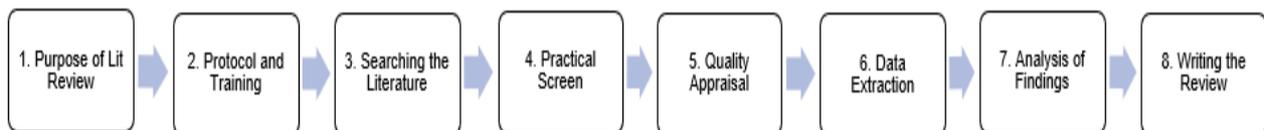
**Figure 4.2: Chapter 4s Contribution towards Developing the Framework**

Phase 1, 2, 3 and 4 of the research involves mapping the selected data, extensive reading and categorizing the selected data, identifying and naming concepts, and deconstructing and categorizing concepts. This all forms part of the systematic literature review and thus the theory that follows will cover the definition as well as procedures relating to a systematic literature review.

Section 4.1 explains the 8-step procedure involved in conducting a systematic literature review and the outputs retrieved from conducting this 8-step procedure. The systematic literature review resulted in the identification of 33 ICT4D frameworks. The concepts within these 33 frameworks were explored and grouped through coding procedures, to extract concepts that form the basis for the ICT4D framework. Section 4.2 summarizes these concepts and Section 4.3 concludes Chapter 4 with a summary of the discussions in this chapter.

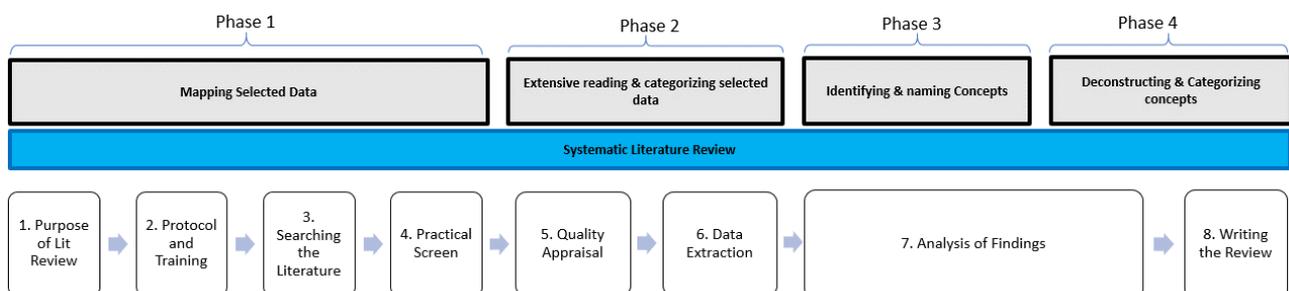
## 4.1 Conducting a Systematic Literature Review

A systematic literature review is one that follows a specific methodology to clearly define the procedures followed in the process of conducting the review. A systematic literature review is comprehensive in its scope and therefore includes all the literature appropriate and relating to the study. A systematic literature review can therefore be recreated by others, obtaining the same results, if the same defined procedure is followed (Okoli & Schabram 2010; Fink 2005). The guideline presented by Okoli & Schabram (2010) present an 8-step guideline for a scientifically rigorous literature review. These 8 steps cover the essential key steps for conducting a successful systematic literature review. The steps are depicted in Figure 4.3 below.



**Figure 4.3: Systematic Guide to develop a Literature Review (Okoli & Schabram, 2010)**

These 8 steps are a guide to completing the Systematic Literature Review and inevitably the overarching Research Phases, Phase 1, 2, 3 and 4. Figure 4.4 illustrates how these steps correlate to the overarching Research Phases of the thesis.



**Figure 4.4: Systematic Literature Review Steps within over all phases of Study**

Section 4.1.1 discusses step 1 and 2 of the 8-step systematic guide. Section 4.1.2 discusses the theory, procedures and results of step 3, 4 and 5. Section 4.1.3 provides a description of the theory surrounding step 6 as well as the outputs resulting from executing this step. Section 4.1.4 describes the theory, procedures and results of step 7 and Section 4.1.5 discusses the theory and results of step 8.

### **4.1.1 Step 1 and 2**

Section 4.1.1 discusses step 1 and 2 of the 8-step Systematic Literature Review. Section 4.1.1.1 focuses on the purpose and methods of step 1 and Section 4.1.1.2 focuses on steps 2s methods and purpose.

#### **4.1.1.1 Step 1-Purpose of the literature review**

Step 1 of the systematic guide used to develop the systematic literature review, requires clearly defining the purpose of the literature review, thus stating the purpose and the intended goal of the review (Okoli and Schabram, 2010). This step was covered in the Problem Statement and the Objectives in Chapter 1.

#### **4.1.1.2 Step 2-Protocol and training**

Step 2 gives clarity to all reviewers regarding the procedure to be followed. Training involves informing reviewers about the protocol and equipping them to execute the detailed procedure to ensure consistency throughout the review. This usually involves a document with detailed steps in the review process. For this thesis, the protocol step will only serve for the one reviewer involved. It clarifies the procedures to accurately and systematically define the means of completing the review (Okoli and Schabram, 2010). This step was covered in Chapter 2, the methodology chapter.

### **4.1.2 Step 3, 4 and 5**

Steps 3, 4, and 5 were executed in order to identify the literature that would to be used in the systematic literature review. Section 4.1.2 discusses the theory, procedures and results obtained from these 3 steps. Section 4.1.2.1, Section 4.1.2.2 and Section 4.1.2.3 describes the purpose and actions and outputs from these 3 steps. Section 4.1.2.4 provides a graphical representation of the procedures and outputs of these 3 steps.

#### **4.1.2.1 Step 3-Searching for the literature**

This step involves defining the parameters used in obtaining the literature and ensuring it is comprehensive by covering the applicable and necessary data relating to the study (Okoli and Schabram, 2010). This step defines all the literature included in the initial search and involved entering certain key words into several search engines. The key words as well as the specific search engines are documented in Table 4.1

#### 4.1.2.2 Step 4-Practical screen

This step screens for inclusion of literature and clearly stipulates which studies were included in the review and which were excluded. Practical including criteria for regarding and disregarding studies without in-depth investigation must be specified, using practical reasoning to justify the comprehensiveness of the study (Okoli and Schabram, 2010).

Step 4, involved scanning the titles from the articles that were retrieved from the search engines to check which comply with the following including criteria:

- Publication language: English
- Specific settings: Developing Countries
- Field: Social Sciences and specifically ICT4D related articles
- Access: Only include articles with open access through university portal

Once the reviewer finished scanning the first page, the next page was scanned. This continued until no more titles were applicable on an entire page and the scanning process would stop, to move onto searching the next search engine. Table 4.1 provides a summary of the keywords, search engines, the duplicates removed, and the number of articles retrieved from snowballing.

**Table 4.1: Searching and Scanning the Literature**

Literature searching action		No of applicable articles retrieved from different search engines						
Key words entered in search engine	Other actions	Google Scholar	Scopus	Web of Science	Emerald	ProQuest	Re-search gate	Total Articles
Information Communication Technology for Development /ICT4D		20	15	6	0	0	24	65
Information Communication Technology for Development Evaluation/ICT4D evaluation		6	2	5	1	0	1	15
Information Communication Technology for Development Assessment		8	1	0	3	0	8	20
Information Communication Technology for Development Framework		5	6	17	3	0	0	31

Information Communication Technology for Development Assessment Framework		6	0	0	0	2	0	8
Information Communication Technology Evaluation Framework		5	0	0	0	3	0	8
	Iterative process identification (snowballing)	6						
	Duplicates removed	-23						
<b>Total no of articles</b>		<b>133</b>						

A total of 133 articles were identified in searching the literature. By entering key words into search engines 147 of these articles were identified and 6 were added at a later stage, when the data in the articles were reviewed and additional references to applicable articles were discovered and then retrieved. Then 23 were removed since they were duplicates.

#### **4.1.2.3 Step 5-Quality appraisal**

The purpose of this step is to screen for exclusion. The reviewer clearly stipulates the criteria used to determine which studies identified in the practical screen possess insufficient quality for exclusion (Okoli and Schabram, 2010). Establishing clear criteria for exclusion, before the literature search starts is important (Okoli and Schabram, 2010).

The following excluding criteria were used for limiting the scope of this study:

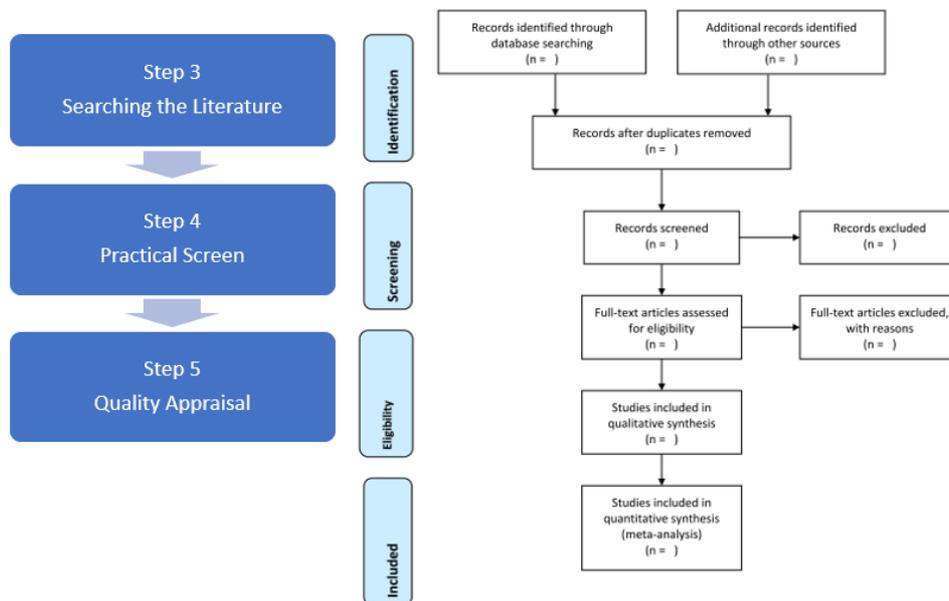
- Specific settings: Articles that did not include findings on developing country settings or was not applicable to rural settings, they were excluded.
- Relevance: If articles that did not relate to the field of ICT4D, they were excluded

Step 5 therefore involved further examination of the 133 articles, by scanning the abstracts and reviewing key words. Articles which did not comply with the certain excluding criterion and proved to be irrelevant to the study, were then eliminated.

Applying the excluding criterion to the 133 articles, resulted in further elimination of articles so that a total of 108 articles remained.

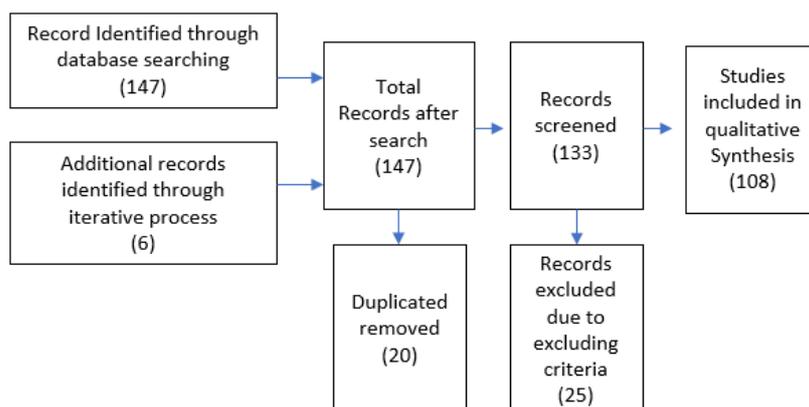
#### 4.1.2.4 Procedures and Outputs from step 3,4 and 5

The flow chart developed by Moher et al. (2009) provides a guideline to follow and document these three steps and is depicted in Figure 4.5.



**Figure 4.5: Flowchart depicting step 3, 4 and 5 within the Systematic Literature Review ( Moher et al. 2009)**

The reviewer used this guideline to follow and document these three steps and record the results from step 3,4 and 5. Figure 4.6 depicts this process involved in mapping the data and subsequently identifying the 108 articles that was used within the systematic literature review.



**Figure 4.6: Process followed to identify articles included in Systematic Literature Review**

#### 4.1.3 Step 6-Data Extraction

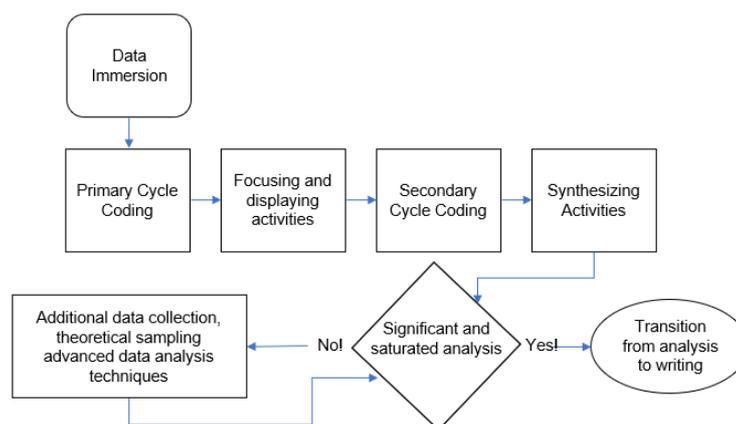
Section 4.1.3 discusses the next step in conducting the systematic literature review, step 6. This step involved systematically extracting the relevant data within the identified articles.

The articles identified in the previous steps, serves as the literature used in the systematic literature review. This data serves as raw material for utilisation in the synthesis stage. The data was extracted according the research questions in the Research Objectives in Chapter 1. Specific procedures were used in the extraction of the data process. Extracting all the necessary data requires going back and forth as knowledge expands throughout the process of reading and extracting information. An iterative process is therefore needed to execute these procedures (Tracy, 2013).

The following data was extracted according to the research objectives established in Chapter 1:

- Investigate and identify the requirements for the development of ICTs4D in developing countries.
- Construct a conceptual framework for the development of ICTs4D in developing countries, by using the knowledge obtained through the attainment of the objectives above.

The 108 articles were analysed and data was extracted by following the 4-step iterative procedure developed by Tracy (2013). Figure 4.7 depicts this iterative analysis process.



**Figure 4.7: Flowchart depicting iterative analysis process adapted from Tracy (2013)**

The iterative process used to execute these procedures as shown in the flowchart, involves 1) Primary Cycle Coding, 2) Focusing and displaying activities, 3) Secondary Cycle Coding and 4) Synthesizing Activities.

Qualitative analysis software Atlas.ti was used to conduct this coding process. This coding process lead to the identification of concepts and patterns in the literature. The 4-step coding process and the results from these 4 steps are now discussed in Section 4.1.3.1- Section 4.1.3.4.

#### **4.1.3.1 Primary Cycle coding**

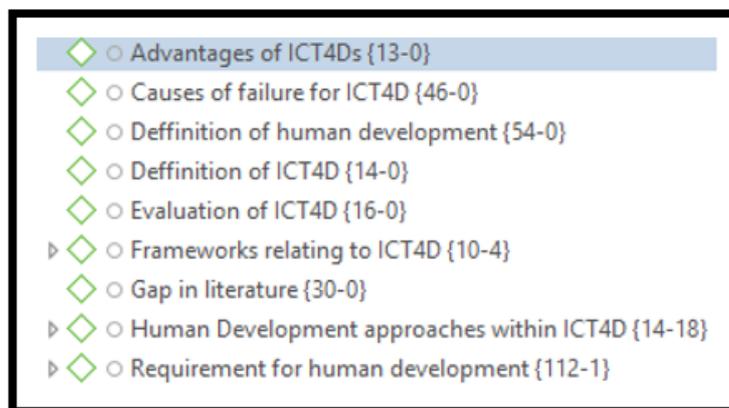
Codes are words or phrases that group certain ideas in a body of literature. These codes capture prominent, collective, fundamental or expressive attributes in the literature. Data is actively identified as belonging to or representing a concept, theme, action, opinion, relationship, cultural practice, or any other type of phenomenon (Tracy, 2013).

Charmaz (1996) and Glaser & Strauss (1970) use the term “open ended” coding for this first cyclic coding process. The term “open ended” coding stems from the idea that this coding opens up the meaning of data. This coding process is a cyclic process, as data can be read and coded several times during this stage. Primary-cycle codes are usually first level codes. These codes identify what occurs in the data. It does not intend to analyse the data, but rather offers a descriptive representation of the basic activities and processes occurring within the data (Tracy, 2013).

This iterative coding procedure resulted in the identification of numerous concepts which were based on the research Objectives 1, 2 and 3.

1. Investigate the definition and literature regarding the social development field by analysing existing theories, tools and frameworks relating to this field.
2. Evaluate the definition and literature regarding ICTs4D in developing countries.
3. Investigate and identify the requirements for the development of ICTs4D in developing countries.

This iterative coding procedure resulted in numerous codes which eventually formed a code tree. The code tree was the result of grouping connecting concepts into hierarchical groups. Figure 4.8 shows the codes which formed part of the primary cycle codes. These were the codes which grouped concepts relating to social/human development and ICT4D.



**Figure 4.8: Primary cycle codes**

#### **4.1.3.2 Focusing the analysis and creating a codebook**

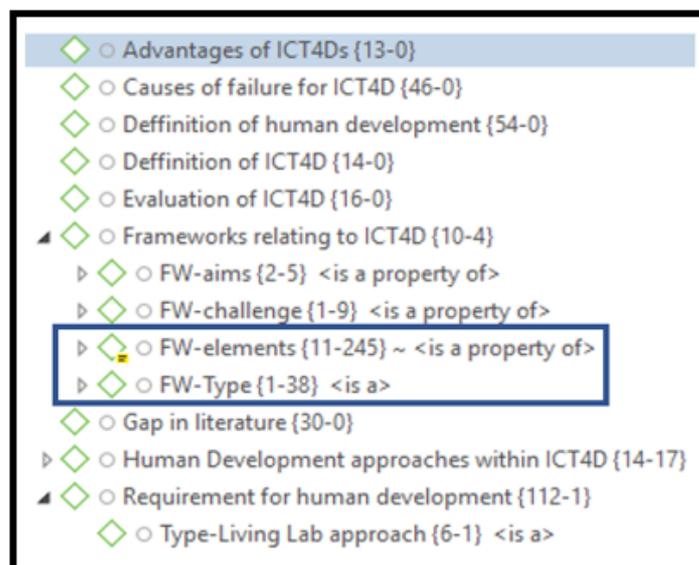
During the Primary-cycle coding, the emerging codes identified in the literature were recorded in a systematic code book which served as a chronological map, depicting the creation of the codes and their changes throughout the coding process. Tracy (2013) states that these code books are good illustrations of the data analysis process and serves as an explanation of the processes followed in the systematic literature review.

### 4.1.3.3 Secondary Cycle Coding

Secondary-cycle coding, also known as axial coding (Charmaz, 2006), goes further than primary-cycle coding, by grouping and organizing codes onto interpretive concepts. These codes are intended to explain the codes by analyzing and developing theories from the primary codes. These interpretations of the codes serve to identify causal relationships, patterns and rules in the literature. Secondary-cycle coding also involves identifying relationships among codes and linking them to make conceptual sense (Tracy, 2013). According to Strauss & Corbin (1994) axial coding reassembles disorganized data formed during open-ended coding, by grouping together codes under hierarchical umbrellas. Secondary-cycle coding will lead the reviewer to retrieve more data, if further explanation is needed to make sense of codes and to further define relationships between codes (Tracy, 2013).

The secondary cycle coding performed by the researcher, produced data that related to the different primary codes. These secondary codes included descriptions and examples of the primary codes.

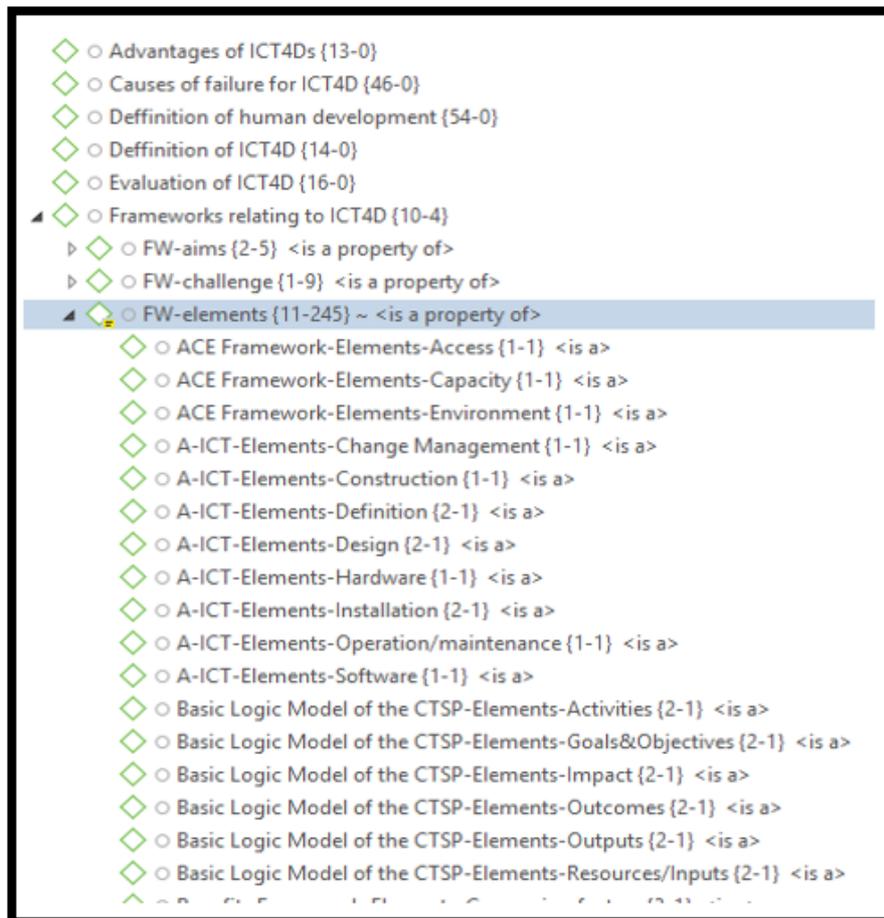
For example, within the primary code, 'Frameworks relating to ICT4D', there are 4 sub folders (secondary codes) relating to the characteristics of frameworks: Types of frameworks (FW-Type), Aim of applying the Framework (FW-aims), challenges faced in applying frameworks (FW-Challenge), and the concepts and elements which these frameworks constitute (FW-elements). The blue block in Figure 4.8 highlights the 38 types of frameworks identified within the 108 articles.



**Figure 4.9: Secondary Cycle coding**

The concepts/elements which constitute the different frameworks, were also identified and each of these concepts/elements were coded and grouped under the code "Framework Elements (FW Elements)". Figure 4.9 indicates that there were 245 elements identified. These elements were further summarized by the reviewer and used to develop the framework

The figure below shows some of the framework elements that were coded under framework elements. These elements are the concepts used as a building block for the ICT4D framework of this study



**Figure 4.10: Framework elements used to develop framework for this study**

The coding process was finished once the reviewer analysed each article and decided that the analysis was significant and saturated. This was decided upon the fulfilment of the following requirements:

- Applicable new data is no longer appearing regarding a certain category.
- The categories are well developed with variation in their explanations of the properties of these categories.
- The relationships among the categories are accurately depicted and validated.

#### **4.1.3.4 Synthesizing and making meaning from codes**

Synthesizing activities assist with secondary-cycle coding, and occurs within the iterative process of secondary coding, serving as an intermediary between the analysis and the writing. During the process of coding, a systematic means of recording the evolving thoughts and ideas of the reviewer is needed. These ideas and thoughts will serve as a synthesizing tool to connect data and

interpreting meaning within the data (Tracy, 2013). These notes are referred to as analytical memos and are conversations among the reviewer, regarding the development of emerging theories and hypothesis (Clarke, Friese and Washburn, 2017). These memos contain information such as definitions of codes, showing relationships among codes, containing developed hypothesis regarding codes, specifying conditions under which codes are applicable, stating consequences of actions. and any other information elaborating on and making sense of the codes (Tracy, 2013).

#### **4.1.4 Step 7-Analysis of findings**

This stage is embedded within the data extraction stage and it also involves an iterative process. As data is being extracted, codes, memos and notes relating to the data are made, they are compared and organized since they are part of making comprehensive sense of the literature. At the end of this stage a complete and refined combination of information is produced that is used in the final step of writing the literature (Okoli and Schabram, 2010).

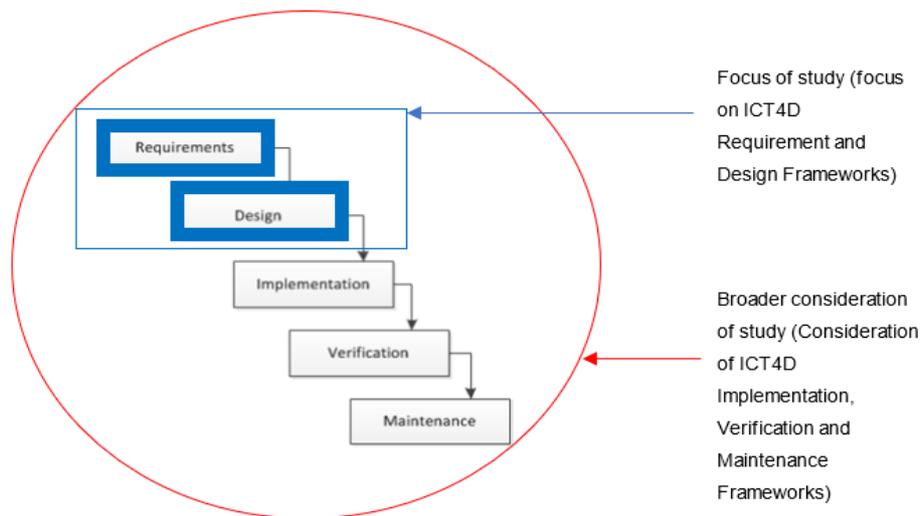
#### **4.1.5 Step 8- Writing the review**

Once all the data was collected for the review, the literature was recorded. Chapter 4 is the comprehensive written document containing the results from the systematic literature review

## **4.2 Concept identification within ICT4D Frameworks**

This section deals with the data gathered from the systematic literature review. The systematic review was completed to identify and extract the concepts that form the basis for the development of ICT4D framework. This section summarises these concepts. As shown in Figure 4.9, 38 frameworks were identified that were relevant to the study. From these 38 frameworks, 5 were discovered to be duplicates and thus 33 frameworks were used to identify the concepts that will now be discussed.

The findings in Chapter 3 highlighted the fact that the Requirement and Design stages of ISD (Information System Development) and in particular ICT4D projects, are the most challenging stages and may be the leading stages where mistakes occur, causing ICT4D failure (Bieber *et al.*, 2007; Bourgeois and Horan, 2007; Donner *et al.*, 2008; Wayi and Huisman, 2010). The concepts discussed in this section, which form the basis for the development of the framework, are therefore drawn from requirement and design phase frameworks – otherwise known as analysis and design frameworks. Other frameworks relating to the implementation, verification and maintenance stages, were also explored, in order to ensure that the whole life cycle of ICT4D was considered.



**Figure 4.11: Requirement and Design Stages of Information System Development (adapted from Schach (2007))**

The challenges that exist in the requirement and design stages of ICT4D projects, are due to the need for extensive ground work, participation and process iteration for the successful implementation of these ICTs (Bieber *et al.*, 2007; Wayi and Huisman, 2010). These processes are necessary in order to gain the required in-depth understanding of the context of the communities in which the ICTs4D are implemented (Bieber *et al.* 2007), and to build awareness and acceptance of the ICT4D (Wayi and Huisman, 2010). Some of the factors that make it challenging to gain this understanding and building awareness and acceptance, are high illiteracy rates and other unstable social factors, often present in developing countries (Wayi and Huisman, 2010). Acquiring access to information relating to community components such as the local people, government structures, groups, communication, legal constraints, supporting organizations (Bieber *et al.*, 2007), as well as knowledge about IS in rural communities, can also be difficult, making successful implementation more difficult (Wayi and Huisman, 2010). For any system to be successful there needs to exist an interaction of social and technical pillars of development. This all requires more time for system developers to discover appropriate stakeholders for the system, and to create an understanding of the system amongst the community users (Harrison and Zappen, 2005).

To understand the necessities for successful development of ICT4D, the requirements and design stages of IS development were explored in more depth. The following chapter therefore uses the data extracted from the 33 frameworks and highlight the concepts within the requirement and design stages of these frameworks. The ICT4D frameworks identified in the systematic literature review are summarized in Appendix B. The different activities/elements/concepts present in these various frameworks are also depicted in the Appendix B and the main elements are discussed in the sections to follow.

The exploration of the 33 frameworks, firstly highlighted three overarching phases within the frameworks. The two main phases present within ICT4D frameworks include the analytical and

functional phases (Duncombe, 2006). The other overarching phase contains activities relating to the design of appropriate technology present in the work of authors such as Van Reijswoud (2009); Heeks (2002); Johri & Pal (2012); Heeks & Krishna (2016); Heeks (2010); Vaughan (2011). The activities/elements present in the ICT4D frameworks were therefore grouped into these three overarching phases: the Analytical Phase, the Functional Phase and the Design Phase of developing ICT4D. These three phases are now discussed in more detail. Section 4.2.1 discusses The Analytical Phase, Section 4.2.2, The Functional Phase and Section 4.2.3 The Design Phase.

### 4.2.1 Analytical Phase of Developing ICT4D

The analytical phase refers to the assessing of empirical evidence in order to understand the livelihoods of the users and communities in which the ICT4D will be implemented (Duncombe, 2006). Within the 33 frameworks, the following elements were identified as elements with analytical roles.

**Table 4.2: Analytical elements present in 33 Frameworks**

Analytical elements present in the 34 frameworks	Authors
Community entry phase	(Krauss, 2013; Mamba and Isabirye, 2015)
Analyse socio-economic context	(Mozelius <i>et al.</i> , 2009; van Reijswoud, 2009; Heeks, 2010; Pade-khene and Sewry, 2011; Mthoko and Pade-Khene, 2013; Pandey and Gupta, 2017; Takavarasha, Hapanyengwi and Kabanda, 2017)
Determine factors that influence choice/ conversional factors	(Gomez and Gould, 2010; Kleine, 2010b; Talantsev <i>et al.</i> , 2014; Uys, 2015; Ashraf <i>et al.</i> , 2017)
Determine opportunities and project risks	(Duncombe, 2006; Heeks, 2010; Talantsev <i>et al.</i> , 2014)
Define Goals, objectives targets	(Richard Heeks, 2002b; Taylor-Powell, 2005; van Reijswoud, 2009; Mozelius <i>et al.</i> , 2009; Heeks, 2010; Pather and Uys, 2010; Pade-khene and Sewry, 2011; Mthoko and Pade-Khene, 2013; Osah, Pade-Khene and Foster, 2014; Mamba and Isabirye, 2015; Krauss, 2017; Thomas, Li and Oliveira, 2017; Pandey and Gupta, 2017)
Define Context specific user requirement	(Pade-khene and Sewry, 2011; Pandey and Gupta, 2017; Takavarasha, Hapanyengwi and Kabanda, 2017)
Define Context Specific System requirements	(Pandey and Gupta, 2017; Takavarasha, Hapanyengwi and Kabanda, 2017)
Define resources inputs	(Taylor-Powell, 2005; Heeks, 2010; Pather and Uys, 2010)
Define intended and expected outputs	(Sein and Harindranath, 2004; Taylor-Powell, 2005; Pather and Uys, 2010)
Define impact	(Taylor-Powell, 2005; Pather and Uys, 2010; Ashraf <i>et al.</i> , 2017)

These analytical elements were identified within the 33 frameworks and each element is discussed in the sections to follow

#### **4.2.1.1 Community entry phase**

Consulting with the local community (Mamba and Isabirye, 2015) and generating ideas with end users (van Reijswoud, 2009) should be the starting point of ICT4D projects. The community entry phase should include cultural interpreters, community leaders, local community visionaries, champions and entrepreneurs (Krauss 2013; Mamba & Isabirye 2015). Together with the community all stakeholders must be engaged in the beginning of the project and an effort should be made towards building relationships amongst the various stakeholders (Mthoko and Pade-Khene, 2013). Multi-stakeholder partnerships should be encouraged as well as an open and competitive environment, together with the participation of local users (Heeks, 2010). To ensure cooperation and understanding of the rural community it is also important to create awareness amongst the community members, informing them of the benefits of using ICTs (Mthoko and Pade-Khene, 2013).

#### **4.2.1.2 Analyse Socio-Economic context**

Authors such as Heeks (2010), Takavarasha et al. (2017) and van Reijswoud (2009), state the importance of analysing and defining the context of the environment in which the ICT4D will be employed. An analysis of this nature involves Financial, Environmental and Cultural impact studies (van Reijswoud, 2009), Capability assessments (Pandey and Gupta, 2017) and assessing Livelihoods profiles (Takavarasha, Hapanyengwi and Kabanda, 2017). These studies are important to understand the socio-economic context and existing socio-economic status (socio-economic and readiness) of the community (Mthoko and Pade-Khene, 2013).

The factors to consider in the analysis are: Information Availability, Legal Context, the Institutions activity and their role in the community, the Human Factors, Technological Progress and Availability, Leadership, Drivers and Demand (Heeks, 2010).

Analysing and defining the context will be accomplished by interacting with community members and stakeholders in order to give insight into the environment in which the ICT4D will be employed. The questions posed to the community members and stakeholders must be weighed against the following criteria proposed by Osah et al. (2014).

- 1) Will data stemming from these questions be used?
- 2) Are the stakeholders interested in each question?
- 3) Is it feasible to answer these questions given the available resources?
- 4) Are these questions worth the expense of answering them?

#### **4.2.1.3 Identify authentic local needs**

Developers who are not part of the local community may have different values and views from that of the community in which the ICT4D project will be implemented and may therefore incorrectly assume the community's desires and needs. It is thus crucial to identify authentic local needs for the success of any ICT4D (Mozelius *et al.*, 2009). This can be achieved through approaching the

community and assessing their needs and goals. The observations relating to vulnerability, which was performed in analysing the socio-economic context, can be used to identify these authentic local needs (Pandey and Gupta, 2017).

The priority in ICT4D projects must be meeting the needs and desires of the rural community. Project investors/owners should be open about their intentions and work, and a conflict of interest should not exist between the owners/investors and the larger community (Mthoko and Pade-Khene, 2013).

#### **4.2.1.4 Determine factors that influence choice/conversional factors**

Conversional factors are factors which influence choice (Kleine, 2010b; Uys, 2015). To determine these conversional factors, the analyst needs to identify constraints regarding all external project factors (Osah, Pade-Khene and Foster, 2014; Ashraf *et al.*, 2017). These external project factors include, Political, Economic, Socio-cultural and Technical factors. Talantsev *et al.* (2014) give examples of these conversional factors and they are summarised in the table below.

**Table 4.3: Example of Conversional Factors**

<b>Conversional Factors</b>	<b>Examples</b>
Political factors	The political factors that will either encourage or constrain the use of ICT4D are determined by <ul style="list-style-type: none"> <li>• Governmental/municipal support for ICT development</li> <li>• Efficiency and Transparency of national/local governance</li> <li>• ICT legislation maturity</li> </ul>
Economic Factors	Economic factors that will have an influence on the capacity of choice of a community and individuals are <ul style="list-style-type: none"> <li>• Recipients disposable income</li> <li>• Employment rate</li> <li>• Affordability of ICT services</li> <li>• Services' price stability</li> <li>• Recipients general education level</li> </ul>
Socio-cultural	Socio-cultural factors include <ul style="list-style-type: none"> <li>• IT literacy of recipients</li> <li>• Personal motivation of recipients</li> <li>• Recipients cultural and ethical support</li> <li>• Health Safety</li> </ul>
Technical	Technical factors increasing the capacity of choice is related to <ul style="list-style-type: none"> <li>• Accessibility of ICT infrastructure</li> <li>• Accessibility of public infrastructure (e.g., electricity)</li> <li>• Availability of skilled technical support</li> </ul>

#### **4.2.1.5 Determine opportunities and project risks**

Defining opportunities and considering project risks are an important step when planning to implement ICT4D, in especially rural communities (Heeks, 2010). These opportunities and risks can

be identified by studying the livelihood assets of the community (Duncombe, 2006) and identifying opportunity freedoms (Talantsev *et al.*, 2014).

According to Duncombe (2006) the livelihood assets include, Physical assets, Social assets, Financial assets, Human assets and Natural assets.

#### **4.2.1.6 Define Goals, objectives and targets**

Defining the goals and targets of the ICT4D project is crucial for direction and accountability (Pather & Uys 2010; Heeks 2010; Thomas et al. 2017). This stage should set realistic limitations (Mozelius *et al.*, 2009) and ensure that the defined targets and goals align with local development goals (Heeks, 2010), as well as prioritizing the needs and desires of the local community (Mthoko and Pade-Khene, 2013). Defining these goals require knowledge regarding the needs of the community (Pandey and Gupta, 2017) and can be evaluated through identifying the personal goals of the community, as well as using the observations from the vulnerability study in the analysis of the socio-economic context (Pandey and Gupta, 2017).

#### **4.2.1.7 Define Context-Specific User requirements**

Coding the user requirements involves translating the needs of the community into information requirements that can be used to develop the ICT4D system (Takavarasha, Hapanyengwi and Kabanda, 2017).

To establish these user requirements a Baseline Study can be used to serve as a form of market research. The study can be used to identify the appropriate required information to address the local needs identified previously. Within this study information relating to the specific use and needs of the system can be gathered. These needs include, training needs, preferred hours of operation, and the willingness to pay for services (Pade-khene and Sewry, 2011).

#### **4.2.1.8 Define Context-Specific System requirements**

This stage specifically focuses on the aspects of operationalization, implementation and sustainability.

The operationalization of the program is determined by considering the processes of the system and identifying the critical program functions, performance criteria and the operationalization of the performance criteria that a program should deliver.

The implementability refers to the practicality of implementing a specific ICT4D project in a certain environment. It evaluates project champions, resource allocation, stakeholder management, technology adoption trends, top management involvement and community engagement. All these factors play a role in the practicality of implementing ICT4D projects in a specific environment and may determine the success or failure of the ICT4D. (Pandey and Gupta, 2017).

Sustainability measures need to be taken in ICT4D projects, as many ICT4D projects have succeeded at initiation stage, but failed in the long run. The sustainability measure includes ensuring project flexibility to accommodate for future changing environments, adequate resources and financing for the long term, and ensuring the service is attractive to members of the community to utilize the system in the long run. (Pandey and Gupta, 2017).

Operationalization, implementation and sustainability should be considered within a planning horizon with long- and medium-term planning. This ensures clear and explicit planning of visits, activities and deliverables of a project so that the full potential of the project is reached (Mozelius *et al.*, 2009).

#### **4.2.1.9 Define resources inputs**

The required and available resource inputs need to be defined and include, money, labour, technology, values, motives, political support, staffing, skills, management systems and structures (Heeks 2010; Pather & Uys 2010; Taylor-Powell 2005). It is important to acquire resources from local institutions as far as possible, to safeguard sustainability of resources (Heeks, 2010).

#### **4.2.1.10 Define intended and expected outputs**

The intended and expected outputs are the direct outputs/products such as skilled persons, training courses, telecentres and manuals that a project will deliver (Pather & Uys 2010; Taylor-Powell 2005). These outputs are also referred to as outcomes and consist of primary and secondary-order outcomes. Primary-order outcomes involve the mere replacement of old technology with new technology. Secondary-order outcomes are outputs which enable more people to benefit from the new technology. (Sein and Harindranath, 2004).

#### **4.2.1.11 Define impact**

Impact differs from outcomes as it involves the long-term changes that a program intends to bring about (Pather & Uys 2010; Ashraf *et al.* 2017; Taylor-Powell 2005). These are also known as development outcomes (Kleine 2010) and involve tertiary-order outcomes which have a societal or innovational impact on the society in which they are implemented (Pather & Uys 2010; Sein & Harindranath 2004).

### **4.2.2 Functional Phase of Developing ICT4D**

The functional factors include activities intended to develop the readiness of the communities who will use the ICT4D, to ensure that the ICTs4D are utilized effectively and correctly and that environments in which they are implemented are suitable for the maintenance of the ICTs4D. Addressing the readiness of the communities requires an active effort to improve livelihoods within the community by addressing factors such as skills and empowerment (Heeks, 2010). The functional factors therefore ensure the successful implementation of ICT4D and inevitably ensure that the desired outcomes and impacts are attained (Taylor-Powell, 2005; Pather and Uys, 2010; Ashraf *et al.*, 2017). The functional elements were identified within the 33 frameworks and serve the purpose

of improving livelihoods by addressing factors such as skills and empowerment. Within the 33 frameworks, the following 3 overarching elements were identified as elements with functional roles: Capacity building, Empowerment and Trust Formation (Heeks, 2010) .

Table 4.4 depicts the functional activities that were identified within the 33 frameworks and highlights the authors who have used the activities within their frameworks and work.

**Table 4.4: Functional elements present within 33 frameworks**

Functional elements	Authors
Capacity building	(Grunfeld, 2007; Mozelius <i>et al.</i> , 2009; Gomez and Gould, 2010; Heeks, 2010; Pather and Uys, 2010; Mthoko and Khene, 2018)
Empowerment	(Taylor-Powell, 2005; Grunfeld, 2007; Gomez and Gould, 2010; Heeks, 2010; Krauss, 2013; Mamba and Isabirye, 2015; Mthoko and Khene, 2018)
Trust Formation	(Gomez and Gould, 2010)(Krauss, 2013)(Vaidya, 2016) (Yamagishi, Kikuchi and Kosugi, 1999)

Each of these functional elements are now discussed in greater detail.

#### **4.2.2.1 Capacity building**

Capacity building is a crucial aspect in any ICT4D project. The capacity of users must be developed in order to allow the effective use of ICT4D (Gomez & Gould 2010; Pather & Uys 2010; Mamba & Isabirye 2015). Developing the local capacities of users and using local institutions as far as possible equip the local community to be involved in ICT4D projects and thus ensure that the ICT4D are indeed utilized by the local community (Heeks, 2010). IT training as well as the promotion of basic IT skills form part of capacity building (Grunfeld 2007; Pather & Uys 2010). These training initiatives are essential to establish a competent network of team members with the required knowledge and skills to maintain the ICT4D infrastructure (Mozelius *et al.* 2009; Grunfeld 2007). Within capacity building initiatives, external linkages should be formed for education, to increase the social capital of the community and thus ensuring more input resources (Grunfeld, 2007).

#### **4.2.2.2 Empowerment**

Development of livelihoods is greatly associated with empowerment initiatives. Empowering individuals and the community can either be accomplished through the avenues of agency or opportunity structures (Mthoko and Khene, 2018). Realizing the need for stakeholders to be empowered is the core of any ICT4D initiative (Krauss, 2013), and an effort towards increasing the livelihoods of the local community is essential as an end product as well as a prerequisite for successful ICT4D implementation (Mthoko and Khene, 2018).

### 4.2.2.3 Trust Formation

Development endeavours which employ trust as an emancipatory tool to improve the risk-taking abilities of individuals has proven crucial in ICT4D projects (Vaidya, 2016) (Yamagishi, Kikuchi and Kosugi, 1999). Trust within development initiatives therefore serves as a tool for overcoming social uncertainty by encouraging those under its influence to be inclined to believe in the goodwill and harmless intentions of others (Vaidya, 2016).

Trust formation involves encouraging practices within development initiatives that shape abilities to form trust such as, cultural similarities, optimum communication, expectations of altruism and individual's ethics.

### 4.2.3 Design Phase

The design phase includes the design of the system as well as the design of the technology used in ICT4D projects. The design is therefore broken up into two sections: Design of Appropriate Technology and Design of the System. These two design phases are now discussed. Within the 33 frameworks, the following elements, as shown in Table 4.5 were identified as elements with design roles. The two main phases are explained in the subsections hereafter.

**Table 4.5: Requirements for Design Phase**

Phase	Requirements	Authors
Design of Appropriate Technology	Accessibility easiness	(Pather and Uys, 2010; Vaughan, 2011; Johri and Pal, 2012)
	Ability to adapt technology	(van Reijswoud, 2009; Vaughan, 2011)
	Ability to create new knowledge from the technology	(van Reijswoud, 2009; Vaughan, 2011)
	Ability for self-expression within the technology (expressive creativity)	(Johri and Pal, 2012)
	Must have a higher output than the traditional technologies and contribute to the increase of productivity	(van Reijswoud, 2009)
	Technology must be understandable for people without specific or academic training to allow all communities to produce, maintain and become involved in the possible innovation and extension of the use of the technology	(van Reijswoud, 2009)
	Local ownership must be encouraged to ensure sustainability	(Mozelius <i>et al.</i> , 2009; Heeks, 2010)
	Appropriate technology mix to match local realities	(Heeks, 2010)
	Ability to allow relationships to be formed when using the technology (relational interactivity)	(Johri and Pal, 2012)
	Should not have a negative impact on the environment and should offer the opportunity to enrich the environment (ecological reciprocity)	(van Reijswoud, 2009; Johri and Pal, 2012)

Phase	Requirements	Authors
Design of the System	This stage considers the aspects of operationalization, implementation and sustainability of the program and designs according to these requirements	(Mozelius <i>et al.</i> , 2009; Pandey and Gupta, 2017)

#### 4.2.3.1 *Design of appropriate technology*

Apart from the analytical and functional phases within ICT4D development process, there exists a design phase which must consider the requirements for the appropriate design of the technology used in ICT4D projects (van Reijswoud 2009; Heeks 2002; van Reijswoud 2009; Heeks 2002; Johri & Pal 2012; Mozelius et al. 2009; Heeks 2010; Vaughan 2011). The design of appropriate technology known as AT, involves designing technology suitable for the cultural, environmental and economic context in which the technology will be implemented. The opposite type of technology is one that is intended to be used under all circumstances, known as one size fits all (van Reijswoud, 2009).

The appropriate technology requirements for technology used in ICT4D and summarized in Table 4.5.

#### 4.2.3.2 *Design of the System*

Similar to the analysis phase this stage specifically focuses on the aspects of operationalization, implementation and sustainability and design.

According to Mozelius et al. (2009), designing a system that is operable in a certain context involves: 1) Considering system within a planning horizon with long- and medium-term planning and 2) Designing the processes of the system suitable to environment.

According to Pandey & Gupta (2017), designing a system so that it is implementable, given the political and organizational environment should involve 1) Business champions, 2) Network mobilization and 3) Engaging the local community.

Pandey & Gupta (2017) state that designing the system for sustainability, involves 1) Designing to be flexible enough to adapt to changing situations, 2) Ensuring there are enough resources for the long run and 3) Engaging the members of community to utilize services provided by the project.

### 4.3 Chapter 4 Conclusion

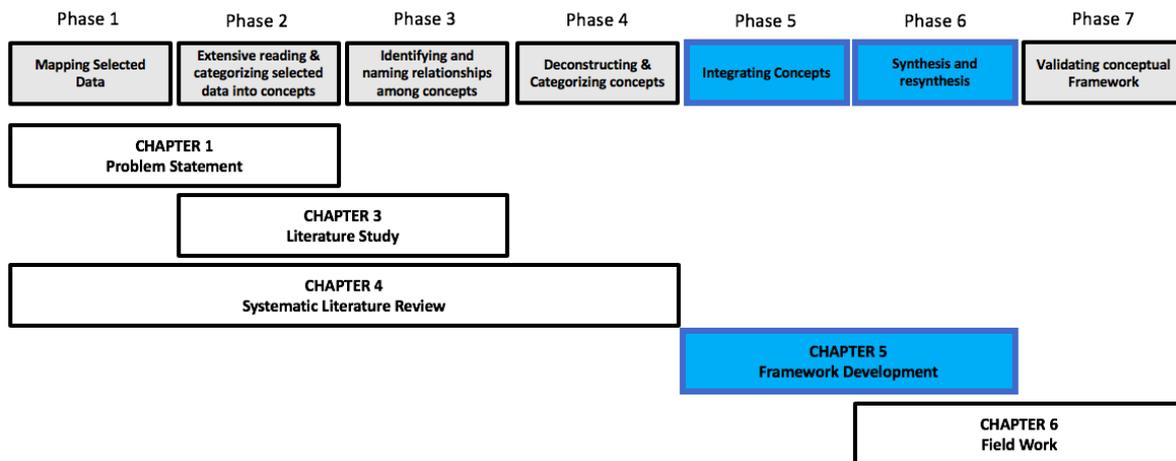
A systematic literature review was conducted and discussed in this chapter. The chapter explains each step involved in conducting this systematic literature review. Through the systematic literature review 33 frameworks relating to ICT4D were explored and used to extract concepts that form the basis for developing the ICT4D framework for this study. Requirement and design frameworks, relating to ICT4D, were the main focus within the exploration of the 34 frameworks, due to the fact that in ICT4D projects in particular, the requirement and design stages are the most challenging stages in the system development process, and may be the leading stages where mistakes are

made causing ICT4D failure (Donner et al. 2008; Bourgeois & Horan 2007; Bieber et al. 2007; Wayi & Huisman 2010). ICT4D frameworks and approaches relating to the implementation, verification and maintenance were also explored, for ICT4D to be considered in its entire life cycle.

The concepts identified within the 33 frameworks can be grouped into three overarching phases of developing ICT4D: analytical phase, functional phase, and design phase. The summary each of the 33 frameworks can be seen in the Appendix B.

## CHAPTER 5 - FRAMEWORK DEVELOPMENT

This section discusses the process involved in developing the conceptual framework. Figure 5.1 provides an overview of the research design structure followed and indicates where in the document each phase is addressed. The Framework Development Chapter forms part of Phase 5 and 6.

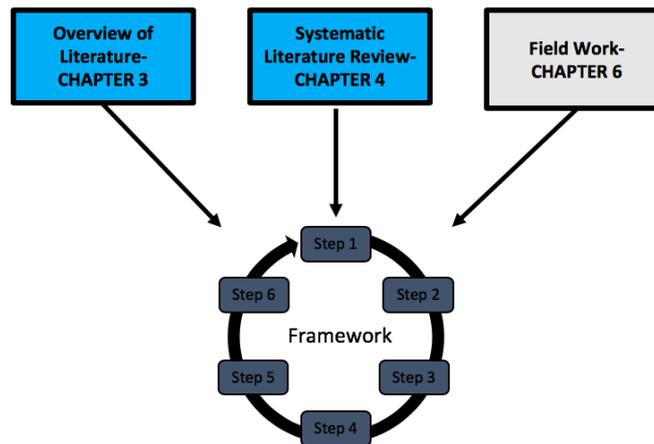


**Figure 5.1: Depicting Chapter 5 within the scope of the whole research**

The key objective, as stated in Chapter 1, which Chapter 5 the Framework Development Chapter addresses is:

- 
- 4) Construct a conceptual framework for the development of ICTs4D in developing countries, by using the knowledge obtained through the attainment of the previous objectives.
- 

The development of the framework involved using the concepts identified in Chapters 3 and 4 and integrating these concepts to form a cohesive whole. This cohesive whole forms the conceptual framework which is improved upon within the next chapter which results in the final framework. The figure below illustrates the knowledge used to develop the initial framework presented in this chapter.



**Figure 5.2: Knowledge used to develop the conceptual framework within Chapter 5.**

The sections within Chapter 5 cover various aspects related to the development of the conceptual framework. Section 5.1 executes Phase 5 by integrating the concepts, which have already been identified within Chapters 3 and 4. The concepts are integrated in order, to reduce the number of concepts to a practical number that will be used to develop the framework. Section 5.2 follows to execute Phase 6 and conducts the synthesis and resynthesis process. This synthesis and resynthesis process is used to establish the relationships between the integrated concepts and then to assemble these concepts according to their appropriate relationships to develop the conceptual framework. Section 5.3 concludes with a summary of the findings within Chapter 5.

## 5.1 Integrating concepts

The previous phases, Phase 2, 3 and 4 of the framework developing process by Jabareen (2009), involved identifying concept's within the overall body off literature. This section discusses the concepts identified within those phases and the integration process used to reduce the number of concepts to a practical number that will be used to develop the framework.

Section 5.1.1 firstly looks at the concepts identified within Chapter 3 and integrates these concepts which leads to the identification of a structural basis, i.e., a systematic process that is used to build upon and develop the framework. Section 5.1.2 further looks at the concepts identified in Chapter 4, which are three overarching concepts relating to activities used within the development of ICT4D, i.e., analytical, design and functional activities. These activities are then further integrated and systematically arranged upon the framework structure.

### **5.1.1 Identifying a structural basis for the ICT4D Framework**

The first common combination of attributes and concepts used to develop the framework was discovered within Chapter 3 and guided the reviewer to develop an appropriate structure to form the basis for the framework.

Section 5.1.1.1 discusses the requirements which the structure of the framework would need to abide to. The first requirement which Section 5.1.1 looks at is the approach that would be embedded within the structure of the framework. Section 5.1.1 therefore looks at the logic behind choosing the agile approach, as this required approach. The second requirement discussed within this section is that the structure would only include the analysis and design steps.

Section 5.1.1.2 then uses the SDLC steps, the general ISD steps used within most ISD methodologies, and adapts these steps according to the requirements identified in Section 5.1.1.1. This adapted SDLC steps results in the structural basis of the framework.

#### **5.1.1.1 Requirements for the Structure of the Framework**

The first section within Chapter 3 dealt with literature relating to ISD. The literature explored the development processes for Information Systems and discovered that the agile approach was most suited for developing ISs for Social Development purposes (i.e., ICTs4D). The reasoning behind choosing the agile approach as the best suited structure for a basis to develop the ICT4D framework, is due to:

- 1) The approach used to develop ICT4D, in especially developing areas need to be simple due to most people in developing areas having limited knowledge regarding information systems. The agile method focuses on simplicity, avoiding redundant work and extensive documentation (Dennis, Wixom and Tegarden, 2015) (Wayi and Huisman, 2010).
- 2) The approach needs to be flexible, due to more volatile environments associated in developing areas (Wayi and Huisman, 2010). The activities depicted in the agile development cycle can be executed simultaneously and the steps can also be repeated. This iterative process allows for flexibility and reconsideration of requirements as the project progresses (Kendall and Kendall, 2011). The changes in user requirements are also expected within the agile approach and welcomed irrespective of when these changes occur during the process of development (Dennis, Wixom and Tegarden, 2015).
- 3) The approach should accommodate the social context by taking into account the needs and capabilities of the community (Wayi and Huisman, 2010). The agile approach esteems working together with end users as a very high priority (Gasson 2003b; Dennis et al. 2015).

Individuals and interactions in this approach are esteemed higher than processes and tools (Gasson 2003b), and face-to-face communication is seen as the most effective and efficient means of establishing requirements (Dennis, Wixom and Tegarden, 2015).

It was therefore decided to structure the framework around the agile approach, which is iterative and flexible in nature. The student was therefore guided to develop a framework with iterations and thus adaptability and flexibility at its core.

The second requirement identified for the structure of the framework is that it would only include the requirements and design phases. This was decided upon the findings in Chapter 3 which indicated that the requirement and design stages in the development of ICT4D, posed the most challenges.

The structural basis of the framework would therefore require to be an agile process which only includes analysis and design phases and thus it is referred to as an Analysis and Design Framework from here.

### 5.1.1.2 Adapted SDLC Steps

The SDLC steps, the general ISD steps used within most ISD methodologies, were used as guiding steps for developing the framework. The SDLC steps were firstly adapted to meet the requirements of the agile approach by ensuring it is applied in an iterative and flexible manner. The SDLC steps were then further adapted to only include the analysis and design stages and therefore the implementation phase within the SDLC was omitted.

Figure 5.3 shows the generally used SDLC steps and highlights the steps which form the focus of this study.

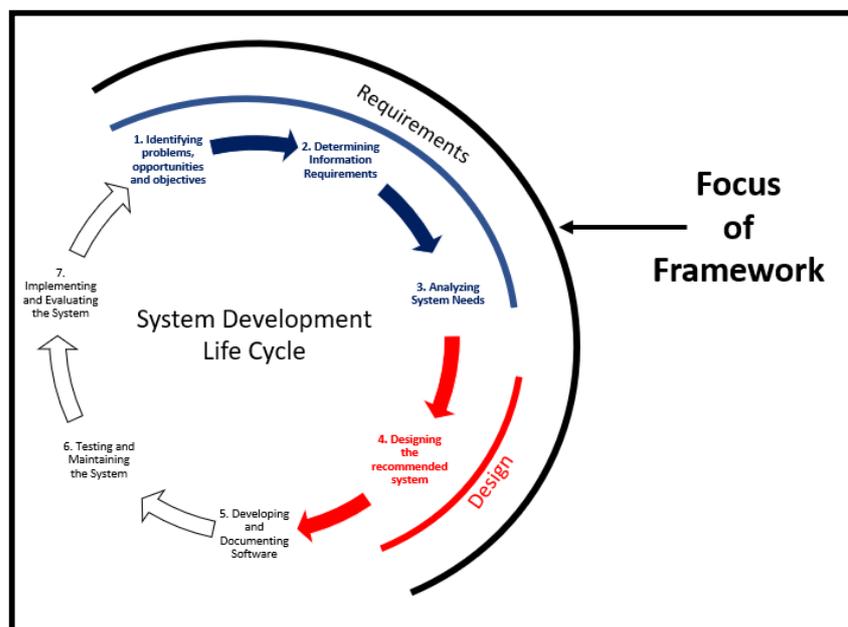
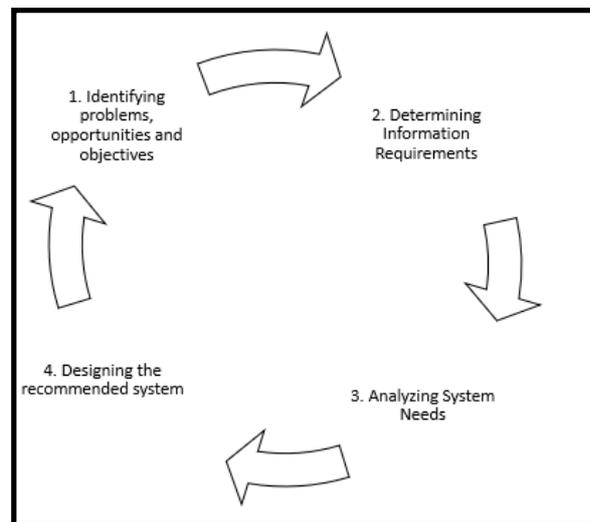


Figure 5.3: Generally used SDLC depicting focus of study

The first three steps in the SDLC, form part of the requirement stage: 1) Identifying problems, objectives and opportunities, 2) Determining information requirements and 3) Analysing system needs: the fourth step forms part of the design stage: 4) The design of the recommended system.

Figure 5.4 shows the SDLC adapted to include the requirement and design phases only.



**Figure 5.4: Structural basis of the framework**

These four iterative steps were therefore used as the structure of the framework which to build upon in order to develop a process to guide the researcher in the development ICT4D.

### **5.1.2 Arranging activities upon the framework structure**

This section explores the common attributes discovered in the 33 frameworks that were studied in Chapter 4. These attributes are grouped into 3 overarching concepts, namely, analytical, design and functional activities. These activities are now systematically arranged upon the framework structure identified in Section 5.1.1.

The framework structure in Section 5.1.1 which consists of the adapted SDLC steps therefore provides a means of establishing order amongst the concepts/activities identified from the 33 frameworks to start providing a systematic guide to follow in the development of ICT4D. This section illustrates the analytical, design and functional activities/concepts grouped into their appropriate SDLC steps. Section 5.2.2.1 discusses the analytical phase activities, Section 5.2.2.2 the design phase activities and Section 5.2.2.3 the functional phase activities.

#### **5.1.2.1 Analytical Phase Activities**

The analytical phase involves accessing empirical evidence to develop understanding regarding the livelihoods of the users and communities in which the ICT4D will be implemented

(Duncombe, 2006). The SDLC steps, as seen in Figure 5.4, which relate to the analytical phase, include the following SDLC steps: Step 1 – Identifying problems, opportunities and objectives, Step – 2 Determining Human Information Requirements and Step 3 – Analysing system needs. These SDLC steps all aim to gain an understanding of the environment in which the system will be implemented as well as gaining an understanding of the users who will utilize the system. The analytical activities, as defined in Section 4.2.1, are therefore grouped according to the SDLC steps that pertain to the analytical phase.

Table 5.1 shows the SDLC steps and the analytical activities that will be executed within each SDLC step.

**Table 5.1: Analytical Activities within the SDLC**

Overarching phases in the development of ICT4D	SDLC Steps	Analytical Activities relating to SDLC Steps
Analytical Phase	1. Identify problems, opportunities and objectives	Community entry phase
		Identify authentic Local Needs
		Determine factors that influence choice/ conversional factors
		Determine opportunities and project risks
		Define Goals, objectives targets
		Define context specific user requirements
	2. Determine human Information requirements	Define context specific System Requirements
	3. Analyse system needs	Define resources inputs
		Define intended and expected outputs
		Define impact

### 5.1.2.2 Design Phase Activities

The Design Phase activities relating to the appropriate SDLC steps are now discussed. The two design activities established in Section 4.2.3 include, 1) the design of appropriate technology, which involves the design of technology suitable for the cultural, environmental and economic context in which the ICT4D will be implemented and 2) the design of the system which involves designing the processes that are sustainable, operatable and implementable.

The SDLC step relating to the Design Phase includes Step 4 of the SDLC – Design recommended system. It is important to note that the design concepts/activities were not grouped into a specific order of execution, as with the analytical phase. The activities identified within this phase must therefore all be considered in unison when designing the technology

and the system. The SDLC steps and their corresponding design activities can be seen in Table 5.2.

**Table 5.2: Design phases within the SDLC**

Overarching phases in the development of ICT4D	SDLC Steps	Analytical Activities relating to SDLC Steps	
Design Phase	4.Design of the System	Design of Appropriate Technology	Accessibility easiness
			Ability to adapt technology
			Ability to create new knowledge from the technology
			Ability for self-expression within the technology (expressive creativity)
			Must have a higher output than the traditional technologies and contribute to the increase of productivity
			Technology must be understandable for people without specific or academic training to allow all communities to produce and maintain and become involved in the possible innovation and extension of the use of the technology
			Local Ownership must be encouraged to ensure sustainability
			Appropriate technology mix to match local realities
			Ability to allow relationships to be formed when using the technology (relational interactivity)
			Should not have a negative impact on the environment and should offer the opportunity to enrich the environment (ecological reciprocity)
	4. Design of the System	This stage involves the process design and considers the aspects of operationalization, implementation and sustainability of the program and designs according to these requirements	

### 5.1.2.3 *Functional Phase Activities*

The functional phase activities involve activities intended to develop the readiness of the communities who will use the ICT4D, to ensure that the ICT4D are utilized effectively and correctly and to ensure the environments in which they are implemented are suitable for the maintenance of the ICT4D. Addressing the readiness of the communities requires an active effort to improve livelihoods within the community by addressing factors such as skills and empowerment (Heeks, 2010). The functional activities therefore ensure the successful implementation of ICT4D and inevitably ensures that the desired outcomes and impacts are attained (Pather & Uys 2010; Taylor-Powell 2005).

None of the SDLC Steps in Figure 5.4 relate to the functional phase description and therefore further investigation was needed to incorporate the functional phase activities into the structure of the framework. The functional elements identified within the 33 frameworks in Chapter 4, the systematic literature review, which serve the purpose of improving livelihoods by addressing factors such as skills and empowerment are depicted in Table 5.3 and will be appropriately incorporated into the framework within the section to follow.

**Table 5.3: Functional Activities**

Overarching phases in the development of ICT4D	SDLC Steps	Activities relating to SDLC Steps
Functional Phase	None of the SDLC steps in Figure 5.4 relate to the functional phase, therefore meaningful relationships with analysis and design phase was explored in Section 5.3, to establish its place within the framework.	Capacity building
		Empowerment
		Trust Formation

## 5.2 Synthesis and Resynthesis

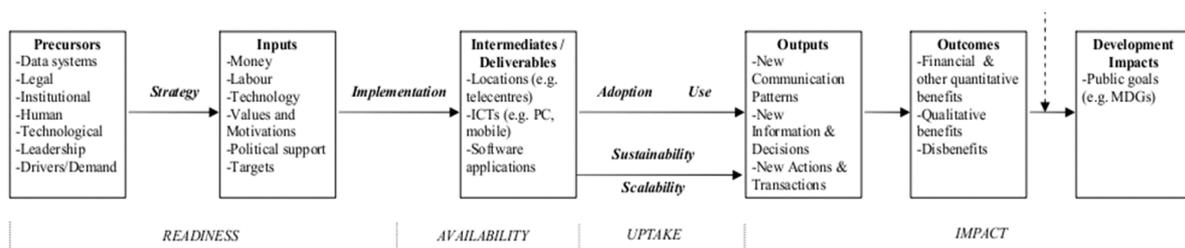
The previous sections within this chapter resulted in analytical and design activities grouped into their appropriate order of execution. This was done by using the frameworks structural basis identified in Section 5.1.1 and grouping the appropriate activities into each SDLC step. There however still exist functional activities that need to be integrated into this structure, but it was discovered that the functional activities did not relate to any of the steps within the structural basis of the framework. This section therefore explores the relationships between the, analytical, design and functional activities in order to appropriately incorporate the functional phase into the structure of the framework.

Section 5.2.1 explores the ICT4D Value Chain Model, developed by Heeks (2010). This model is used to identify the relationship between the analytical, design and functional phase activities. Section 5.2.2 synthesises all the findings from this Chapter to form a cohesive whole and illustrates this through a systematic process that can be followed to guide the analysis and design of ICT4D, i.e., the conceptual framework.

### 5.2.1 Using the ICT4D Value Chain Model to establish meaningful relationships

The ICT4D Value Chain Model, by Heeks (2010), was used to identify the relationships between the analytical, design and functional phase activities within the framework. It was discovered that the traditional SDLC model, incorporated analytical and design steps but did not include any functional steps before implementation of the system. As the aim of the functional activities is to address and improve the livelihoods of the users and community (Duncombe, 2006), the SDLC process as depicted in Figure 5.4 was modified to incorporate steps that address livelihoods and therefore include functional activities.

Heeks (2010) in his ICT4D value Chain model, refers to the degree of the existence of specific livelihoods/precursors as readiness of an ICT4D before implementation. The ICT4D value chain model refers to readiness, as a prerequisite to implementation, and involves having precursors in place before commencing with the implementation of the system. The knowledge gained from the literature study and specifically the ICT4D value chain framework therefore confirmed the necessity of addressing livelihoods, and therefore executing functional activities, before commencing with implementation of the system. Figure 5.5 illustrates the concept of readiness and illustrates its importance before the implementation of the ICT4D



**Figure 5.5: ICT4D Value Chain (Heeks 2010)**

The readiness of implementing an ICT4D can be improved through addressing certain precursors and thus increasing the possibility of delivering successful outcomes and impact (Heeks, 2010). These precursors can be seen in Figure 5.5.

The Functional Phase, which involves improving livelihoods by addressing factors such as skills and empowerment, was therefore incorporated into the framework as a tool to address

the readiness of an ICT4D before its implementation. Heeks (2010) states the foundational precursors within the ICT4D value chain model which includes, legal, institutional, human, technological, leadership and drivers/demand

The readiness precursors as shown in (Heeks, 2010) value chain model, can be largely addressed through capacity building and empowerment initiatives (Thomas et al. 2017; Gurumurthy 2016; Narayan 2001; Mozelius et al. 2009). The functional activities are therefore incorporated into the framework to ensure readiness before implementation and thus was incorporated at the end of the analytical and design phases, just before implementation would take place.

### **5.2.2 The ICT4D Framework**

This section involves integrating the findings from the previous sections to develop a systematic process that can be followed to guide the analysis and design of ICT4D. This systematic process is known as the Analytical and Design Framework for the development of ICT4D.

The framework incorporates a cyclic process to allow for incremental improvements throughout the analysis and design phases. Figure 5.6 depicts the Analysis and Design Framework, illustrating the analytical, design and functional phases, their relationships and the activities within each of these phases. The SDLC steps have been removed from the table as the activities identified in the systematic literature review form the new steps within the framework. Table 5.4 summarises the analytical, design and functional activities and provides a guiding tool for the analysis and design of ICT4D.

## Analysis and Design Framework for ICT4D

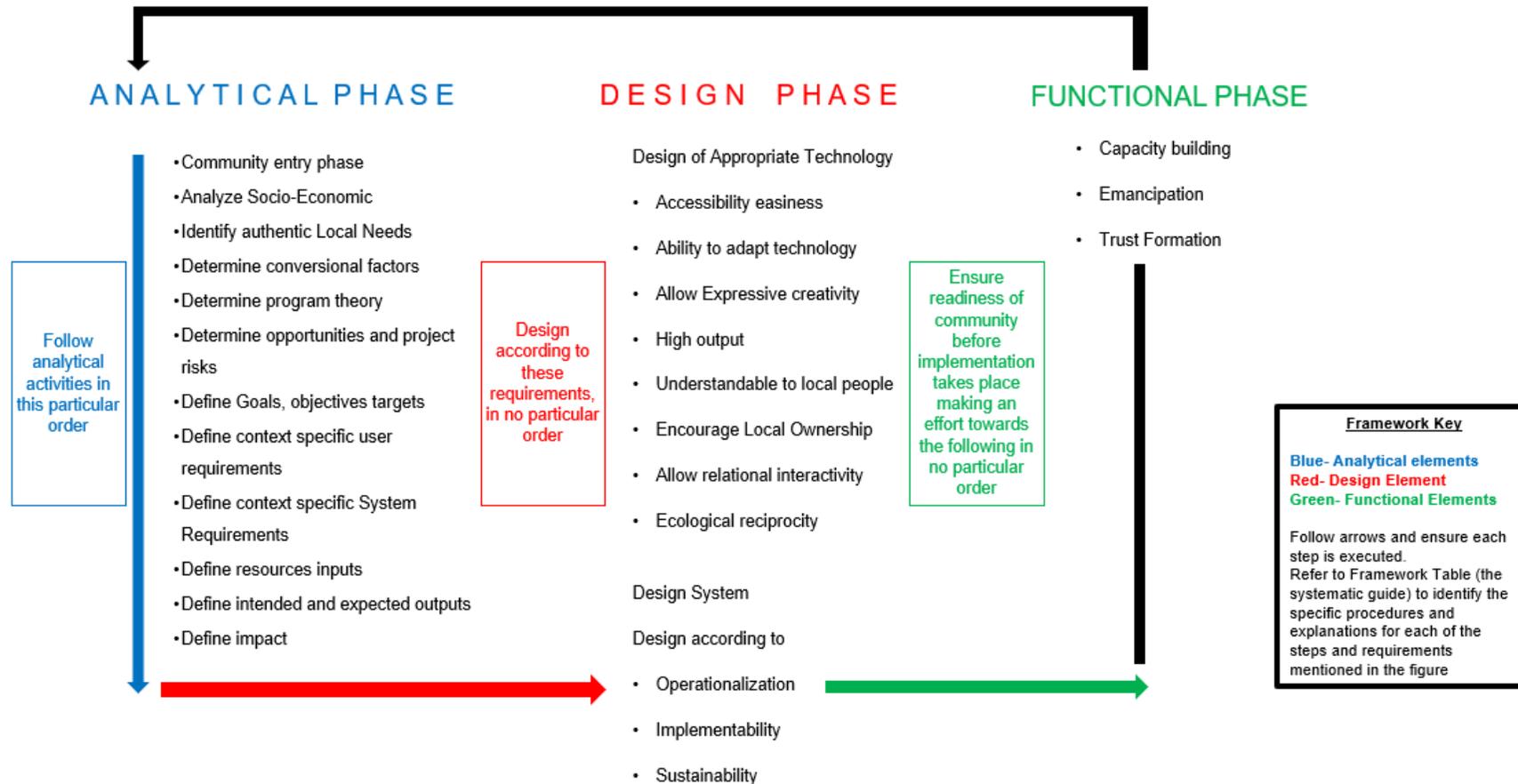


Figure 5.6: Analysis and Design Framework for ICT4D

**Table 5.4: Systematic guide for the Analysis and Design of ICT4D in a developing country settings**

Overarching phases in the development of ICT4D	Systematic process of activities followed in each phase	Description	Procedures followed to carry out activities
<b>Analytical Phase</b>	Community entry phase	Consult with the local community and ensure a participatory design process is followed, including all stakeholders and members of the local community	<ul style="list-style-type: none"> <li>• Consult with the local community</li> <li>• Generate ideas with end users</li> <li>• Engage stakeholders in the beginning of the project and an effort should be made towards building relationships between the various stakeholders</li> <li>• Encourage partnerships as well as an open and competitive environment together with the participation of local users</li> <li>• Create awareness amongst the community members, informing them of the benefits of using ICTs</li> </ul>
	Analyse Socio-Economic	Analyse Socio-Economic context by defining the context of the environment in which the ICT4D will be employed.	<ul style="list-style-type: none"> <li>• Execute the following studies</li> <li>• Financial</li> <li>• Environmental and</li> <li>• Cultural impact studies</li> <li>• Capability assessments</li> <li>• Assess Livelihoods profiles</li> <li>• Analyse following factors</li> <li>• Information availability</li> <li>• Legal context</li> <li>• Institutions active in the community and their role</li> <li>• Human factors</li> <li>• Technological progress and availability</li> <li>• Leadership</li> <li>• Drivers</li> <li>• Demand</li> </ul>
	Identify authentic Local Needs	Identify the authentic local needs and make sure the developers understand the community needs as these local needs may be different to the needs the developers could identify, due to the different values and views of the developers and community members	<ul style="list-style-type: none"> <li>• Conduct observations relating to vulnerability</li> <li>• Define stakeholder Interest</li> <li>• Keep focus on primarily meeting the needs and desires of the rural community.</li> <li>• Make sure the project investors/owners are open about their intentions and work so that a conflict of interest between the owners/investors and the larger community align</li> </ul>
	Determine conversional factors	Conversional factors are factors which influence choice. To determine these the analyst needs to identify constraints regarding all external project factors	<ul style="list-style-type: none"> <li>• These conversional can be <ul style="list-style-type: none"> <li>Political factors</li> </ul> </li> <li>• Which are factors that will either encourage or constrain the use of ICT4D and are determined by</li> <li>• Governmental/municipal support for ICT development</li> <li>• Efficiency and Transparency of national/local governance</li> </ul>

Overarching phases in the development of ICT4D	Systematic process of activities followed in each phase	Description	Procedures followed to carry out activities
			<ul style="list-style-type: none"> <li>• ICT legislation maturity</li>   <li style="padding-left: 40px;">Socio-cultural</li> <li>• Socio-cultural factors include</li> <li>• IT literacy of recipients</li> <li>• Personal motivation of recipients</li> <li>• Recipients cultural and ethical support</li> <li>• Health Safety</li>   <li style="padding-left: 40px;">Technical</li> <li>• Technical factors are related to</li> <li>• Accessibility of ICT infrastructure</li> <li>• Accessibility of public infrastructure (e.g., electricity)</li> <li>• Availability of skilled technical support</li> </ul>
	Determine program theory	<p>Once the needs and lack in capabilities have been identified, the program theory that is required to address these needs and lack in capabilities can be identified (Pandey and Gupta, 2017)</p> <p>The problems that needs to be addressed are either rooted in economic, social or socio-economic issues.</p>	<p>Determine development intervention</p> <p>Intervention can be</p> <ul style="list-style-type: none"> <li>• Economic Intervention (achieving economic growth)</li> <li>• Social Intervention (capability improvement, health care, literacy and gender equality.</li> <li>• or Socio-Economic Intervention (combination of both)</li> </ul> <p>Choose Agency of intervention</p> <p>Agency can be</p> <ul style="list-style-type: none"> <li>• State</li> <li>• People</li> <li>• Market</li> </ul> <p>Determine design approach</p> <p>The design approach can either be in the form of a</p> <ul style="list-style-type: none"> <li>• Product or</li> <li>• Service</li> </ul>
	Determine opportunities and project risks	Identify livelihood assets which can help determine project risk and opportunities	<ul style="list-style-type: none"> <li>• Livelihood assets include</li> <li>• Physical assets</li> <li>• Social assets</li> <li>• Financial assets</li> <li>• Human assets</li> <li>• Natural assets</li> </ul>
	Define Goals, objectives targets	Defining the goals and targets of the ICT4D project is crucial for direction and accountability. This stage should set realistic limitations and ensure that the defined targets and goals align with local development goals as well as prioritizing the needs and desires of the local community	<ul style="list-style-type: none"> <li>• Access knowledge from identified local needs of the community</li> <li>• Use observations from the vulnerability study in the context analysis</li> <li>• Set realistic limitations</li> <li>• Ensure that the defined targets and goals align with local development goals</li> <li>• Prioritize the needs and desires of the local community</li> </ul>

Overarching phases in the development of ICT4D	Systematic process of activities followed in each phase	Description	Procedures followed to carry out activities
	Define context specific user requirements	Translate the needs of the community into information requirements for coding purposes so that the Information can be used to develop the ICT4D system	<ul style="list-style-type: none"> <li>• Gather information relating to the specific use and needs of the system such as</li> <li>• Training needs</li> <li>• Preferred hours of operation</li> <li>• Willingness to pay for services</li> </ul>
	Define context specific System Requirements	This stage considers the aspects of operationalization, implementation and sustainability and analyses system needs weighing them up against these requirements.	<p>Analyse operationalization</p> <ul style="list-style-type: none"> <li>• Identify critical program functions</li> <li>• Identifying performance criteria</li> <li>• Identify the operationalization of the performance criteria that the program should deliver.</li> </ul> <p>Analyse implementability</p> <ul style="list-style-type: none"> <li>• Implementability focuses on assessing how practical it is to implement a project in a given political and organizational environment</li> <li>• Consider business champions</li> <li>• Sponsors.</li> <li>• Stakeholder Management</li> <li>• Network mobilization</li> <li>• Technology adoption,</li> <li>• Top management commitment and</li> <li>• Community engagement.</li> </ul> <p>Analyse Sustainability</p> <ul style="list-style-type: none"> <li>• Analyse most appropriate ways to engage the members of community to utilize services and products provided by the project</li> </ul>
	Define resources inputs	The required and available resource inputs need to be defined	<p>Identify available resources such as</p> <ul style="list-style-type: none"> <li>• Money</li> <li>• Labour</li> <li>• Technology</li> <li>• Values</li> <li>• Motives</li> <li>• Political support</li> <li>• Staffing, skills</li> <li>• Management systems and structures</li> </ul> <p>Acquire resources from local institutions as far as possible, to safeguard sustainability of resources</p>
	Define intended and expected outputs	These are direct outputs/ products of the project	<p>The following outputs are examples of the products delivered by the project</p> <ul style="list-style-type: none"> <li>• Skilled persons</li> <li>• Training courses</li> <li>• Telecentres</li> <li>• Manual's that a project will deliver etc.</li> </ul>

Overarching phases in the development of ICT4D	Systematic process of activities followed in each phase	Description	Procedures followed to carry out activities
	Define impact	Involves the long-term changes that a program is intended to bring about	These can be <ul style="list-style-type: none"> <li>• A societal or</li> <li>• Innovation impact on the society in which they are implemented.</li> </ul>
<b>Design Phase</b>	Design of Appropriate Technology	Accessibility easiness	Accessibility involves the ability to access an object and by using that object accessing information which is of value to the user
		Ability to adapt technology	The technology must be flexible and easily to be adapted to changing circumstances
		Allow expressive creativity	Ability for self-expression within the technology. Being able to produce and use personal energy creativity to learn and solve problems with the technology
		High output	Technologies may be relatively labour-intensive but must have a higher output than the traditional technologies and contribute to the increase of productivity
		Understandable to local people	Technology must be understandable for local people without specific or academic training to allow all communities to produce and maintain and become involved in the possible innovation and extension of the use of the technology
		Encourage Local Ownership	Local Ownership of the technology must be encouraged and made possible to ensure sustainability.
		Allow relational interactivity	Technology must be designed to give the ability when used for relationships, to learn with others in and through interactions
		Ecological reciprocity	The technology should not have a negative impact on the environment and should offer the opportunity to enrich the environment

Overarching phases in the development of ICT4D	Systematic process of activities followed in each phase	Description	Procedures followed to carry out activities
Design of System	Process Design	This stage considers the aspects of operationalization, implementation and sustainability of the program and designs according to these requirements	<ul style="list-style-type: none"> <li>• Design system that is operatable in certain context</li> <li>• Design the processes of the system suitable to environment</li> <li>• Design so that system is implementable for the given political and organizational environment</li> <li>• Involve business champions</li> <li>• Network mobilization</li> <li>• Engagement of local community.</li> <li>• Design so that system is Sustainable</li> <li>• Design so that it is flexible enough to adapt to changing situations</li> <li>• Ensure sufficient resources for the long run</li> <li>• Engage the members of community to utilize services provided by the project</li> </ul>
	Functional Phase	Capacity building	The capacity of users must be developed to allow the effective use of ICT4D by the local community Developing the local capacities of users and using local institutions as far as possible to equip the local and is essential to establish a competent network of team members with the required knowledge and skills to maintain the ICT4D infrastructure
Emancipation		Emancipate the local community and stakeholders by attempting to eradicate limitations for the well-being of humans. In return this will empower the community and users	Emancipate community at the <ul style="list-style-type: none"> <li>• physical,</li> <li>• legal and</li> <li>• moral level</li> </ul> Emancipate and empower individuals and the community either through the avenues of <ul style="list-style-type: none"> <li>• agency</li> <li>• opportunity or</li> <li>• structures</li> </ul>
Trust formation		Trust serves as a tool for overcoming social uncertainty by encouraging those under its influence to believe in the goodwill and harmless intentions of others. Trust therefore, is important where complex	<ul style="list-style-type: none"> <li>• Encourage trust amongst stakeholders</li> <li>• Form relationships with community members</li> </ul>

Overarching phases in the development of ICT4D	Systematic process of activities followed in each phase	Description	Procedures followed to carry out activities
		situations without easy contractual relation or enforcement exist.	

### 5.3 Chapter 5 Conclusion

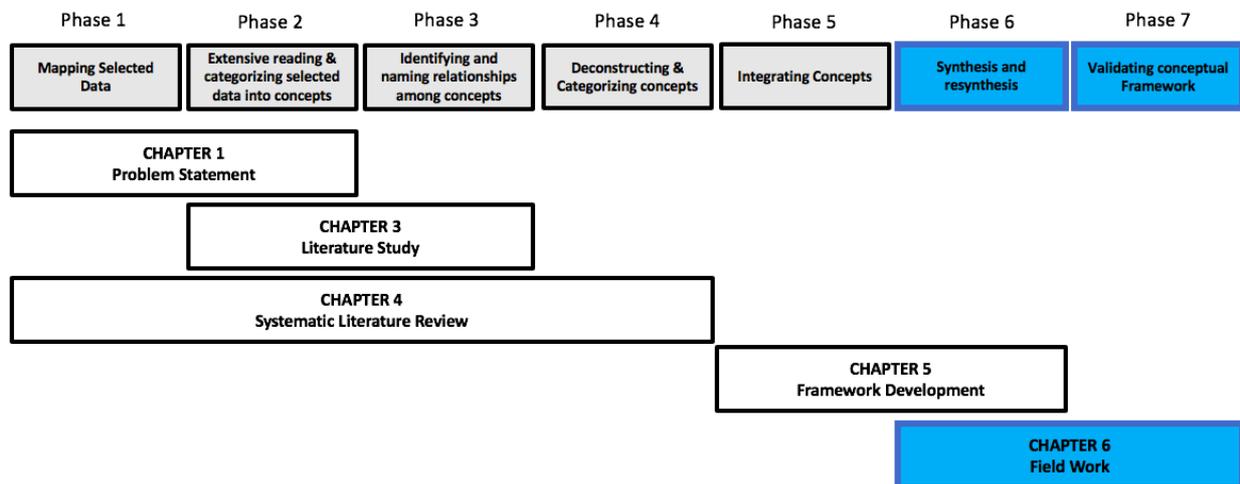
Chapter 5 discusses the process involved in developing the conceptual framework. The process involved using the concepts identified in Chapters 3 and 4, integrating these concepts to establish their meaningful relationships and then using this knowledge to form a cohesive whole known as the conceptual framework.

Section 5.1 discusses the concepts identified within the overall body of literature, as identified within the previous phases and the integration process used to reduce the number of concepts to a practical number that was used to develop the framework. The first section in Section 5.1 uses the concepts identified in Chapters 3 and 4 and then integrates these concepts to develop a structural basis, i.e., a systematic process that is used to build upon and develop the framework. Developing this structural basis involved using the SDLC steps, the general ISD steps used within most ISD methodologies, as basic guiding steps. The SDLC steps were then adapted to meet the requirements of the agile approach, the approach identified as most appropriate for ICT4D projects, by ensuring it is applied in an iterative and flexible manner. This process was then further adapted to only include steps applicable to the analysis and design of ISD. The second part of Section 5.1 then went further to explore the concepts discovered in the 33 frameworks that were studied in Chapter 4. These attributes are 3 overarching concepts, namely, analytical, design and functional activities. These activities were then systematically arranged upon the framework structural basis. This process resulted in analytical and design activities grouped into their appropriate order of execution that can be used to develop ICTs4D.

It was however discovered that the functional activities did not relate to any of the steps within the structural basis of the framework and therefore the functional activities still needed to be integrated into this structure. Section 5.2 therefore uses a process of synthesis and resynthesis to establish the appropriate relationship amongst the activities within the framework's structure. Section 5.2 firstly looks at the ICT4D Value Chain Model, developed by Heeks (2010) to identify the relationship between the analytical, design and functional phase activities. This section then finally synthesises all the findings from this Chapter to form a cohesive whole which is a systematic process that can be followed to guide the analysis and design of ICT4D, i.e., the conceptual framework.

## CHAPTER 6- FIELD WORK

This section discusses the process involved in improving and validating the framework. Figure 6.1 provides an overview of the research design structure followed and it indicates where in the document each phase, or part thereof, is addressed. The Field Work Chapter forms part of, Phase 6 and 7



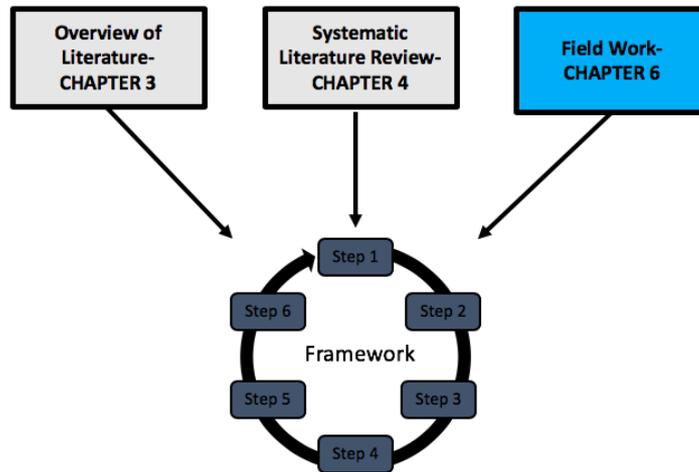
**Figure 6.1: Chapter 6 within the scope of the research**

Figure 6.1 depicts the flow of Chapter 6 within the scope of the research. Chapter 6, the Field Work, forms part of Synthesis and Resynthesis, and Validating the conceptual framework. This is all accomplished through attainment of the last 3 objectives of this study.

As stated in Chapter 1 the objectives of the study are attained within two overarching studies, Study 1 – Theoretical Study and Study 2 – Empirical Study. Chapter 6 forms part of Study 2, The empirical study. The key objectives in Phase 2, which Chapter 6 The Field Work Chapter aims to attain:

- 
- 5) Empirically test the framework by investigating and identifying the requirements for the development of ICTs4D in South Africa, by executing in-depth interviews with experts in the ICT4D field.
  - 6) Improve the framework upon the above findings.
  - 7) Validate the framework upon attainment of objective 5
- 

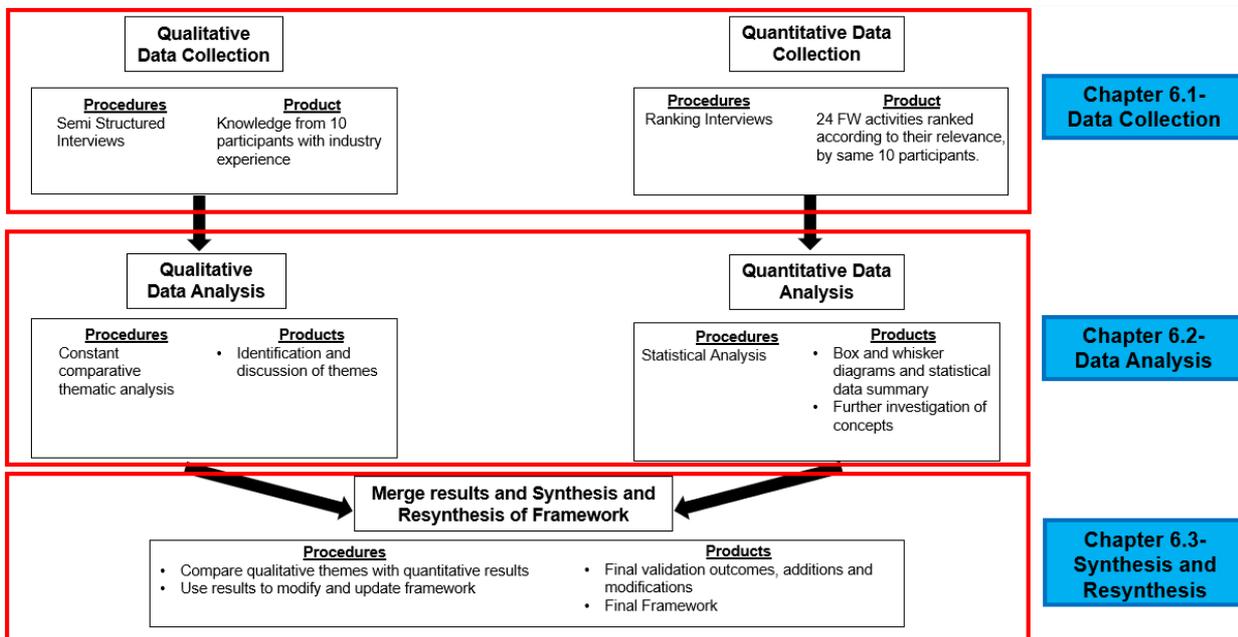
Chapter 6, The Field Work, contributes to the final knowledge needed for developing the framework. The knowledge gained from conducting the Literature Study, the Systematic Literature Review and now the Field Work, together contribute to the development of the improved and validated framework. Figure 6.2 depicts the knowledge input to develop the framework



**Figure 6.2: Knowledge input used to develop the framework within Chapter 6**

The mixed methods approach was used to accomplish the field work within this chapter. The mixed methods approach involves qualitative and quantitative data collection and analysis procedures. This chapter discusses these procedures, used to ultimately improve and validate the framework.

Section 6.1 explains the qualitative and quantitative data collection procedures, as well as the results from the data collection. Section 6.2 discusses the qualitative and quantitative data analysis procedures and their results. The results from the qualitative and quantitative analysis procedures are then compared and the results are used to update the framework in Section 6.3 – Synthesis and resynthesis. Section 6.4 then ends of this chapter with a summary of the findings.

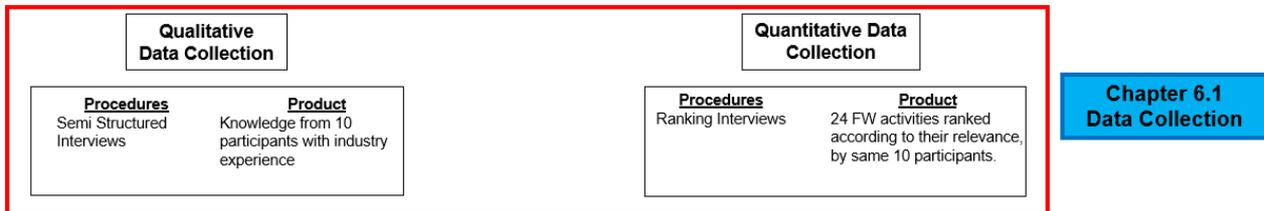


**Figure 6.3: Validation Process and corresponding Sections within the Chapter**

Figure 6.3 depicts the process followed to accomplish the field work and each corresponding section that addresses each stage within the field work.

## 6.1 Data Collection

Figure 6.4 highlights the first step within the field work process, the data collection. As explained in the figure the data collection consists of qualitative and quantitative procedures. This chapter explains the data collection procedures and the products obtained from these procedures.



**Figure 6.4: Data collection within validation process. Adapted from (Stenger et al., 2014)**

The participants who were involved in the data collection process consisted of 10 individuals with South African based industry experience, in the development of ICT4D. Table 6.1 provides an outline of the participants profiles and summarises their experience regarding the development of ICT4D.

**Table 6.1: Participants involved in the validation process**

Participant	Industry and experience	Method of Interview
1	<ul style="list-style-type: none"> <li>Management consultant with the industry experience in ICT4D &amp; rural development</li> <li>PhD and further Research in the field of ICT4D</li> </ul>	Zoom Interview
2	<ul style="list-style-type: none"> <li>PhD in the field of ICT4D</li> <li>Principal Researcher at private institute with employment experience of 12 years in the following fields               <ul style="list-style-type: none"> <li>ICT4D</li> <li>ICT4Education</li> <li>Monitoring and evaluation</li> <li>Foresight</li> <li>Social capital in support of developmental initiatives</li> </ul> </li> </ul>	Zoom Interview
3	<ul style="list-style-type: none"> <li>Industrial Engineer and Product Owner</li> <li>Product manager at a private institute and responsible for management of product development and maintenance, management of product team and interaction with clients</li> <li>Experience with product development in the ICT4D field</li> <li>MEng. Industrial Engineer with field of study in ICT4D</li> </ul>	Zoom Interview
4	<ul style="list-style-type: none"> <li>Executive director at an institution involved in management and consulting and research and knowledge management within the educational sector</li> <li>Institution which the respondent is involved in provides ICTs4D specifically for educational purposes</li> </ul>	Zoom Interview
5	<ul style="list-style-type: none"> <li>Head of Strategy &amp; Innovation at an innovative digital health group that creates partnerships in the healthcare/medical industries</li> <li>Entrepreneur and business improvement specialist with years of management and consulting experience in process simulation and industrial engineering applications in the healthcare, mining, logistics, telecommunications, information technology and finance industries</li> <li>Consulting experience in ICT4D projects</li> </ul>	Zoom interview

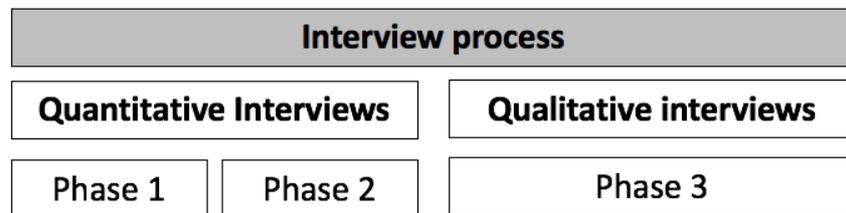
Participant	Industry and experience	Method of Interview
6	<ul style="list-style-type: none"> <li>• Experience in software development industry for almost 13 years</li> <li>• Owner of a business that provides businesses with IT solutions from business analysis and applications conceptualisation to industry-leading software development, testing and support.</li> <li>• Experience in developing IT solutions for social development projects</li> </ul>	Face to face interview
7	<ul style="list-style-type: none"> <li>• A supply chain engineer where some of his responsibilities include identification and implementation of innovative technological solutions</li> <li>• Experience in ICT4D fields through the companies CSI branch.</li> <li>• MSC degree in the field of developing health platforms</li> <li>• Volunteer at learning centres</li> </ul>	Zoom interview
8	<ul style="list-style-type: none"> <li>• CEO of a software developing company</li> <li>• Previous experience includes software developing for non-profit organisation which works with the public and private sector to develop ICTs for educational purposes, economic development and social inclusion</li> </ul>	Zoom interview
9	<ul style="list-style-type: none"> <li>• Qualification in BEng. Mechatronics</li> <li>• Software Developer for a few companies with 10 years' experience</li> <li>• Experience within the field of developing software for non-Profits</li> </ul>	Face to Face Interview
10	<ul style="list-style-type: none"> <li>• Professor at an institution in the field of Computing and Information and Communication for Development (ICT4D, HCI4D, M4D)</li> </ul>	Zoom Interview

The researcher was put into contact with the first participant by the study leader. The rest of the participants were identified, either through identification from searches on the internet or through snowballing, where participants suggested possible candidates for further participation. The researcher made contact with the participants by following ethical procedures as agreed in the REC: Humanities stipulations. Initially the researcher made contact with the institutions in which the participants were involved in and sent a request for an institutional permission form via email. The participants were contacted once institutional permission was given by the institutional representatives. Once the participants were contacted, a consent form for their participation was also emailed to them. Both these consent forms provide background regarding the subject of the thesis and the framework under review. The purpose of the study and the requirements of participation were also stipulated in the forms. The form highlighted the confidentiality and terms of engagement. Confidentiality of participants and institutions was guaranteed by stating that participants would be anonymised throughout the study documentation. The agreement also stated that no personal information of any participant or institution would be disclosed. The request for institutional permission is attached in Appendix C.1.

Once institutional and participant consent was obtained, the researcher sent the participants a document containing the framework and three sections of questions, so that they could familiarise themselves with the framework and questions before the interview commenced. This document can also be viewed in Appendix D. The researcher and participants then agreed on appropriate times and places to conduct the interviews.

## 6.1.1 Interviews

The interviews conducted with the 10 participants include qualitative and quantitative interviews. These interviews were conducted within three phases. These three phases are discussed within the sections to follow. The figure below highlights the 3-phase process followed to conduct the interviews.



**Figure 6.5: 3 Phase Process used to conduct the Interview Process**

### 6.1.1.1 Qualitative Interviews

The design for interview questions mostly differentiates between questions in search of facts, behaviour or beliefs and attitudes (Steyn, 2004). Since the study is based on literature with varying opinions where facts are difficult to prove, the qualitative review sets out to explore the beliefs and attitudes surrounding the use and development of the ICT4D framework.

The questions presented to the participants in the qualitative interviews were presented within two phases. Section 6.1.3.1 describes the first phase of the quantitative, semi-structured interviews and Section 6.1.3.2 discusses Phase 2 of the semi-structured interview process.

#### 6.1.1.1.1 Phase 1 of the Semi-structured Interviews

Phase 1 of the semi-structured interviews set out to discover the beliefs and attitudes towards the ICT4D framework regarding its usefulness and validity in the ICT4D industry. Each of the questions were asked in order to establish certain themes (i.e characteristics pertaining to the improvements and validations of the framework). The open-ended questions posed in this phase also prompted the participants to provide any other useful information. The feedback was then categorised into the different themes that came up during the interviews and was then analysed in the data analysis phase.

The open-ended questions used in phase 1 allowed participants to express their views spontaneously and without influence from the researcher. The first phase of the interview process was conducted with experts in the ICT4D field and were either conducted face to face or over zoom. The interviews were conducted over a time span of one month and individual interviews lasted between 1–2.5 hours.

The information regarding the interview procedures and interview questions were sent to participants and can be seen in Appendix D. This information, as well as the preliminary framework, as it is presented in Section 5.4, was sent to the participants and provides an explanation of the framework

and stipulates what is required of the participants within the interview process. The questions posed to the participants within Phase 1 of the interview process, and the purpose of each question are summarized in Table 6.2 below.

**Table 6.2: Purpose of each questions in Phase 1 of interview process**

#	Question	The purpose of the questions to establish the following themes
1	In your opinion is it necessary for an Analysis and Design Framework for the Development of ICT4D in South Africa	<ul style="list-style-type: none"> <li>• The need for an ICT4D framework</li> <li>• Open the scope of the question to identify additional themes</li> </ul>
2	Have you experienced any difficulty in specifically the design and analysis phases of system development within the field of ICT4D?	<ul style="list-style-type: none"> <li>• The need for an ICT4D framework</li> <li>• Open the scope of the question to identify additional themes</li> </ul>
3	Does the framework address any of these challenges?	<ul style="list-style-type: none"> <li>• The validity of concepts upon which the framework is developed</li> <li>• The usefulness of the framework</li> <li>• Open the scope of the question to identify additional themes</li> </ul>
4	Is this framework appropriate for the Analysis and Design of ICT4D in South Africa?	<ul style="list-style-type: none"> <li>• The validity of the concepts upon which the framework is developed</li> <li>• The usefulness of the framework</li> <li>• Open the scope of the question to identify additional themes</li> </ul>
5	Is the structure logical?	<ul style="list-style-type: none"> <li>• The usefulness of the framework</li> <li>• Open the scope of the question to identify additional themes</li> </ul>
6	Is the structure of the framework appropriate to accomplish the goal of providing a guide for developers to develop ICT4D in South Africa?	<ul style="list-style-type: none"> <li>• The validity of the concepts upon which the framework is developed</li> <li>• The usefulness of the framework</li> <li>• Open the scope of the question to identify additional themes</li> </ul>
7	Do you agree that many ICT4D project failures occur within rural and developing settings within South Africa? (By ICTD failure it is implied that the implemented ICT4D did not achieve the goals and objectives it was developed to achieve) If you do agree what are the reasons for most ICT4D failure?	<ul style="list-style-type: none"> <li>• Open the scope of the question to identify additional themes</li> </ul>
8	Do you make use of any specific guides/tools to design and develop ICTs4D?	<ul style="list-style-type: none"> <li>• The validity of the concepts upon which the framework is developed</li> <li>• The usefulness of the framework</li> <li>• Open the scope of the question to identify additional themes</li> </ul>
9	What changes or improvements would you make to the framework. Please explain.	<ul style="list-style-type: none"> <li>• The validity of the concepts upon which the framework is developed</li> <li>• Open the scope of the question to identify additional themes</li> </ul>
10	Suggestion for any other comments you think could be useful?	<ul style="list-style-type: none"> <li>• Open the scope of the question to identify additional themes</li> </ul>

#### 6.1.1.1.2 Phase 2 of the Semi Structured interviews

Phase two of the interviews involved asking the participants to comment on each activity within the framework and provide additions and modifications.

Table 6.3 shows the table provided to participants in phase 2 of the interview process. The table shows the activities within the framework and provides a column where each participant could provide additions and modifications to each activity.

**Table 6.3: Table presented to participant within Phase 2 of the Interview Process**

Phase	Activities		Additions to activity and its procedures	Modifications to activity and its procedures
Analytical Phase	Community entry phase			
	Analyse socio-economic context			
	Identify authentic local needs			
	Determine conversional factors			
	Determine program theory			
	Determine opportunities and project risks			
	Define context specific user requirements			
	Define context specific system requirements			
	Define resources inputs			
	Define intended and expected outputs			
	Define impact			
	Define goals, objectives and targets			
Design Phase	Design of Appropriate Technology	Design technology for accessibility easiness		
		Design for ability to adapt technology		
		Design technology to allow expressive creativity		
		Design technology for high output		
		Design Technology to be understandable to local people		
		Encourage local ownership of technology		
		Allow relational interactivity within use of technology		
		Design technology for ecological reciprocity		
	Design System	Process design		
Functiona l Phase	Capacity building			
	Emancipation			
	Trust formation			

The following table illustrates the purpose of each question presented to the participants in Phase 2.

**Table 6.4: The purpose of the questions in Phase 2 of the Semi-Structured Interviews**

#	Questions	The purpose of the questions to establish the following themes
1	Addition to activity and its procedures	<ul style="list-style-type: none"> <li>Identifying potential improvements to the framework.</li> <li>Open the scope of the question to identify additional themes</li> </ul>
2	Modification to activity and its procedures	<ul style="list-style-type: none"> <li>Identifying potential improvements to the framework.</li> <li>Open the scope of the question to identify additional themes</li> </ul>

Phase two of the interviews therefore focused specifically on the concepts within the framework. Prompting the participants to comment more specifically on each of the concepts within the framework provided more specific and well-defined improvements and reasons for the validity of the the framework.

#### **6.1.1.2 Quantitative Interviews**

Following the open-ended questions, a set of quantitative questions were asked to each participant. These questions were posed as ranking questions and occurred within Phase 3 of the interview process.

In order to collect appropriate, valuable and useful quantitative data, a measurement instrument had to be developed for the quantitative data collection phase. Thus, the Likert Scale was chosen as it provides the ability to measure specific levels of agreement between individuals and groups (Burns and Burns, 2008), and thus could be used to rate the value and usefulness of each concept within the framework. This was used to establish the validity of the concepts upon which the framework was developed.

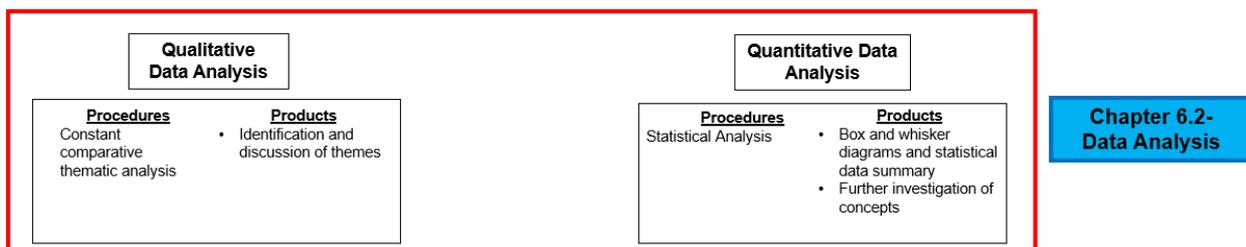
Table 6.5 below depicts the LIKERT Scale used for the ranking interviews. The scale provides a specific set of ranking criteria which is used for validation of each concept within the framework. Participants were asked to indicate the degree of relevance to the success of the design and development of ICT4D, which each concept within the framework posed. Participants were given five mutually exclusive options to select from.

**Table 6.5: Ranking Criteria**

Validation Rating
5. Extremely high relevance for the success of the design and development of ICT4D
4. High relevance for the success of the design and development of ICT4D
3. Moderate relevance for the success of the design and development of ICT4D
2. Minor relevance for the success of the design and development of ICT4D
1. Negligible relevance for the success of the design and development of ICT4D

## 6.2 Data Analysis

Figure 6.6 highlights the second step within the field work, the data analysis. This chapter explains the qualitative and quantitative data analysis procedures and their results.



**Figure 6.6: Data Analysis within the field work process. Adapted from** (Stenger et al., 2014)

The qualitative analysis procedures and products are explained in Section 6.2.1 and quantitative data analysis procedures and products are explained in Section 6.2.2.

### 6.2.1 Qualitative data analysis

As depicted in Figure 6.6, the qualitative data analysis involves a constant comparative thematic analysis. This method provides a way whereby researchers can access and analyse articulated perspectives (Burns and Burns, 2008). The constant comparative thematic analysis procedure is discussed in Section 6.2.1.1 and the themes identified from this analysis is discussed in Section 6.2.1.2- Section 6.2.1.6.

#### 6.2.1.1 Constant Comparative Thematic Analysis

This approach focuses on data which is collected through interviews or questionnaires. The open-ended questions used within the interview process encouraged participants to articulate their

perceptions and experiences spontaneously and without influence from the reviewer. The responses gathered from these participants are in their own words.

Maykut & Morehouse (1994) describes this method of constant comparative thematic analysis as a task which involves finding patterns and themes in words and displaying those patterns for others to inspect. This method also focuses on avoiding deviation from the participants words, and displaying the patterns as close to the participants explanation of the phenomenon, as possible. The constant comparison involved in this method is important in developing a theory grounded in data (Glaser and Strauss, 1967). According to Tesch (1990) comparison is the primary intellectual activity within all analysis in the grounded theory approach, and the method of comparing and contrasting is used for basically all analysing tasks. This comparison within this procedure involves comparison of concepts and themes. A cycle of comparison and reflection can occur between old and new data and can therefore be repeated many times (Boeije, 2002).

According to Boeije (2002) comparative thematic analysis allows researchers to inductively develop a theory through 1) categorizing, 2) coding, 3) delineating categories and 4) connecting categories.

As discussed in the previous section, the qualitative data collection was accomplished through interviews conducted within two phases. The questions posed in these interviews were developed in order to validate the framework and to identify themes which would be used in the data analysis phase.

The 4 themes established by the questions in phase 1 of the interviews are: 1) The need for an ICT4D framework, 2) The validity of the concepts upon which the framework is developed, 3) The usefulness of the framework and 4) Improvements to the Framework. The questions from the interviews and all the responses from the participants are documented in Appendix E. The responses were categorised into themes and Table 6.6 provides a summary of these responses within the identified themes.

**Table 6.6: Themes identified from the questions posed in phase 1 of the interview process**

The need for an ICT4D framework	The validity of the concepts upon which the framework is developed	The usefulness of the framework	Improvements to the Framework
<ul style="list-style-type: none"> <li>• All participants established the need for the framework</li> <li>• Difficulties in analysis and design process are highlighted and aspects of framework which addresses</li> </ul>	<ul style="list-style-type: none"> <li>• Framework addresses appropriate needs through stipulating valid concepts</li> <li>• Validation of agile and adaptable development approach</li> <li>• Difficulties in analysis and design process are highlighted and aspects of framework which addresses these are established</li> </ul>	<ul style="list-style-type: none"> <li>• Difficulties in analysis and design process are highlighted and aspects of framework which addresses these are established</li> <li>• The need of ICT4D intervention in SA and the aspects of the framework</li> </ul>	<ul style="list-style-type: none"> <li>• Modifications               <ul style="list-style-type: none"> <li>○ Highlight the importance of establishing goal clarity</li> <li>○ Use terminology appropriate for development approaches</li> <li>○ Provide more flexibilityModify iteration approach</li> </ul> </li> </ul>

The need for an ICT4D framework	The validity of the concepts upon which the framework is developed	The usefulness of the framework	Improvements to the Framework
<p>these are established</p> <ul style="list-style-type: none"> <li>• The lack in such existing frameworks established</li> <li>• Need for a design plan with clear procedures to be followed is established</li> </ul>	<ul style="list-style-type: none"> <li>• Validation of participatory approach</li> <li>• Validation of the iterative process</li> <li>• Validation of appropriate resource solutions for poor resource environments</li> <li>• Validation-extensive steps</li> <li>• Validation of the following concepts/activities               <ul style="list-style-type: none"> <li>○ Defining goals and objectives</li> <li>○ Capacity building</li> <li>○ Identifying authentic local needs</li> <li>○ Identify a project champion</li> <li>○ Exploration phase</li> <li>○ Explore socio-economic context</li> <li>○ Design phase</li> <li>○ Encourage local ownership</li> <li>○ Design appropriate technology</li> <li>○ Analytical phase</li> <li>○ Functional phase</li> <li>○ Goal clarity amongst stakeholders</li> <li>○ Goal identification which is in line with community needs</li> <li>○ Understanding local context</li> <li>○ Identifying project risks</li> <li>○ Design technology appropriate to local context</li> </ul> </li> </ul>	<p>which addresses these were established by participants</p> <ul style="list-style-type: none"> <li>• The need for a structured process was established and the participant endorsed the framework as an appropriate structured process to follow</li> <li>• Difficulties in analysis and design process are highlighted and aspects of framework which addresses these are established</li> </ul>	<p>with shorter less extensive sprints (flexibility)</p> <ul style="list-style-type: none"> <li>○ Constantly monitor, review and evaluate</li> <li>○ Highlight the importance of establishing goal clarity</li> <li>○ Modify structure so that functional phase runs parallel with other phases</li> </ul> <ul style="list-style-type: none"> <li>• Additions               <ul style="list-style-type: none"> <li>○ Knowledge share</li> <li>○ Change management</li> <li>○ Monitor after implementation</li> <li>○ Sustainable funding</li> <li>○ Need for a package of tools</li> <li>○ Field testing after iterations</li> <li>○ Addition of concrete examples</li> <li>○ Include measuring impact</li> <li>○ Include policy development</li> </ul> </li> </ul>

The second phase of the interview process involved questioning each specific concept within the framework. The conceptual framework was given to each participant so that the participant could comment on each specific concept within the framework. Each person was asked to provide additions and/or modifications for each concept within the framework. The summary from the proposed additions and modifications can be seen in Table 6.7.

**Table 6.7: Feedback received from Phase 2 of the interview process**

<b>Activities</b>	<b>Modifications</b>	<b>Additions</b>
Analytical Phase	<ul style="list-style-type: none"> <li>• Highlight the importance of the iterative phase</li> <li>• Readiness to be addresses within this phase and throughout all the other phases</li> <li>• Move development approach before community entry phase</li> </ul>	<ul style="list-style-type: none"> <li>• Include market research within exploration phase</li> <li>• Include a knowledge-share platform</li> </ul>
Community entry phase	<ul style="list-style-type: none"> <li>• Use appropriate terminology in line with development philosophies</li> <li>• Change terminology from “community entry phase” to “community engagement” phase</li> </ul>	
Analyse socio-economic context	<ul style="list-style-type: none"> <li>• Use appropriate terminology in line with development philosophies</li> <li>• Change terminology from “analyse socio-economic context” to “explore socio-economic context”</li> </ul>	<ul style="list-style-type: none"> <li>• Establish readiness within Analyse socio-economic context</li> </ul>
Identify authentic local needs		<ul style="list-style-type: none"> <li>• Highlight the importance of not over examining when identifying authentic local needs</li> </ul>
Determine conversional factors		<ul style="list-style-type: none"> <li>• Include theory surrounding Amplifiers of ICT4D</li> <li>• Include environmental factors within explanation table</li> <li>• Include choice enablers theory</li> </ul>
Determine program theory	<ul style="list-style-type: none"> <li>• Create more flexibility within framework by improving iteration approach</li> </ul>	
Determine opportunities and project risks		<ul style="list-style-type: none"> <li>• Include development approach before opportunities and risks</li> </ul>
Define context specific user requirements		<ul style="list-style-type: none"> <li>• Include physical capabilities as a consideration within explanation table</li> </ul>
Define context specific system requirements	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Define resources inputs	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Define intended and expected outputs	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Define impact	<ul style="list-style-type: none"> <li>• Design for Impact</li> <li>• Highlight the fact that this must be established through the iterative process</li> <li>• Adapt Defining Impact throughout the process</li> </ul>	

Activities	Modifications	Additions
Define goals, objectives and targets	<ul style="list-style-type: none"> <li>• Modify goals to a shifting goals post</li> </ul>	
Design phase	<ul style="list-style-type: none"> <li>• Use appropriate terminology in line with development philosophies</li> </ul>	<ul style="list-style-type: none"> <li>• Highlight participatory design</li> <li>• Include training package</li> </ul>
Design technology for accessibility easiness	<ul style="list-style-type: none"> <li>• Define accessibility more clearly</li> <li>• Easiness of accessing value of technology</li> </ul>	
Design for ability to adapt technology	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Design technology to allow expressive creativity	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Design technology for high output	<ul style="list-style-type: none"> <li>• Replace with another relevant requirement such as               <ul style="list-style-type: none"> <li>○ Cognisance of resource constraints.)</li> <li>○ Cost effective design</li> </ul> </li> </ul>	
Design technology so that it is understandable to local people	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Encourage local ownership of technology	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Allow relational interactivity within use of technology		<ul style="list-style-type: none"> <li>• Consider privacy requirements</li> </ul>
Design technology for ecological reciprocity	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Process design	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Functional phase	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Capacity building	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Emancipation	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	
Trust formation	<ul style="list-style-type: none"> <li>• No additions or modifications suggested</li> </ul>	

The themes identified within phase 1 and 2 of the interview process are now discussed.

### **6.2.1.2 The need for an ICT4D framework**

All 10 participants agreed that it is necessary for an Analysis and Design framework for the development of ICT4D in South Africa. Participant 2, who is involved in the research field of ICT4D stated that such a framework is needed for the purpose of making sure that the influence of the system has been magnified to the maximum possible extent. In other words, such a framework is needed to ensure maximum return for investment. The participant also stated that such a framework is important to analyse the scope of the system that is being designed to ensure that there is a balanced focus between the technology component of a project and the human development

component of a project. Participant 5 who has experience in the health sector stated that there is very little support and knowledge around the development of ICT4D in South Africa and therefore an Analysis and Design Framework would be immensely supportive to established and growing businesses. The same participant said,

*“There is an immersive lack of healthcare workers in the healthcare industry. The appointment and training of more manpower is mostly not possible due to the lack of resources within our government and thus an alternative must be found to meet this need. It is here where we need to utilize technology to bridge this gap. Frameworks such as these are very important to provide a guide to utilise technology to address these shortfalls. I think your framework is spot on for addressing this gap and is therefore is very needed.”*

### **6.2.1.3 Addressing the lack of a guiding tool within the development of ICT4D**

Only 1 participant made use of a specific guide/tool to design and develop ICTs4D within their institution. The framework the participant used is a framework for professional development and is specifically for the design and implementation of systems for digital learning. There were therefore no generic tools or guides used by the other participants. Participant 1 stated that these types of frameworks are scarce in the ICT4D field and that generic frameworks are specifically scarce. Participant 1 further stated that these types of frameworks are important as there is a generic direction needed. The participant however suggest that the framework must highlight the fact that each concept is a guide and needs to be considered but not necessarily applied. The participant was of the opinion that this option would provide a framework with a definite generic guide.

The other participants either adapted generic system development processes or developed their own in-house process, to follow for the design of ICT4D. Not one of the participants were aware of any specific tool or guide in the analysis and design of ICT4D and everybody believed such a guide would be useful. The participants therefore established the fact that such a framework addresses the lack of a guiding tool within the development of ICT4D.

### **6.2.1.4 The usefulness of the framework**

All participants agreed on the usefulness of the framework. The participants voiced the major difficulties experienced in the analysis and design of ICTs4D and everybody agreed that the framework addresses these difficulties in some way or another. The major difficulties within the analysis and design of ICTs4D, identified by the participants, include: Lack of existing structure within ICT4D development process; Knowledge sharing is limited within ICT4D field; Goal uncertainties amongst stakeholders; Need for Capacity Building; Local needs are difficult to identify.

These difficulties are discussed in Table 6.8, along with the aspects of the framework which address these difficulties.

**Table 6.8: The difficulties within the analysis and design of ICT4D and the aspects of the framework which addresses these**

Difficulties within design and development of ICT4D	Description of difficulties within the analysis and design of ICT4D	Framework response to the difficulty
Lack of existing structure within ICT4D development process	<p>One of the major challenges identified within the analysis and design of ICTs4D, is that there is a lack of a structured process that developers can follow. According to Participant 1, <i>“There are a lot of passionate people who come together to solve problems within the ICT4D field but there is not necessarily a structured process that is being followed”</i>. Participant 1 went further by stating, <i>“In IT development there are clear procedures being followed but in development initiatives it does not seem as if there is much structure to solving the problems”</i>. Another participant states, <i>“In IT development there are clear procedures being followed but in development initiatives it does not seem as if there is much structure to solving the problems.”</i></p>	<p>Participant 3 was of the opinion that the framework provides structure to this process, she states, <i>“I think the steps explained in each phase will add value to the process of developing a system. It encourages developers to discover more than the specs but encourages them to include the community in every step. I think it’s a very extensive list of concepts to include in each phase which will aid developers”</i>. Participant 1 agreed that, <i>fundamentally, the framework addresses the lack of structure within this process. She states that the framework is “very logic and engineering like”</i>. Participant 1 did however believe that within this logical structure, there exists some room for improvement. Her major concern was the use of terminology that seemed to be too systematic and which in her opinion could hinder the adoption of the framework. She suggested that the framework be modified to change the system engineering terms to more user-friendly terminology in line with development philosophies. Her reasoning was that the structure could put off some very philosophical developers. She states that the reason for this is that their beliefs stem from the philosophical debate in which development projects evolve as the community participates and the process cannot truly be defined in the beginning of a project. Therefore, according to this participant</p>

Difficulties within design and development of ICT4D	Description of difficulties within the analysis and design of ICT4D	Framework response to the difficulty
		<p>there does exist a massive lack in structure, but the question is <i>“how to make these processes more relatable and digestible to the group of people in this field who believe strongly in an evolving process?”</i> This suggestion will be discussed further within the theme – Improvements to the framework.</p>
<p>Knowledge sharing is limited within ICT4D field</p>	<p>Another challenge identified by participants is the lack of knowledge sharing within the ICT4D field. Participant 5 stated that the biggest challenge, in his experience, was that there were no examples to follow in the industry and that developers <i>“had to make their own ground, innovate and test things”</i>. Participant 5 stated, <i>“We had to learn as we went along. We had to learn from doing our own research into similar projects and take the best pieces from these projects and consider this in our projects”</i>. Participant 7 stated, <i>“Many companies do not have access to ICT4D frameworks and the companies which do have access to such frameworks are not sharing their experiences. There is therefore a big need for knowledge sharing within this field. If there existed more knowledge sharing and collaboration between companies, the wheel would not have to be re-invented each time and the same mistakes would not continually have to be made.”</i></p>	<p>Participant 5 acknowledged that the framework addressed this challenge by stating that, <i>“If someone had to use this framework the learning curve would be much quicker, and the process would be much more cost effective, especially for new companies. New companies often do not have this type of skill set in house and they must source from outside. But sourcing people who have this knowledge costs money. I think it would make the entire process from ideation to a product or service much more efficient and less costly when using this framework”</i>. Participant 4 added that the framework could be made more practically useful by including examples from real life projects. Participant 7 added that the framework could be given to experts so that they could document the processes they have used, and these can be incorporated into the framework to form part of a knowledge-sharing platform within the framework.</p>

Difficulties within design and development of ICT4D	Description of difficulties within the analysis and design of ICT4D	Framework response to the difficulty
Goal uncertainties amongst stakeholders	<p>Another difficulty experienced within the analysis and design phases is a lack in agreement regarding goals. Participant 1 compared ICT4D projects with commercial ICT development projects. Here the participant stated that greater agreement exists amongst stakeholders regarding goal and success definition within commercial ICT development projects and therefor more success amongst such projects also exists. This participant states, <i>“There is often no clarity regarding the ultimate goals and the definition of the success of the projects shared amongst stakeholders of ICT4D projects”</i>. A general feeling existed amongst participants that there exists a lack in agreement regarding goal clarity and expected impact. One participant goes further and states, <i>“This is due to the nature of the diverse stakeholders who come together in these projects along with the complexity of the communities in which these ICTs are being developed.”</i></p>	<p>Most participants voiced their approval regarding the activity-defining goals and objectives and agreed that it provided a means of establishing goal clarity amongst stake-holders. Many of the participants agreed that this was often overlooked in real life projects. All the participants’ comments, in Phase 2 of the interview process, reflected that the activity-identifying goals and objectives (stipulated within the analysis phase of the framework) was extremely necessary for the success of developing ICTs4D. Four participants did however suggest that the goals and objectives should be redefined after each step within the analysis phase. This suggestion will be discussed in the theme, Improvements to the framework.</p>
Need for Capacity Building	<p>Capacity building was also identified by participants as an aspect which was crucial within these phases but that it is usually over looked or forgotten due to the difficulty of implementing it. Participant 2 stated that the lack of the capacity in the system to continue the follow up training of the teachers highlights this issue. The participant states, <i>“teachers are not trained to teach the next ‘generation’ to use the ICT. There is not enough focus on training and adoption,</i></p>	<p>Participants generally agreed that capacity building within the functional phase, addresses this issue. Participant 2 states, <i>“You implement a type of change management through your enablement phase, where you focus on capacity building before implementation, ensuring the community is equipped and that you form relationships”</i>. The capacity building within the functional phase was therefore endorsed by participants as a</p>

Difficulties within design and development of ICT4D	Description of difficulties within the analysis and design of ICT4D	Framework response to the difficulty
	<p><i>developing the capacity of users and teachers. About 80% must be invested in skills and training (capacity building) and only 20% in the technology itself. At present, in most ICT4D projects, there is 99% investment in the technology and as an afterthought 1% in training. Capacity building needs to be focused on more. Capacity building is essential for sustainability”</i></p>	<p>necessary requirement addressing the need to equip the community.</p>
<p>Local needs are difficult to identify</p>	<p>Identifying local needs were also identified by participants as a challenge within these phases. The participants voiced that incorrectly identifying needs is a major cause for failure in developing appropriate technology. Participant 8 believes developing a solution that is efficient and that meets all the requirements is difficult when developers do not necessarily understand the local context and needs. Participant 8 goes further by stating, <i>“Even for inhouse projects where we have knowledge in the field, it’s difficult to cater for the end user if they are not technically inclined”</i>. Participant 9 agreed by stating <i>“The difficulty is understanding the local needs and designing technology appropriate to the community”</i>.</p>	<p>Participant 3 comments upon the usefulness of the framework and highlights the fact that the framework addresses these difficulties and states, <i>“The framework encourages community participation within the development process and thus inevitably identifying the needs, which the community themselves have highlighted, is central to your framework. This is clearly seen within the concept – identifying authentic local needs and the co-creation phase, which is seldomly used. The co-creation phase shows that the community champions are being utilized so that the appropriate needs are being identified and in return the appropriate system is developed.”</i> Participant 7 states, <i>“In most such projects within SA, local authentic needs are not being identified, the donor is being considered above the community. Your framework addresses these issues and therefore makes an effort towards sustainability”</i>. Participant 9 is of the same</p>

Difficulties within design and development of ICT4D	Description of difficulties within the analysis and design of ICT4D	Framework response to the difficulty
		<p>opinion and states, "<i>The framework considers the needs of the community and focuses on appropriate technology which ensures most of the challenges are addressed</i>".</p> <p>The framework was therefore validated as useful in bridging the gap for mistakes often made in practice within the analysis and design of ICTs4D. A comment made by participant 8 does highlight the importance of the correct adoption of the framework which will inevitably determine its usefulness. He states, "<i>The framework is appropriate and necessary for SA, but it also depends on how it is embraced by the individuals. A framework like this could be a bridge between someone who has domain expertise and someone who has technical expertise or technical development skills. It can therefore allow the one entity to move into the world of the other and vica versa. So, a framework like this, if its appropriately managed and adopted could be a very good framework to bridge this gap. Bridging this gap, I believe holds the potential for more efficient and cost-effective solutions.</i>"</p>

### 6.2.1.5 **The validity of the concepts upon which the framework is developed**

Throughout the conversations with the participants, the necessity of certain concepts within the framework were established and thus the concepts were endorsed. The usefulness and the need for the framework were also discussed by the participants. The summary of the validations will be discussed in Chapter 6.4.1 – Validation Outcomes.

### 6.2.1.6 **Improvements to the framework**

Throughout the interview process, suggestions regarding improvements to the framework, were made by participants. In Phase 1 the participants were asked general questions regarding the framework and they were asked to provide general suggestions regarding the modification of the framework. In Phase 2 the participants were asked to provide modifications and additions to each specific activity within the framework. The responses received from both Phase 1 and 2 are grouped into modifications and additions and are discussed hereafter.

#### **Modifications**

The suggestions regarding modifications to the framework were made by participants and include i) Structural modifications and ii) the use of appropriate terminology for development approaches.

#### **I. Structural Modifications**

Table 6.9 discusses the type of structural modification which the participants proposed for the framework.

**Table 6.9: Structural Modifications proposed by Participants**

Type of modification to the structure	Reasons given by participants
Modify identification of goals to a shifting goal post	Participant 3, 2 and 1 suggested that identifying goals objectives and targets, within the analytical phase should be redefined after each activity within the analytical phase. Participant 1 states, <i>“Make this activity a parallel process with the analysis phase, as it needs to be considered throughout the project. It needs to be identified in the beginning and redefine as you learn in each phase. Therefore, continually update this and form a shifting goals post.”</i> Another participant states, <i>“This is a very important activity as this is where all the problems lie. Prioritize this activity. It needs to be aligned with original intent of project.”</i> Participant 2 agrees with this as he states, <i>“These things will emerge as you go, you can’t truly define it early on, therefore consider it throughout analytical phase”.</i>
Modify iteration approach with shorter sprints to allow for more flexibility	The necessity for such a framework to be flexible was highlighted by the majority of participants (1,2,3,5,6,7,8). A general suggestion was to make the iterative process with shorter sprints in the beginning and then to increase the depth of the procedures as the iterations continue –increase the extensiveness of each activity as the iterations commences. Participant 5 reflects this suggestion in the following statement, <i>“One thing I do see, when it comes to technology, one must think of being agile, flexible, shorter connections of communication and shorter sprints. What I have also seen in these types of projects is that developers basically just design a functionality which they can tick off, so they never really change their root based on new</i>

Type of modification to the structure	Reasons given by participants
	<p><i>information coming into the scope. Even though many people do follow an agile development approach, they stretch one cycle out too long and then they do not really have a service or product that appropriately addresses the needs. They were never truly agile as they were never willing to pivot and make changes to what they were focusing on. Therefore, it is important to constantly monitor, review and evaluate whether change is needed. I would therefore suggest you follow the iterative approach on a smaller scale and continually monitor and evaluate and continually make a merited decision about the step forward. You need to keep on improving."</i></p> <p>Participant 6, 8 and 7 makes similar comments. Participant 6, <i>"The iterative approach is what is essential in our design approaches, and to continually gather more detailed information regarding the project, to go through cycles more than once is very important"</i>. Participant 8, <i>"The framework is very extensive, I don't feel it really needs much. The only thing I would change is I would break it up into more steps. Often it is not possible to thoroughly assess the environment in the first sprint and you will only be able to assess a large part with field testing. In such a case it would be beneficial to go back to the exploration phase and just correct the path you are taking for the co-creation phase."</i> Participant 7, <i>"The key is to follow those iterative design steps, to design and redesign and then to continually present the design to the community. The more cycles are followed within this iterative design approach, the greater becomes the probability of success."</i></p> <p>Further suggestions regarding the iterative process included a suggestion by participant 2 to illustrate the iterative process of the framework by depicting it on a graph. Participant 2 stated, <i>"Depict on the one axis, the number of iterations over time and on the other axis, depict the level of mutual understanding. On another diagram you can have the iteration number on one axis and risk of failure decreasing as the number of iterations increases. This will show how your level of understanding increases with each iterative process and highlight the importance of the iterative process. The iterative process is important for developing a high level of mutual understanding sustainable plan and in return you are reducing risk and improving the quality of the plan."</i></p>
Modify functional phase to run parallel to all other phases	<p>Participant 1, 2 and 5 suggested that the functional phase run parallel to all the other phases. Participant 1 makes this clear and states, <i>"Readiness needs to be addressed within the beginning phases and not later in the functional phase only, I suggest making the functional phase run parallel with all the other phases, as ensuring readiness is a process that occurs throughout the development process. Therefore, change the structure so that enablement phase runs parallel to whole process."</i> The participants agreed that the activities within the functional phase, capacity building, emancipation and trust formation is a continual process through the analysis and design process and thus suggested the functional phase run parallels to the other 2 phases.</p>

## II. Use appropriate terminology for development approaches

The second modification proposed by the participants is to use appropriate terminology for development approaches.

Participant 1 states, *"Look at the frameworks terminology. Change words such as analyse to explore and consider changing the functional phase to enablement phase. These words are less scientific and explains exactly what is happening in the phase. Design phase does not suggest participation*

*but rather suggests the developers are removed from the community, therefore, to highlight development approaches by using co-creation instead of design.”* Two of the participants suggested this type of terminology is more user-friendly and encourages that all stakeholders stay on board with the project as it accommodates development philosophies with a strong collaborative, and participatory approach.

## **Additions**

Suggestions regarding additions to the framework are now discussed and include the following: i) Knowledge Sharing, ii) Market research, iii) Identify Development Approach and iv) Themes beyond the scope of this project

### **I. Incorporate Knowledge sharing**

The concept of knowledge sharing, and the need therefor, is discussed in Section 6.2.1.4- The usefulness of the framework. Even though participants agreed that this topic is addressed within the framework, there were further suggestions to increase the scope of a knowledge-sharing platform within the framework. Participant 7 states, *“The projects I have been involved in, which have been successful have tapped into this concept of knowledge sharing, even before the exploration phase started. To find out what has been done, what works and what does not work...”*. There is therefore a big need for knowledge sharing within this sector. If there was more knowledge-sharing and collaboration between companies, the wheel would not have to be re-invented each time and the same mistakes would not be made continually. Participant 4 suggests further addressing this issue by including concrete examples of each of the activities and procedures. Participant 7 adds onto this suggestion and states, *“The guiding questions within your framework make it possible for companies to document what works and what does not within the framework. The framework can then be passed on to the next company and through this type of knowledge-sharing you can create an environment with knowledge- sharing within ICT4D”*.

### **II. Include market research before analysis phase**

A few participants suggested that an activity such as market research be included before the analysis phase. Participant 5 states, *“Something I have not seen in your framework is something similar to market research. You must do research on your approach. You cannot do anything in the exploration phase if there are barriers which you do not know of. For example, the culture you are engaging with of the community is important to understand before you engage with that community. You need to be prepared for your exploration phase and you need to identify your approach beforehand”*. Participant 5 suggests that knowledge sharing could be incorporated into a market research as it forms part of trying to understand what makes these projects work and thus inevitably will influence your community entry phase.

The researcher therefore explored the literature in order to define market research and knowledge sharing within the ICT4D field. The findings are summarised as follows;

According to Kleine & Unwin (2009) there has been little attention to the lessons that can be learnt from previous information and communication initiatives. Developers therefore need to access knowledge relating to previous experiences in the field. Developers also need to determine the way in which they will identify, gather, organize, share and interpret information to acquire this knowledge in the field of ICTs4D, and this is known as knowledge management. An important aspect of knowledge management is prioritizing information sharing in order to promote learning and the development of ideas. Knowledge management is embedded within market research as managing knowledge allows knowledge to be gathered about systems and technologies, as well as people and organizations who have been involved in ICT4D projects. (MarketResearch.com, 2018).

### III. **Identify Development Approach**

It was proposed by 3 participants that the activity – determine development philosophy – be included within the analysis process. Determining the development philosophy according to Participant 1 and 2, is crucial to the success of ICT4D projects. Participant 3 stated that this activity informed the rest of the design and Participant 1 stated that it had to be determined as soon as possible within the Analysis Process. The researcher therefore conducted additional research relating to Development Approaches within ICT4D. The following information explains the purpose and procedures relating to development approaches.

According to Ashraf et al. (2017) there exist various ICT4D approaches with different views regarding development. The appropriate approach to follow for ICT-led socio-economic development needs to be identified. This can be achieved by exploring various notions of development, for example, Sens notion of development as freedom (Ashraf et al. 2017). Within these various approaches there exist different design methods and thus the most appropriate design method needs to be determined. The end result of the design can either be in a form of a product or service (Pandey & Gupta 2017). The approaches will all either fall under Economic Intervention, Social Intervention or Socio-Economic Intervention (Pandey & Gupta 2017). The 3 agencies according to Pandey & Gupta (2017) that can be used for the intervention, includes 1) State, 2) People, and 3) Market.

It is also important for developers to identify the Programme Theory in this stage (Pade-khene & Sewry 2009, Osah et al. 2014, Pandey & Gupta 2017). This according to Osah et al. (2014) is done through defining the Process theory and defining the Impact theory.

### IV. **Themes beyond the scope of the project**

There were various other suggestions made by participants regarding additions to the framework, but these were beyond the scope of the framework and include, measuring impact, policy development and monitoring after implementation.

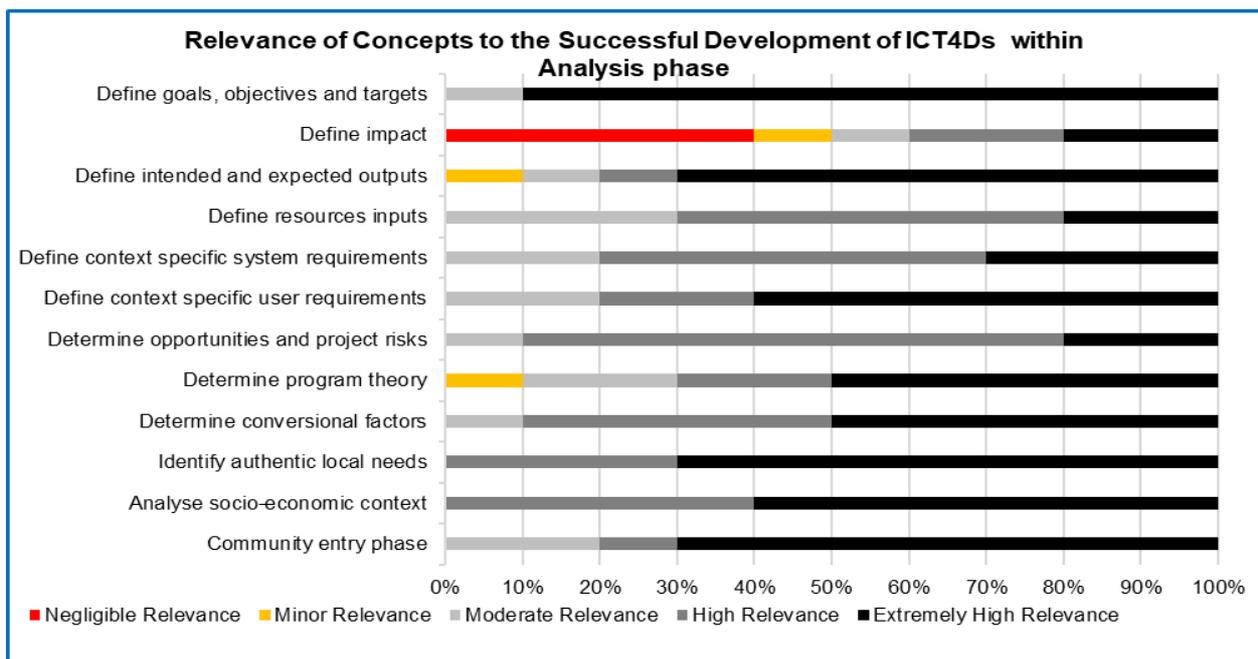
## 6.2.2 Quantitative data analysis

The qualitative research approaches provided good insight into the field of ICTs4D. The framework-ranking interviews provide a quantitative basis to support the qualitative findings. The results obtained from the ranking interviews are discussed in the following section.

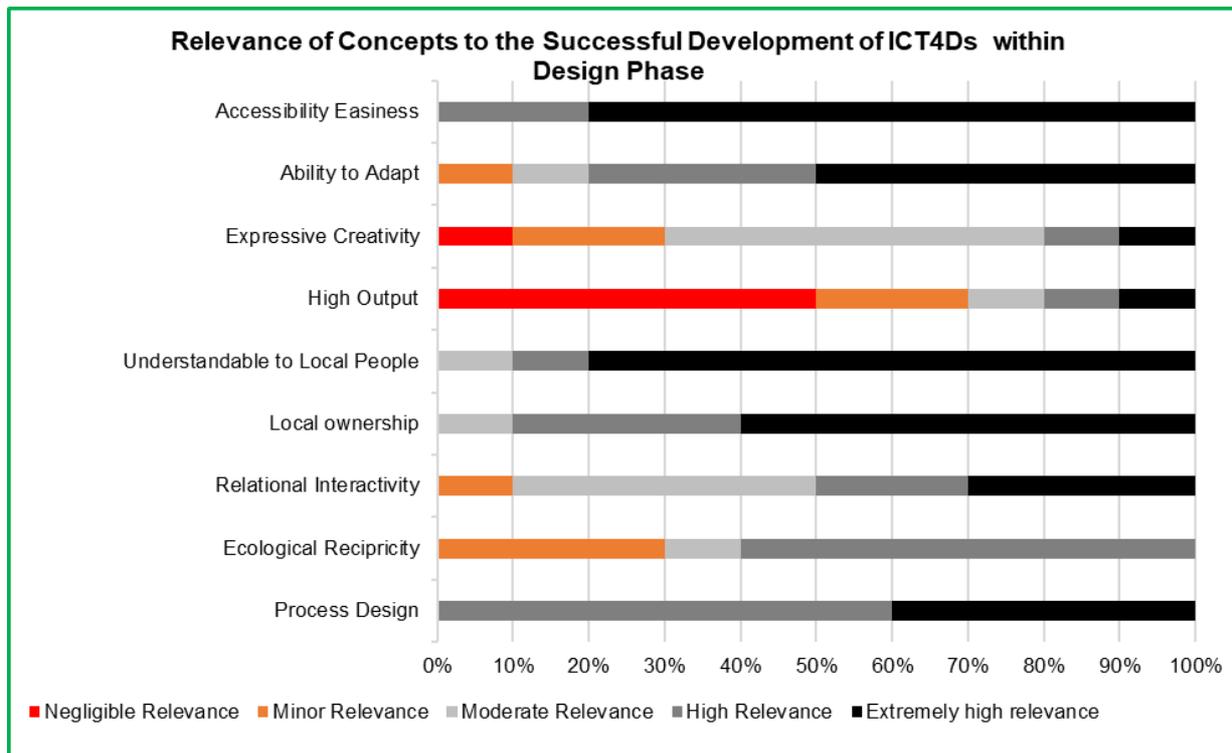
Section 6.2.2.1 discusses the statistical data resulting from the feedback from the ranking interviews in phase 3 of the interview process. The results from this section guided the reviewer to identify concepts for further investigation, Section 6.2.2.2 explains the concepts that were identified for further investigation

### 6.2.2.1 Statistical Analysis from Ranking Interviews within Phase 3

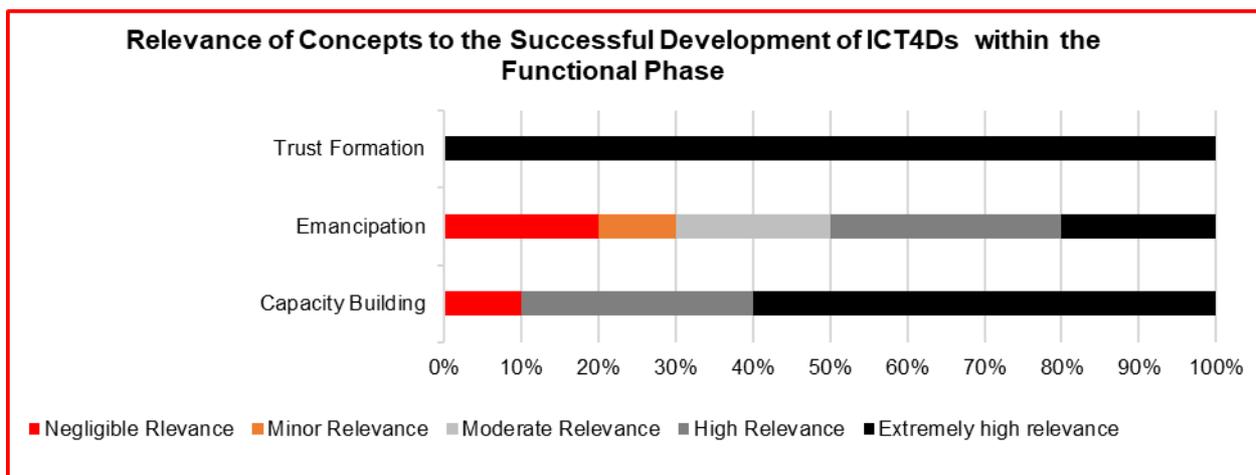
Ranking interviews were conducted with the same individuals interviewed in Phase 1 and 2. The individuals were asked to express their opinion, regarding the concepts within the frameworks, relevance to the successful design and development of ICT4D. The figures to follow provide charts depicting the ratings given to each concept by the participants. Figure 6.7 depicts the scores for the analytical phase, Figure 6.8 for the design phase and Figure 6.9 for the functional phase. A number of 10 responses were received for the rating of every concept, therefore n=10.



**Figure 6.7: Rating given to each concept within the Analytical Phase, n=10**



**Figure 6.8: Ratings given to each concept within the Design Phase, n=10**



**Figure 6.9: Ratings given to each concept within the Functional Phase of the framework in the ranking, n=10**

A statistical analysis was done on all the received feedback from the ranking questions. The analysis is used to select specific concepts with a rating that indicated a significantly low relevance to the success of the development of ICT4D. The concepts identified with a significantly low relevance to the successful development of ICTs4D are further investigated. The statistical analysis of each phase is now discussed.

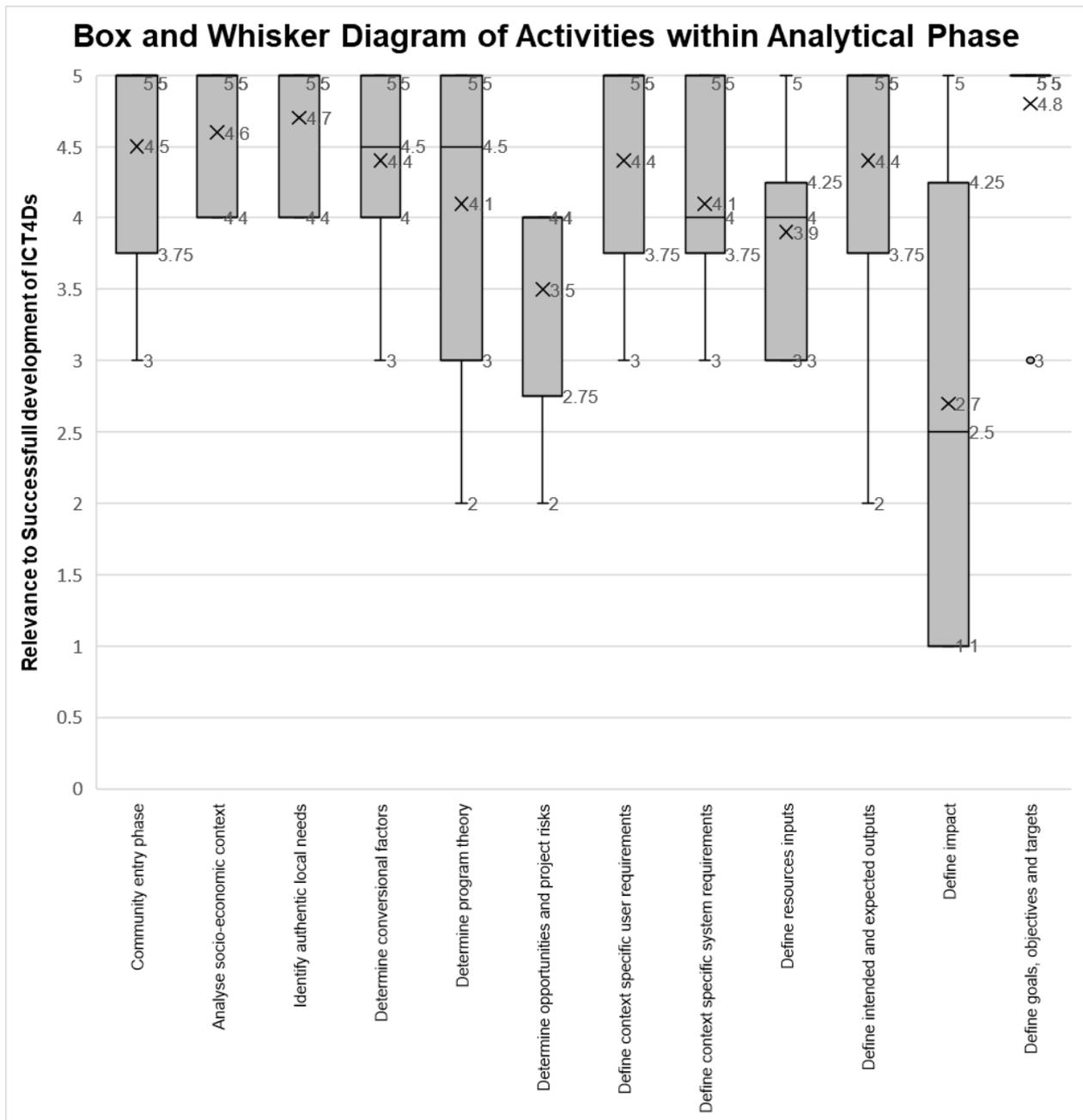
**Analytical Phase Statistics**

As seen in Figure 6.10, the box and whisker diagram, as well as the summary of stats in Table 6.10 below, a high average mean exists for all concepts except for *defining impact*; which has a ranking

with average mean of 2.7. Table 6.10 depicts the frequency of the mode for *defining impact* as 4, where the mode is 1. This indicates that a large percentage of participants (40%) scored this activity as having a negligible relevance to the success of the project. *Defining impact* was therefore selected as a concept for further investigation. The next lowest average mean is 3.5 and refers to, *defining projects risks and opportunities*. Table 6.10 reveals that defining project risks and opportunities does however have a frequency mode of 7, where the mode is 4. Thus, most participants scored this activity as having a high relevance to the success of the project. The outlier within these rankings (for *defining risks and opportunities*) is 2 and is the reason for the low average mean. Defining opportunities and project risks was therefore not selected for further investigation.

Subsequently all the concepts, except for the two mentioned above have a high average mean and only *defining impact* was selected for further investigation; in fact, the scores indicate the validity of all the concepts within the analytical phase.

Figure 6.10, The Box and Whisker Diagrams for Activities within the Analytical Phase is displayed below.



**Figure 6.10: Box and Whisker Diagram for Analytical Rankings**

A summary of the statistics for the analytical phase is depicted in Table 6.10 below

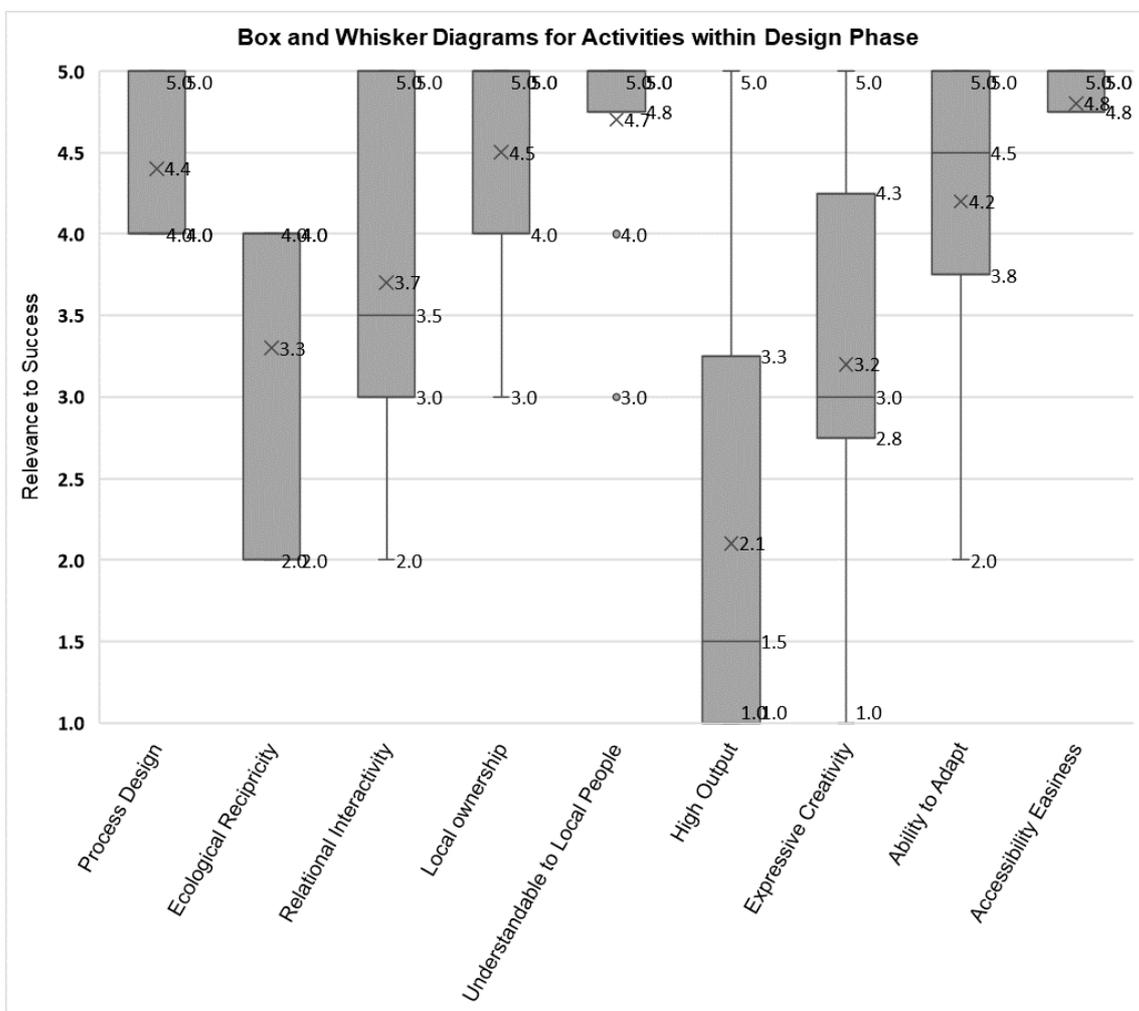
**Table 6.10: Statistical data summary of Analytical Phase Rankings**

	Mean	Median	Mode	Frequency of Mode	Outliers	Min	Max	Lower Quartile	Upper Quartile	Std.dev
Community entry phase	4.5	5	5	7	3	3	5	4.3	5.0	0.8
Analyse socio-economic context	4.6	5	5	6	none	4	5	4.0	5.0	0.5
Identify authentic local needs	4.7	5	5	7	none	4	5	4.3	5.0	0.5
Determine conversational factors	4.4	4.5	5	5	none	3	5	4.0	5.0	0.7
Determine program theory	4.1	4.5	5	5	none	2	5	3.3	5.0	1.1
Determine opportunities and project risks	3.5	4	4	7	2	2	4	3.3	4.0	0.8
Define context specific user requirements	4.4	5	5	6	none	3	5	4.0	5.0	0.8
Define context specific system requirements	4.1	4	4	5	none	3	5	4.0	4.8	0.7
Define resources inputs	3.9	4	4	5	none	3	5	3.3	4.0	0.7
Define intended and expected outputs	4.3	5	5	7	3	2	5	4.3	5.0	1.1
Define impact	2.7	2.5	1	4	none	1	5	1.0	4.0	1.7
Define goals, objectives and targets	4.8	5	5	9	none	3	5	5.0	5.0	0.6

## Design Phase Statistics

As seen from the box and whisker diagram, Figure 6.11, as well as the summary of stats Table 6.11, a high average mean for concepts, *Process Design*, *Ecological Reciprocity*, *Relational Interactivity*, *Local ownership*, *Understandable to Local People*, *Expressive Creativity*, *Ability to Adapt* and *Accessibility Easiness*, exist. These activities have an average mean above 3. Therefore, the participants deemed these activities as having a significant impact on the successful design of ICT4D. Concepts with an average mean above 3 were therefore not considered for further investigation.

The only activities with a low average mean include, *Designing Technology for High Output*. The activity, *High Output*, was ranked very low by most participants. 60% of the participants ranked the activity as having negligible relevance to the successful development of ICTs4D. This concept was therefore selected for further investigation.



**Figure 6.11: Box and Whisker Diagram for Design Rankings**

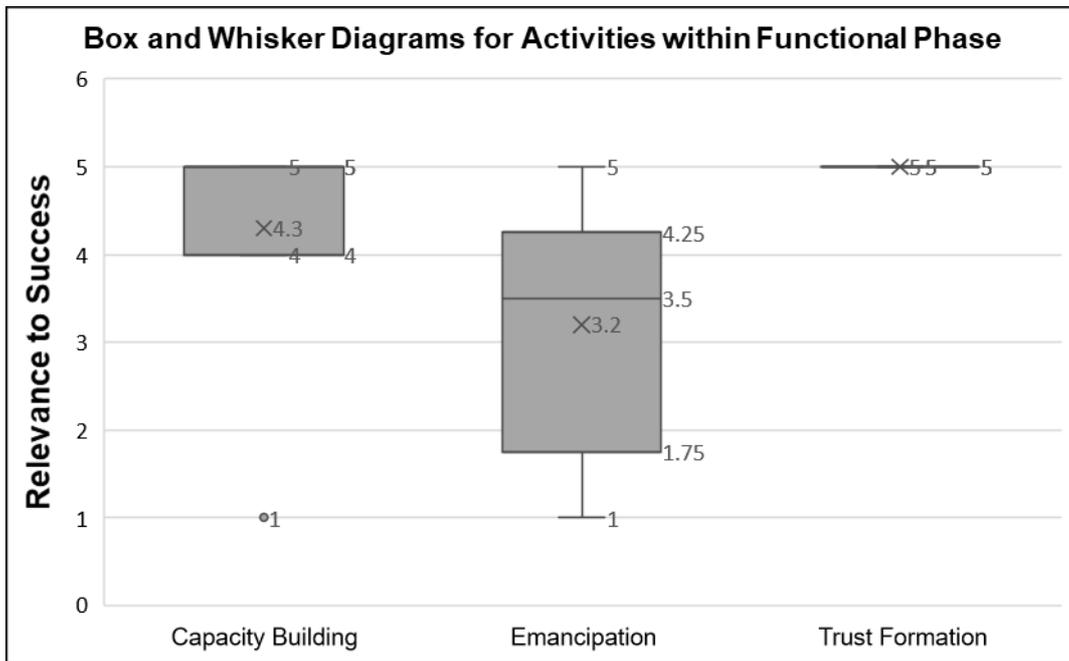
Table 6.11 is a summary of the information in Figure 6.11

**Table 6.11: Statistical data summary of Design Phase Rankings**

	Mean	Median	Mode	Frequency of Mode	Outliers	Min	Max	Lower Quartile	Upper Quartile	Std.dev
Process Design	4.4	4.0	4.0	6.0	None	4.0	5.0	4.0	5.0	0.5
Ecological Reciprocity	3.3	4.0	4.0	6.0	None	2.0	4.0	2.0	4.0	0.9
Relational Interactivity	3.7	3.5	3.0	4.0	None	2.0	5.0	3.0	5.0	1.1
Local ownership	4.5	5.0	5.0	6.0	None	3.0	5.0	4.0	5.0	0.7
Understandable to Local People	4.7	5.0	5.0	8.0	3 and 4	3.0	5.0	4.8	5.0	0.7
High Output	2.1	1.5	1.0	5.0	None	1.0	5.0	1.0	3.3	1.4
Expressive Creativity	3.2	3.0	3.0	5.0	None	1.0	5.0	3.0	4.3	1.2
Ability to Adapt	4.2	4.5	5.0	5.0	None	2.0	5.0	3.8	5.0	1.0
Accessibility Easiness	4.8	5.0	5.0	8.0	None	4.0	5.0	4.8	5.0	0.4

**Functional Phase Statistics**

Figure 6.12 and Table 6.12 depict the statistical analysis results from the Functional Phase Rankings



**Figure 6.12: Box and Whisker Diagram for Functional Rankings**

Table 6.12 summarises the information depicted in Figure 6.11 above.

**Table 6.12: Statistical data summary of Functional Phase Rankings**

	Mean	Median	Mode	Frequency of Mode	Outliers	Min	Max	Lower Quartile	Upper Quartile	Std.dev
Capacity Building	4.0	5.0	5.0	6.0	1	1.0	-5.0	4.0	5.0	1.3
Emancipation	2.8	3.5	4.0	3.0	None	1.0	-5.0	1.8	4.3	1.5
Trust Formation	5.0	5.0	5.0	10.0	None	5.0	-5.0	5.0	5.0	0.0

As seen in Figure 6.12 and Table 6.12, a high average mean for all functional activities exists. These concepts were ranked as significantly relevant to the successful development of ICT4D by the vast majority of the participants and therefore these concepts are not selected for further investigation. The stats therefore show proof of the validity of all three concepts.

**6.2.2.2 Concepts identified for further investigation**

The ranking interviews guided the researcher to investigate activities within the framework with an average low rating. These activities had to be either modified or completely removed from the framework depending on the findings from further investigation. The qualitative results as well as referral to literature provided additional insight into these concepts. Table 6.13 summarises the

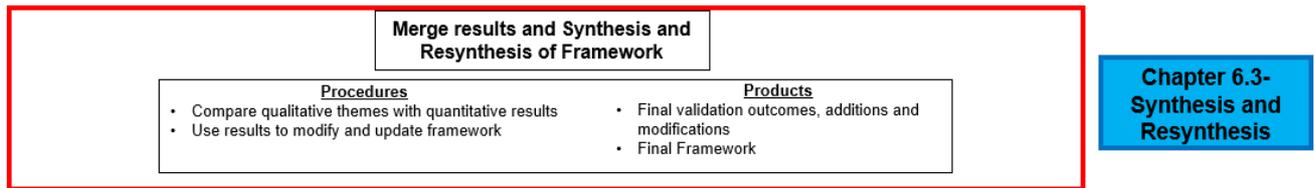
concepts to be addressed, the findings from the investigation and the modifications required for these activities.

**Table 6.13: Concepts Identified for Further Investigation**

Concepts to address	Findings from Qualitative Results and the Literature	Modification required
Define Impact	The qualitative results showed that the reasons low rankings were given to this concept, by the majority of participants, were due to the fact that they believed defining impact in the beginning of the project was not truly possible. One participant stated that the impact of the project only becomes clear later on and therefore it should be redefining as much as possible throughout the iterative process. Participant 5 states, "Defining impact is important in order to establish a clear vision, but this is too early in the development phase to determine. This develops as you go. You need to define it, but you need to adapt it as you go." 4 of the 5 participants who rated this activity as negligible to the success of developing ICT4D, ranked it low because they believed it could not be established in the first iteration of the analysis phase. They all agreed it needed to be updated.	Upon the findings from the qualitative results, the researcher chose to keep the concept in the framework. The majority of participants agreed it is an important activity but that it was not useful if defined too early. Defining impact thus is important only if the agile approach is followed (running through the framework in iterations). It was therefore decided to highlight the importance of following an iteration approach and redefining impact, as well as all the other activities, within each iteration, in order to ensure the usefulness of this activity
High Output	The majority of the participants agreed that designing technology for high output was not applicable to most ICT4D cases. The qualitative results indicated the low relevance of this concept. Three participants suggested to change this concept to e.g., design with Cognizance of Resource Constraints. The literature revealed that this involves designing technology which is cost-effective making use of available resources and emphasizing the use of renewable energy such as sun, hydro and wind power (Sonar, 2017).	Upon the findings from the qualitative results, the researcher decided to remove the activity- High Output, from the framework. The findings also lead the researcher to replace the concept with designing technology with Cognizance of Resource Constraints.

### 6.3 Merging results – Synthesis and resynthesis

Figure 6.13 highlights the last step of the field work process, Merging the Results and Synthesis and Resynthesis of the Framework. As explained this step involves comparing the qualitative and quantitative results in order to update the framework and provide final validation, additions and modifications.



**Figure 6.13: Merging Results- Synthesis and Resynthesis within validation process. Adapted from (Stenger et al., 2014)**

Section 6.3.1 discusses the final validation outcomes drawn from the results from the qualitative and quantitative studies. Section 6.3.2 discusses the final additions and modifications also derived from the qualitative and quantitative studies. The final modifications and additions are then applied to the framework and the updated Framework is presented in Section 6.3.3.

### 6.3.1 Validation Outcomes

The Qualitative and Quantitative Studies established the themes, The Need for an ICT4D Framework, Addressing the lack of a guiding tool within the development of ICT4D, The Usefulness of the Framework and The Validity of the Concepts upon which the Framework is Developed. These themes were established by the responses which the participants provided for the questions asked in the interviews. These responses provided validity upon the reliability, usefulness, need and relevance of the framework. Each of these aspects are validation outcomes and are discussed in Table 6.14.

**Table 6.14: Validation Outcomes**

Outcome	Explanation	Application within validation process
Reliable	Reliability is the degree to which an assessment tool produces stable and consistent results (Phelan and Wren, 2005).	The ranking exercise was used to determine the reliability of the framework. Section 6.2.2 discusses the statistical results obtained from the ranking exercises and thus gives insights into Inter-rater reliability, which, according to Phelan & Wren (2005) "is a measure of reliability used to assess the degree to which different raters agree in their assessment decisions". All concepts were validated by the participants within this exercise and thus proving the reliability of the framework as a whole. The two concepts which scored low ratings will be discussed in the Modification section.
Usefulness	The usefulness of the framework is based on the appropriate relationships between the concepts which ensures the framework is useful in guiding the development of ICTs4D.	The usefulness of the framework is validated through the feedback in Phase 1 and 2 of the Interview process. The summary of the theme, The usefulness of the framework, is discussed in Section 6.2.1.4. In Section 6.2.1.4, the participants gave feedback regarding the difficulties faced in developing ICD4Ds. The participants highlight how the framework is useful in addressing these design challenges.
Need	The need for the framework is indicated by the absence of existing frameworks/tools to guide developers in the analysis and	The need for the framework is established through the feedback from Phase 1 of the Interview process. The theme, the need for the

Outcome	Explanation	Application within validation process
	design of ICT4D, as well as the recognition of participants that such a framework can be used as such a guide.	framework, is identified within the responses received by participants in Phase 1 of the interview process. Section 6.2.1.2 discusses the feedback and summary of this theme and establishes the need for the framework.
Relevance	The relevance of the framework is established through a correlation between the concepts within the framework to contribute to the successful development of ICT4D.	Phase 2 of the interview process involved participants ranking each concept within the framework. The ranking results and the statistical analysis can be seen in Section 6.2.2. Within this section the relevance of the concepts are established and thus the relevance of the framework as a whole. The 2 concepts which proved to have insignificant relevance to the successful development of ICT4D will be discussed in the modification section of this Chapter.

### 6.3.2 Additions and Modifications to the Framework

The results from the qualitative and quantitative data analysis are finally compared. Table 6.15 provides a summary of the final modifications and additions that are applied to the framework.

**Table 6.15: Final Modifications and Additions to Framework**

Improvements made to the framework	Description of improvements		Where it is addressed within this Chapter
Modifications	Modify Structure of framework <ul style="list-style-type: none"> <li>• Modify identification of goals to a shifting goal post</li> <li>• Indicate that the iteration approach will start with shorter sprints to allow for more flexibility</li> <li>• Modify functional phase to run parallel to all other phases</li> </ul>	Use appropriate terminology for development approaches <ul style="list-style-type: none"> <li>• Change Phase names to Exploration, Co-Creation and Enablement Phase</li> <li>• Change word such as Analyse to explore</li> <li>• Change community entry to community engagement</li> </ul>	Section 6.2.1.6 discusses the suggestions the participants provided regarding the improvements to the framework. These suggestions can be seen in Table 6.9.
Additions	Additions to Analytical Phase	<ul style="list-style-type: none"> <li>• Include Field Research and Knowledge Management at the beginning of the analysis phase</li> </ul>	Including Field Research and Knowledge Management as an activity within the framework was derived from the suggestions to include market research and incorporate a knowledge sharing platform. These suggestions are discussed in Section 6.2.1.6. The researcher investigated these concepts further to include it in the framework. The findings from this investigation are also discussed in Section 6.2.1.6.

Improvements made to the framework	Description of improvements		Where it is addressed within this Chapter
		<ul style="list-style-type: none"> <li>• Include Defining Development Approach after Community Engagement Phase</li> </ul>	<p>Participants voiced the necessity of defining a development approach within the analysis phase. The feedback from the participants are discussed in Section 6.2.1.6. The researcher researched this concept further to include it in the framework. These further findings are also discussed in Section 6.2.1.6.</p>
		<ul style="list-style-type: none"> <li>• Include environmental factors within explanation table within conversional factors</li> <li>• Include choice enablers theory within Conversional Factors</li> <li>• Include development approach before opportunities and risks</li> <li>• Include physical capabilities as a consideration within explanation table in Define context specific user requirements</li> </ul>	<p>Section 6.2.1.6 provides suggestions for additions to the framework received from the feedback in the interview process and this information is used to include additional information within the framework.</p>
	Additions to Design Phase	<ul style="list-style-type: none"> <li>• Replace High Output requirement with Design Technology with Cognisance of Resource Constraints</li> </ul>	<p>Due to the quantitative data indicating an insignificant relevance regarding, designing high output technology to the successful development of ICTs4D, it was replaced by Designing Technology with Cognisance of Resource Constraints. The decision to replace high output is discussed within Table 6.13 in Section 6.2.2.2</p>
		<ul style="list-style-type: none"> <li>• Highlight participatory design within this phase</li> <li>• Include training package design within design phase</li> <li>• Regarding, Allowing Relational Interactivity in explanation table, include the importance of Considering privacy</li> <li>• Regarding, Design Technology for Accessibility easiness; Define accessibility more clearly</li> </ul>	<p>Table 6.7 provides suggestions for additions to the framework received from the feedback in Phase 2 of the interview process and this information is used to include additional information within the framework.</p>
	Additions to Functional Phase	No Additions	

These modifications and additions were applied to the framework to develop the final framework as depicted in section 6.3.3

### 6.3.3 Final Framework

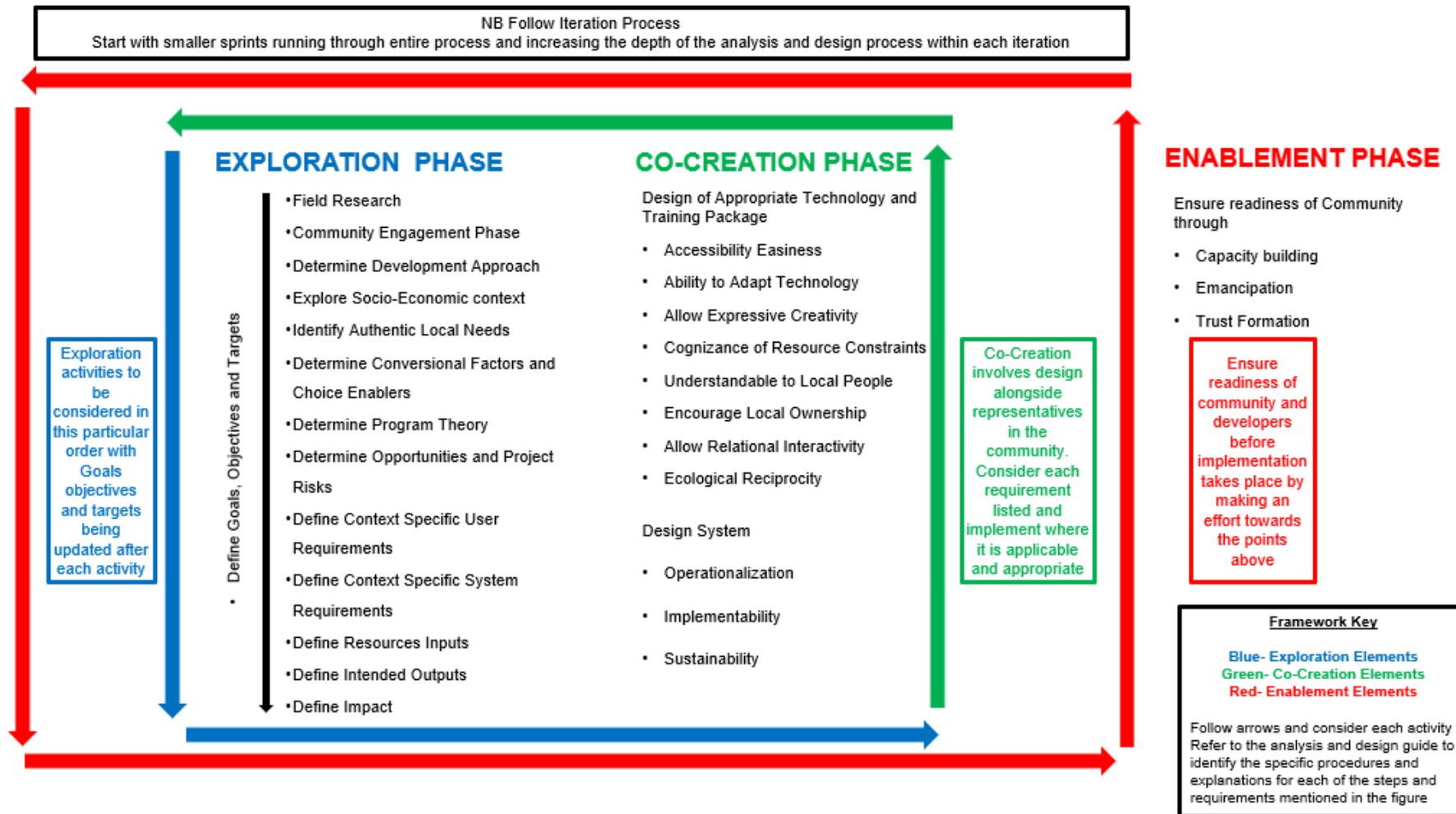


Figure 6.14: Updated Framework

**Table 6.16: Systematic guide for the Analysis and Design of ICT4D in developing country settings**

Phase		Activities within each phase	Description	Procedures followed to carry out activities
<b>Enablement Phase</b>	<b>Exploration Phase</b>	Define goals objectives and targets	Field Research and Knowledge Management	<p>A sort of market research needs to be conducted. Developers need to determine the way in which they will identify, gather, organize, share and interpret information to acquire knowledge in the field of ICTs4D</p> <ul style="list-style-type: none"> <li>• Gather knowledge about systems and technologies as well as people and organizations who have been involved in ICT4D projects.</li> <li>• Access Knowledge Sharing Platforms relating to ICT4D</li> <li>• Create a knowledge sharing platform for all involved in the development of the ICT4D as well as for those that will be involved in the development of ICTs4D in the future.</li> <li>• Prioritize information sharing in order to promote learning and the development of ideas.</li> </ul>
			Community Engagement Phase	<p>Consult with the local community and ensure a participatory design process is followed, including all stakeholders and members of the local community</p> <ul style="list-style-type: none"> <li>• Consult with the local community.</li> <li>• Generate ideas with end users.</li> <li>• Engage stakeholders in the beginning of the project and an effort should be made towards building relationships between the various stakeholders.</li> <li>• Encourage partnerships as well as an open and competitive environment together with the participation of local users.</li> <li>• Create awareness amongst the community members, informing them of the benefits of using ICTs.</li> </ul>
			Determine Development Approach	<p>Determine the appropriate approach to follow for ICT-led socio-economic development.</p> <ul style="list-style-type: none"> <li>• Immerse in the community to explore how ICTs influence the community in a broader context.</li> <li>• Understand how ICTs can contribute to development from the users' perspectives.</li> <li>• Determine appropriate approach for understanding human behaviour within the surrounding context.</li> <li>• Explore different development notions such as</li> </ul>

Phase		Activities within each phase	Description	Procedures followed to carry out activities
<b>Enablement Phase</b>	<b>Exploration Phase</b>	Define goals objectives and targets		<ul style="list-style-type: none"> <li>○ Sen's (1999) "development as freedom"</li> <li>○ Information chain model</li> <li>• Consider the Information chain model to determine how humans can be assisted to transform data to information. Therefore, consider people's capabilities to                             <ul style="list-style-type: none"> <li>○ Access</li> <li>○ assess data</li> <li>○ acquire and</li> <li>○ share knowledge</li> </ul> </li> </ul>
		Explore Socio-Economic Context	Explore Socio-Economic context by defining the context of the environment in which the ICT4D will be employed.	<p>Conduct the following studies</p> <ul style="list-style-type: none"> <li>• Financial</li> <li>• Environmental and</li> <li>• Cultural impact studies</li> <li>• Capability assessments</li> <li>• Assess Livelihoods profiles</li> </ul> <p>Explore following factors</p> <ul style="list-style-type: none"> <li>• Information availability</li> <li>• Legal context</li> <li>• Institutions active in the community and their role</li> <li>• Human factors</li> <li>• Technological progress and availability</li> <li>• Leadership</li> <li>• Drivers</li> <li>• Demand</li> </ul>
		Identify Authentic Local Needs	Identify the authentic local needs and make sure the developers understand the community needs as these local needs may be different to the needs the developers could identify, due to the different values and views of the developers and community members.	<ul style="list-style-type: none"> <li>• Conduct observations relating to vulnerability.</li> <li>• Define stakeholder Interest.</li> <li>• Keep focus on primarily meeting the needs and desires of the rural community.</li> <li>• Make sure the project investors/owners are open about their intentions and work so that a conflict of interest between the owners/investors and the larger community align.</li> </ul>

Phase	Activities within each phase	Description	Procedures followed to carry out activities	
Enablement Phase	Exploration Phase	<p>Determine Conversional Factors and Choice Enablers</p>	<p>Conversional factors are factors which influence choice of users, which either encourage or constrain the use of ICTs4D.</p> <p>Choice enablers are factors which increase the ability/opportunity of users to make choices.</p>	<p>These conversional factors and choice enablers can be</p> <p>Political factors such as</p> <ul style="list-style-type: none"> <li>o Governmental/municipal support for ICT development</li> <li>o Efficiency and Transparency of national/local governance</li> <li>o ICT legislation maturity</li> </ul> <p>Socio-cultural factors include</p> <ul style="list-style-type: none"> <li>o IT literacy of recipients</li> <li>o Personal motivation of recipients</li> <li>o Recipients cultural and ethical support</li> <li>o Health Safety</li> </ul> <p>Technical factors are related to</p> <ul style="list-style-type: none"> <li>o Accessibility of ICT infrastructure</li> <li>o Accessibility of public infrastructure (e.g., electricity)</li> <li>o Availability of skilled technical support</li> </ul> <p>Environmental Factors include</p> <ul style="list-style-type: none"> <li>o Location</li> <li>o Climate</li> <li>o Exposure</li> </ul>
		<p>Define goals objectives and targets</p> <p>Determine Program Theory</p>	<p>Once the needs and lack in capabilities have been identified, the program theory that is required to address these needs can be identified.</p>	<ul style="list-style-type: none"> <li>• Determine development intervention</li> </ul> <p>Intervention is either</p> <ul style="list-style-type: none"> <li>o Economic Intervention (achieving economic growth)</li> <li>o Social Intervention (capability improvement, health care, literacy and gender equality.</li> <li>o or Socio-Economic Intervention (combination of both)</li> </ul> <ul style="list-style-type: none"> <li>• Choose Agency of intervention</li> </ul> <p>Agency is either the</p> <ul style="list-style-type: none"> <li>o State</li> <li>o People</li> <li>o Market</li> </ul> <ul style="list-style-type: none"> <li>• Determine design approach</li> </ul> <p>The design approach can either be in the form of a</p> <ul style="list-style-type: none"> <li>o Product or Service</li> </ul>

Phase	Activities within each phase	Description	Procedures followed to carry out activities	
<b>Enablement Phase</b>	<b>Exploration Phase</b>			
		<p style="text-align: center;">Define goals objectives and targets</p> <p>Determine Project Opportunities and Risks</p>	<p>Define opportunities and consideration of project risks</p>	<ul style="list-style-type: none"> <li>• Define livelihood assets                             <ul style="list-style-type: none"> <li>○ Physical</li> <li>○ Social</li> <li>○ Financial</li> <li>○ Human</li> <li>○ Natural</li> </ul> </li> <li>• Identify opportunity freedoms</li> </ul>
		<p>Define Context specific User Requirements</p>	<p>Translate the needs of the community into information requirements for coding purposes so that the information can be used to develop the ICT4D system</p>	<p>Gather information relating to the specific use and needs of the system such as</p> <ul style="list-style-type: none"> <li>• Training needs</li> <li>• Preferred hours of operation</li> <li>• Willingness to pay for services</li> <li>• Physical capabilities</li> </ul>
<p>Define Context Specific System Requirements</p>	<p>This stage considers the aspects of operationalization, implementation and sustainability and analyses system needs weighing them up against these requirements.</p>	<ul style="list-style-type: none"> <li>• Analyse operationalization                             <ul style="list-style-type: none"> <li>○ Identify critical program functions</li> <li>○ Identifying performance criteria</li> <li>○ Identify the operationalization of the performance criteria that the program should deliver.</li> </ul> </li> <li>• Analyse implementability Implementability focuses on assessing how practical it is to implement a project in a given political and organizational environment                             <ul style="list-style-type: none"> <li>○ Consider business champions</li> <li>○ Sponsors</li> <li>○ Stakeholder Management</li> <li>○ Network mobilization</li> <li>○ Technology adoption</li> <li>○ Top management commitment and</li> <li>○ Community engagement.</li> </ul> </li> <li>• Analyse sustainability</li> <li>• Analyse most appropriate ways to engage the members of community to utilize services</li> </ul>		

Phase		Activities within each phase	Description	Procedures followed to carry out activities
<b>Enablement Phase</b>	<b>Exploration Phase</b>			and products provided by the project
		Define Resources Inputs	The required and available resource inputs need to be defined	Identify available resources such as <ul style="list-style-type: none"> <li>• Money</li> <li>• Labour</li> <li>• Technology</li> <li>• Values</li> <li>• Motives</li> <li>• Political support</li> <li>• Staffing, skills</li> <li>• Management systems and structures</li> </ul> Acquire resources from local institutions as far as possible, so to safeguard sustainability of resources
		Define Intended Outputs	These are direct outputs/products of the project	The following outputs are examples of the products delivered by the project <ul style="list-style-type: none"> <li>• Skilled persons</li> <li>• Training courses</li> <li>• Telecentres</li> <li>• Manual's that a project will deliver</li> </ul>
		Define Impact	Involves the long-term changes that a program is intended to bring about	These are either <ul style="list-style-type: none"> <li>• A societal or</li> <li>• Innovational impact on the society in which they are implemented.</li> </ul>

Phase	Activities within each phase	Description	Procedures followed to carry out activities	
Enablement Phase	Exploration Phase	Define Goals, Objectives Targets	Defining the goals and targets of the ICT4D project is crucial for direction and accountability. <ul style="list-style-type: none"> <li>• Update these goals, objectives and targets throughout the exploration phase by using               <ul style="list-style-type: none"> <li>○ knowledge from identified local needs of the community;</li> <li>○ observations from the vulnerability study in the context analysis;</li> <li>○ observations throughout the engagement of the community within the exploration phase</li> </ul> </li> <li>• Set realistic limitations</li> <li>• Ensure that the defined targets and goals align with local development goals</li> <li>• Prioritize the needs and desires of the local community</li> </ul>	
	Co-Creation Phase (Design alongside community representatives)	Ability to adapt technology	The technology must be flexible and easy to be adapted to changing circumstances.	
		Easiness of accessing the value of the technology and training package	Accessibility involves the ability to access an object by using that object to access information which is of value to the user. This is made possible by overcoming barriers so that users can truly access the value of technology and not just the tangible technology. Consider aspects such as location, availability.	
		Allow Expressive creativity	Ability for self-expression within the technology and training package. Being able to produce and use personal energy creativity to learn and solve problems with the technology.	
		Design with Cognizance of Resource Constraints	Design technology and training package which is cost effective making use of available resources and emphasizing the use of renewable energy such as sun, hydro and wind power.	

Phase	Activities within each phase	Description	Procedures followed to carry out activities		
<b>Enablement Phase</b>	<b>Co-Creation Phase</b> (Design alongside community representatives)	<b>Design of Appropriate Technology and Training Package</b>	Understandable to local people	Technology and training package must be understandable for local people without specific or academic training to allow all communities to produce and maintain and become involved in the possible innovation and extension of the use of the technology.	
			Encourage Local Ownership	Local ownership of the technology and training package must be encouraged and made possible to ensure sustainability.  Design training package that will equip users and ensure follow up training of teachers who can train new users when developers have left.	
			Allow relational interactivity	Technology and Training Package to be designed to give it the ability to allow relationships to be formed when using the technology by learning with others in and through interactions.	
			Ecological reciprocity	The technology and training package should not have a negative impact on the environment and should offer the opportunity to enrich the environment.	
			Process design	This stage considers the aspects of operationalization, implementation and sustainability of the program and designs according to these requirements	<p>Design system that is operable in certain context</p> <ul style="list-style-type: none"> <li>○ Design the processes of the system suitable to environment</li> </ul> <p>Design so that system is implementable the given political and organizational environment</p> <ul style="list-style-type: none"> <li>○ Involve business champions</li> <li>○ Network mobilization</li> <li>○ Engagement of local community.</li> </ul> <p>Design for Sustainability</p> <ul style="list-style-type: none"> <li>○ Design so that it is flexible enough to adapt to changing situations</li> <li>○ Ensure enough resources for the long run</li> </ul> <p>Engage the members of community to utilize services provided by the project</p>

Phase	Activities within each phase	Description	Procedures followed to carry out activities
<b>Enablement Phase</b>  (This phase addresses the readiness of the community to adopt the ICT4D)	Emancipation	Emancipate the local community and stakeholders by attempting to eradicate limitations for the well-being of humans. In return this will empower the community and users	<ul style="list-style-type: none"> <li>• Emancipate community at the               <ul style="list-style-type: none"> <li>○ physical</li> <li>○ legal and</li> <li>○ moral level</li> </ul> </li> </ul> Emancipate and empower individuals and the community either through the avenues of agency or opportunity structures
	Trust formation	Trust serves as a tool for overcoming social uncertainty by encouraging those under its influence to believe in the goodwill and harmless intentions of others. Trust therefore is important, where complex situations without easy contractual relation or enforcement exist.	<ul style="list-style-type: none"> <li>• Encourage trust amongst stakeholders</li> <li>• Form relationships with community members</li> </ul>
	Capacity building	The capacity of users must be developed to allow the effective use of ICT4D by the local community, developing the local capacities of users and using local institutions, as far as possible equip the local, and is essential to establish a competent network of team members with the required knowledge and skills to maintain the ICT4D infrastructure.	Examples of Capacity building include <ul style="list-style-type: none"> <li>• IT training</li> <li>• Promotion of basic IT skills forms</li> <li>• Other training initiatives</li> <li>• Increase the social capital of the community which in return ensures more input resources</li> <li>• Implement initiatives that will form external linkages for education</li> <li>• Use local institutions as far as possible</li> </ul>

## **6.4 Chapter 6 Conclusion**

Chapter 6 discusses the field work within the research. The field work results in improvements and validation of the framework. The framework was validated and improved through presenting it to experts within the ICT4D field. The suggestions regarding the improvements to the framework were applied and the final modified framework is presented in Chapter 6.3.3. The validation and modification process involved a qualitative and quantitative study, known as a mixed methods study. This study provided the researcher with qualitative and quantitative data which was analysed and compared in order to validate and modify the framework.

## CHAPTER 7- FINAL CONCLUSION

Chapter 7 concludes and summarises the entire study. Firstly Section 7.1 provides a summary of the research. Following is Section 7.2, a discussion of the objectives attained in and finally Section 7.3 ends off with the limitations and further opportunities for research.

### 7.1 Research Summary

The research was structured within two overarching studies, namely 1) the theoretical study and 2) the empirical study and is discussed in Chapter 2. A summary of each of these studies is given below. Section 7.1.1 discusses the theoretical study, Section 7.1.2 discusses the empirical study and Section 7.1.3 discusses the result of these 2 studies, i.e, the Conceptual Framework.

#### 7.1.1 Theoretical Study

The theoretical study was executed in Phase 1, 2, 3, 4 and 5 of Jabareens CFA methodology. The chapters in the thesis in which these phases are covered, include Chapter 1, The Problem Statement, Chapter 3 the overview Literature study, Chapter 4, The Systematic Literature Review and Chapter 5, the Framework Development Chapter.

The first part of the theoretical study was executed within Chapter 1 and 3 and established the problem space and identified the required literature to address the problem. The first part of the theoretical study is discussed in Section 7.1.1.1. The next part of the theoretical study involved addressing the problem identified by developing a conceptual framework. This framework was developed by drawing from the findings in the exploration of the identified fields of literature established to conceptualise the problem. The Conceptual Framework Developed in the second part of the theoretical study is the preliminary framework and is discussed in Section 7.1.1.2.

##### 7.1.1.1 Identifying the problem space and literature to conceptualise it

The literature revealed ample examples of ICTs4D used as a strategic tool for social development. Despite this potential of harnessing ICTs for social development, the literature also highlighted the fact that there still exists a significant percentage of ICT4D implementations that fail to deliver the results that they were developed for. Adoption of many ICTs to address social problems have even resulted as a hindrance to social development and caused further damage.

This issue is prevalent specifically where traditional ICT development models, originating from resource-rich, developed countries, have been applied in resource-constrained developing countries. It is therefore crucial that ICTs are harnessed and employed correctly within rural and developing settings and not merely to implement a one-size-fits-all solution. Understanding the nature of ICTs in complex social environments, as well as their social consequences in developing or rural settings is pivotal to establish reasons for ICT4D failure in these settings. The appropriate

literature surrounding the topic of ICT4D had to be considered and an effort made towards field-based, qualitative work to establish the effects and requirements for ICTs4D in rural and developing countries.

The study has three fields of literature in which it is situated, namely 1) Information System Development, 2) Human Development and 3) Information Communication Technologies for Development. These three fields were investigated to understand the functioning of ICT4D from the perspective of all three of these fields and to develop a theoretical base of knowledge within each field. The exploration of these three fields formed part of the overview Literature Study and the Systematic Literature review in Chapter 3 and 4, respectively.

The explorations of these fields exposed the reasons for failure for most ICT4D projects and highlighted the phases that require the most attention within the development of ICT4D, namely the analysis and design phases. These findings laid the foundation for further exploration of the analysis and design stages of IS development in ICT4D. This thesis is therefore an effort towards the development of a framework that will lay the foundation for the requirements for developing ICT4D in rural and developing countries – specifically within the analysis and design phases of development.

#### **7.1.1.2      *The Preliminary Conceptual Framework***

To address the issues identified within the problem landscape, a conceptual framework was developed by drawing from the findings in the exploration of the three fields of literature as discussed above. A Conceptual Framework Analysis (CFA) by Jabareen (2011) was chosen to develop the ICT4D framework. The CFA by Jabareen (2011) is based upon the grounded theory and follows a qualitative approach to create the conceptual framework. A 7-step process, as proposed by Jabareen (2011), was followed to conduct the entire study and inevitably establish the framework.

Through executing these 7 steps, 3 main stages within the development of ICT4D, including analytical, functional, and design phases, were established. A further 10 concepts within the Analytical Phase, 11 concepts within the Design Phase and 3 concepts within the Functional Phase were identified within the Systematic Literature Review in Chapter 4. The phases and their corresponding concepts laid the foundation for the requirements for the development of ICT4D. Chapter 5 is the Framework Development chapter and explains the entire process involved in using these concepts, integrating them and establishing meaningful relationships amongst them to develop the preliminary conceptual framework.

#### **7.1.2 *Empirical study***

The empirical study was executed in Phase 5 and 6 of Jabareen's CFA methodology the empirical study used these 2 phases to improve and validate the framework developed in the theoretical study. The mixed methods approach, using qualitative and quantitative data collection and analysis

procedures were used to validate and provide improvements to the framework. These procedures involved semi-structured interviews with 10 experts in the field of ICT4D.

The feedback received from the empirical study established the themes, The Need for an ICT4D Framework, Addressing the lack of a guiding tool within the development of ICT4D, The Usefulness of the Framework and The Validity of the Concepts upon which the framework is developed. These themes were established by the responses which the participants provided for the questions asked in the interviews. These responses provided validity upon the reliability, usefulness, need and relevance of the framework. These results presented insight into the practical world of ICT4D and validate the use and need for the framework in reality. The results from the empirical study further ensured that the framework underwent necessary improvements to inevitably make it applicable to real life situation and to establish a robust framework. The final framework developed within the empirical study is discussed in Section 7.1.2.1

#### **7.1.2.1      *The Final Framework- Analysis and Design Framework***

The final Analysis and Design Framework for ICT4D for developing settings, specifically in SA, is established through the framework development and validation procedures and is presented in Section 6.3.3. The framework aims to provide a guide to develop ICT4D within the Analysis and Design phases.

The framework in the study was specifically established to identify the best practices for the development of ICT4D to ensure successful implementation. The framework was developed with the consideration that in the future ICT4D Body Knowledge (BOK) would grow and that the framework will have to adapt accordingly. To cater for these changes, the framework was developed to be adaptable and flexible, therefore having the ability to apply to changing situations. This was made possible through developing the framework to provide guidance to developers without enforcing rigid requirements. The framework can therefore be expanded by additional knowledge input from users and literature and then applied appropriately. The research highlighted the fact that there is not one coherent approach to developing ICTs4D, but that a combination of frameworks and tools are needed. This framework, therefore, is a contribution to the available tools and approaches that can be used.

## **7.2 Attainment of research objectives**

The final aim of this thesis is summarized as follows:

Apply the knowledge gained through the theoretical study, and empirically investigate the development of ICT4D to create a framework that will lay the foundation for the requirements of developing ICTs4D in the South African context, specifically for the developing areas.

The entire document is dedicated to the attainment of this aim and resulted in the development of an Analysis and Design Framework for ICT4D, specifically in developing country settings. Firstly, the formation of the framework was accomplished through a theoretical study to establish a preliminary conceptual framework. The empirical study followed to provide validation and improvements to the framework. To develop an appropriate framework the scope of the problem required an understanding of the three fields of literature in which the study is situated, namely: 1) Information Systems; 2) Human Development; and 3) ICT4D. The seven objectives each contributed to the investigation of each of these fields to develop understanding of the functioning of ICT4D and to inevitably accomplish the attainment of the main aim. The means of attainment of the seven objectives and the location of these efforts within the document is summarised in the table below.

**Table 7.1: Attainment of Research Objectives**

Objective	Explanation of Attainment of Objective	Document Reference
Objective 1 Investigate the definition and literature regarding the field of social development by analysing existing theories, tools and frameworks, relating to this field.	Chapter 3, The Literature Review, is the first contribution towards the knowledge needed for developing the framework. The conceptualisation of human development was accomplished through investigation of theory, relating to views and dimensions of human development. A summary of the different human development-based arguments is discussed in detail within Appendix A and is summarised in Chapter 3.3. Within these arguments are various theories, tools and frameworks that were brought to attention.	Chapter 3 Section 3.3
Objective 2 Evaluate the definition and literature regarding ICTs4D in developing countries.	The second research objective is achieved through the Literature Review in Chapter 3. Here ICT4D is investigated as it is, one of the fields of literature in which the study is situated. Within this chapter the definition and theory regarding ICT4D is established. The findings lead the reviewer to focus on the Analysis and Design of ICT4D; as this proved to be the leading stages in the development of ICT4D where mistakes occurred, and thus causing failure of the system.	Chapter 3 Section 3.4
Objective 3 Investigate and identify the requirements for the development of ICTs4D in developing countries.	Chapter 4, The Systematic Literature Review, was the second contribution towards the knowledge needed for developing the framework. Through following an 8-step systematic literature review procedure, 108 articles were identified and 33 ICT4D frameworks/approaches were identified within these articles. These frameworks and approaches provided the researcher with a foundation for the requirements for the development of ICT4D.	Chapter 3 Section 3.4  Chapter 4

Objective	Explanation of Attainment of Objective	Document Reference
Objective 4 Construct a conceptual framework for the development of ICTs4D in developing countries, by using the knowledge obtained through the attained objectives above.	Research objective 4 was attained through the development of the preliminary conceptual framework. The framework was constructed through the CFA method, by Jabareen. The knowledge gained from the attainment of the previous objective is used during this process to develop an Analysis and Design Framework for ICT4D, specifically for developing country settings.	Chapter 5
Objective 5 Empirically test the framework by investigating and identifying the requirements for the development of ICTs4D in South Africa, specifically in developing areas, by executing in-depth interviews with experts in the ICT4D field.	The attainment of the fifth objective is accomplished through the first part of the empirical study which involved a qualitative and quantitative study, known as a mixed methods study. In Chapter 6 which forms part of the field work, the preliminary framework is presented to experts within the field of ICT4D through a 3-phase interview process. The feedback of the interviews was used in order to shed more light on requirements for ICT4D development from a practical point of view.	Chapter 6
Objective 6 Improve framework upon the above findings.	The feedback and findings from the qualitative and quantitative analysis (mixed methods approach) were incorporated to provide modifications and additions to the framework.	Chapter 6 Section 6.3
Objective 7 Empirically validate the framework by investigating and identifying the requirements for the development of ICTs4D in South Africa, specifically in developing areas, by executing in-depth interviews with experts in the ICT4D field.	The responses from the interviews, which formed part of the qualitative and quantitative analysis were analysed and compared and provided validity upon the reliability, usefulness, need and relevance of the framework.	Chapter 6 Section 6.3

### 7.3 Limitations and further research opportunities

The limitations of the study are now considered to establish the appropriate context for interpreting the findings within this study. Firstly, it has to be acknowledged that many articles, books and other sources exist with insight into the topic of ICT4D. This study, however, was limited by using only sources of English Publications, sources that related to the field of Social Sciences and specifically ICT4D related articles and sources which the researcher had open access to, through university portal and library. The theoretical knowledge used in the study was therefore limited according to these factors. As a larger sample size theoretically leads to more accurate results, the empirical investigation was limited by the number of possible interviews that could be conducted within the qualitative and quantitative analysis. The reason for this limitation was mostly due to resource and time constraints. It was however ensured that the experts interviewed represented a large scope of industry experience with insights from various sectors that could be considered, thus limiting bias.

Discernment and consideration for the context are important when employing the framework. The framework is a guide and not a coherent approach to developing ICT4D. This framework is therefore limited to be used as a contribution together with other available tools and approaches that are appropriate for the specific context of implementation. Human interpretation will always pose limitations as the findings are dependent upon the researchers' understandings. This limitation was, however, minimized by using systematic procedures to uncover bias and establish accurate results as far as possible. The empirical validations and identification of limitations lead the researcher to recommendations and future opportunities. These include various suggestions made by participants regarding additions to the framework, and include measuring impact, policy development and monitoring after implementation. These suggestions were beyond the scope of the research but are valuable recommendations to incorporate into the framework for future opportunities. Even though the validation process proved the validity of the framework, further study is required to map the issues that may arise from the implementation, and to confirm the usefulness thereof in real-life situations.

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## **Appendix A: Human Development-based Arguments**

This section provides background literature relating to the Human-Development Based Arguments that are summarised in Chapter 3.3

### **Appendix A.1: Actor Network Theory (ANT)**

The Actor Network Theory is a theoretical and methodological approach to social theory (Díaz Andrade and Urquhart, 2012) and is therefore used to understand social phenomena (Simandan, 2010), and is therefore applied in studies such as case development. ANT can therefore either be used in theory to explore development or as a sense-making tool (Thapa and Saebø, 2016). ANT applications originally focused on the sociology of science and has now shifted its focus to include technology and has been used for a number of years in the ICT4D field (Walsham, 2017).

The fundamental aim of ANT is to explore and explain the process whereby social networks are formed through countless interactions between actors and their relationships (Thapa & Saebø 2016; Heffernam et al. 2016; Carroll et al. 2012). The actors range from humans to technology to scientific regulations (Heffernam, Lin and Thomsan, 2016). ANT is based on actors that are both human and inanimate (Thapa and Saebø, 2016) and these agents are either acted upon by technology or themselves act upon technology to create a diverse range of changing networks (Heffernam, Lin and Thomsan, 2016). An actor network is established for the purpose of achieving a specific goal. The pursuit of this goal commonly stimulates networks with different goals or intend to hinder the goal being achieved. These different networks compete for tangible and intangible resources to achieve their specific goals (Heffernam, Lin and Thomsan, 2016). The study of development uses this theory to identify these resources, networks, agents and relationships present in development and therefore to describe and understand the process of development.

### **Appendix A.2: Capability approach**

The capability approach was established in the 1970s by Amarty Sen in response to the traditional approaches of development which considered wellbeing mostly from an economic perspective (Heffernam, Lin and Thomsan, 2016) (Poveda and Roberts, 2018). The capability approach was further developed by authors such as Des Gasper, Ingrid Robeyns, Sabin Alkire and Martha Nassbaum. The capability approach provides a standard framework for the conceptualization of development (Poveda and Roberts, 2018).

Development according to Sen, is a means of facilitating the acquisition of capabilities. Capabilities are the “beings and doings” of individuals, which enable them to gain access to resources and choices (Alkire, 2002). Sen names these “being and doings functionings”. It is these functionings which are used to create a life which is deemed valuable to the individual (Robeyns, 2005) and which makes up that person’s being (Alkire, 2005). These capabilities are what create freedoms for individuals and thus constitute development. The expansion of freedom is therefore the primary end to a means of development and the means of development itself (Grunfeld, 2007) (Sen, 2000). The expansion of capabilities in order to allow the expansion of freedoms is what forms the building blocks of development, of which some of these freedoms include, freedom to participate in political events and access to basic education (Grunfeld, 2007).

Nussbaum defines a list of fundamental human capabilities which should form the basis of political goals to stimulate development. The fundamental capability list by Nussbaum (2001) consist of following capabilities: length and quality of life, health of the body, integrity of the body, senses, imagination and thought, emotions, practical reason, affiliation, living with concern for other species, play, control over one’s political and material environment.

Each of these capabilities defined by Nussbaum (2001) have a threshold level and below this level it is deemed that true human functioning does not exist. The goal should therefore be to get citizens above each of these threshold levels and in return stimulate development (Vaughan, 2011). Sen on the other hand does not specify a list of capabilities. He believes that the aim of developing capabilities is to allow citizens to choose for themselves the important capabilities which in return creates the freedoms to attain a life they consider valuable. These capabilities, in his point of view, will differ according to different circumstances, culture and social status (Sen, 2000) (Vaughan, 2011). The fact that Sen does not define a set of capabilities has encouraged public deliberation and participation in capability literature (Oosterlaken, 2009).

The other aspects which the capability approach places great importance on is critical-agency/value judgement and free choice. Critical agency is the ability of citizens to critically analyse their social circumstances and which in return enables them to act and transform the situation. This ability of acting is known as agency (Roberts, 2016). Value judgement goes hand in hand with critical agency as it is the ability of citizens to judge whether something is right or wrong and then to apply it to agency (LLC, 2018), so to respond in the appropriate way. Realization of free choice in personal, work life and, areas extending beyond this in a citizen, as a whole, life, is also crucial for development (Hirschheim and Klein, 1994).

The perspectives regarding development and present in the capability approach has been commonly adopted and applied in the design of ICT4D (Zheng *et al.*, 2018). There are however numerous application for this approach and Robeyns (2006) identifies 9 different types of application of the capability approach, including; 1.) general assessments of human development of countries, 2.) assessing small-scale development projects, 3.) identifying the poor in developing countries, 4.) poverty and well-being assessment in advanced economies, 5.) deprivation of disabled people, 6.) assessing gender inequalities, 7.) debating policies, 8.) assessing gender inequalities and 9.) functioning's and capabilities as concepts in non-normative research.

The capability approach, though widely used and conceptually rich, has its short falls in addressing development (Poveda and Roberts, 2018). The approach is difficult to operationalise (Heffernam, Lin and Thomsan, 2016) as measuring quality of life and livelihoods, relating to doings and functionings are very difficult (Heffernam, Lin and Thomsan, 2016). The approach by Sen is deliberately vague and unclear and is therefore more appropriate to be used as guide to think rather than to be used as a tool kit for development (Heffernam, Lin and Thomsan, 2016). The approach also does not give a systematic process of addressing and enhancing critical- agency, free choice and capabilities and therefore does not give the means for citizens to overcome structural unfreedoms (Poveda and Roberts, 2018). It is also important to note that there exists specifically shortcomings in applying the approach in the In the ICT4D field as the deliberate vagueness and ill defined concept of capability, as defined by Sen, makes it difficult to link specific impacts of a technology to development (Heffernam, Lin and Thomsan, 2016).

### **Appendix A.3: Emancipatory approach**

According to Hirschheim & Klein (1994) development is a social process and certain ideals and principles should direct this process. Emancipatory principles are argued to be one of these principles that should direct the process of development.

Before going deeper into the requirements of emancipation one must look at the definition of emancipate. According to the Collins English dictionary emancipate means:

1. "to free from restriction or restraint, especially social or legal restraint";
2. "to free from inhibitions imposed by conventional morality"; and
3. "to liberate (a slave) from bondage"

Ulrich (1983) describes emancipation as liberating affected people from being treated as a means to an end by others who are striving to achieve a certain goal.

Emancipation occurs at three levels, at the physical, legal and moral level and thus people require emancipation in all 3 of those areas (Vaidya, 2016). A systems development methodology is emancipatory if it attempts to eradicate limitations to the well-being of humans due to physical ( which includes natural or technical), psychological, or social conditions or forces, which fall under the moral level and if it enables free inquiry and democratic practices, which falls under the political level. (Hirschheim and Klein, 1994)

The principal of emancipation for development purposes have been increasing in application of ICT4D projects as there has been a shift from traditional ISD methodologies which focused mainly on functionality and efficient user requirements. The functionalist assumptions promote efficiency and effectiveness whereas the neohumanism philosophy applied in ISD, promote emancipation. Neohumanism also encourages participation in the development of Information Systems in order to attain emancipation. Participation and emancipation therefore go hand in hand and is essential for social sense making and shared understanding in ISD (Hirschheim and Klein, 1994). Often ICT4D impact assessments measure emancipation in the form of benefits stemming from information emancipation. Some of these benefits include improvement in the quality of governance and improvement in access to services by reduced costs of access (Vaidya, 2016).

According to Vaidya (2016) the main requirement for successful implementation of ICT4D projects is emancipation and that the desired outcomes of these projects can be acquired by meeting emancipatory expectations.

According to Alvesson & Willmott (1992) the following four conditions should be present in methodology if the methodology is to be considered emancipatory.

1. The methodology must encourage individuals as well as the community in the act of self-determination and therefore equip citizens to control their own lives.(Ulrich, 1983) states this as the act of liberating others from becoming a mean to an end for the purpose of others to achieve their goals.
2. An emancipatory methodology must incorporate aspects of self-reflection and self-transformation. The researches therefore have the responsibility to reflect upon their own actions and ideologies and where necessary transform these so that emancipation may be acquired within the research field.
3. Such a methodology must include a wider set of institutional matters such as social justice and human freedom
4. Critical evaluation is essential in these methodologies so to validate the claims made throughout the development process and uncover the underlying beliefs and knowledge upon which these claims are made.

## **Appendix A.4: Critical Theory**

Critical Theory is a guide for human actions in attaining emancipation. The theory is reflective in nature which is intended to equip its users with knowledge that will serve to enlighten and emancipate them. (Roberts, 2015). The theory deliberately questions the status quo by reflecting on experiences, beliefs and values and so uncovers the hidden political and ideological agendas. The theory critically observes social phenomena and takes a stance against or for it in order to address the factors that might be keeping its agent from emancipation (Krauss, 2016). The critical method is able to guide its users to uncover hidden features of social structures and so make them aware of their circumstances which in return allows the users to determine their own actions for development (Roberts, 2015).

(Roberts, 2015) states 4 fundamental characteristics of Critical theory which aims: a) to enlighten, b) to emancipate by freeing its agents from hidden or obvious oppression, c) to create productivity from knowledge and d) to reflective rather than objectify.

A core belief embedded within the Critical theory and understood by theorists is that one cannot simply be an observer of social phenomena but that by theorists mere presence, they become partakers in social interactions whereby they influence the system as well as are influenced upon by the system (Hammersley, 1992). The responsibility of the researcher moves beyond offering mere explanation and understanding regarding social phenomenon but to a responsibility to “critique unjust and inequitable conditions of the situation from which people require emancipation” (Ngwenyama and Lee, 1997). The philosophy of this theory does not allow the research propagated by it to be separated from practice (Ngwenyama, 1991) and therefore researches have an obligation to stimulate change and bring about transformation (Krauss, 2013).

The challenges and shortcomings surrounding this theory is that the theory and practice of doing the research do not often align. The theory is conceptually rich but empirical research in the critical theory sphere is lacking. This is due to the general disagreement regarding the methodology of critical research. (Krauss, 2016). Despite these shortcomings the critical theory has been used in ICT4D projects, especially due to its focus on bringing about enlighten and emancipation (Krauss, 2013).

## **Appendix A.5: Sustainable Development Goals**

The global leaders at the United Nations Millennium Summit came together in September 2000. At the summit, millennium Development goals were established which progress was to be measured in 2015 again (Bates-Earner et al., 2012). In 2015 this summit continued to an

agenda for 2030. Known as the Sustainable Development Goals adopted by all United Nations Member States. These goals consist of 17 Sustainable Development Goals (SDGs), which included targets aimed at eradicating poverty, hunger sickness, illiteracy, environmental damage and discrimination (United Nations, 2017).

- 1.) End poverty in all its forms everywhere
- 2.) End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- 3.) Ensure healthy lives and promote well-being for all at all ages
- 4.) Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- 5.) Achieve gender equality and empower all women and girls
- 6.) Ensure availability and sustainable management of water and sanitation for all
- 7.) Ensure access to affordable, reliable, sustainable and modern energy for all
- 8.) Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- 9.) Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- 10.) Reduce inequality within and among countries
- 11.) Make cities and human settlements inclusive, safe, resilient and sustainable
- 12.) Ensure sustainable consumption and production patterns
- 13.) Take urgent action to combat climate change and its impacts
- 14.) Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- 15.) Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- 16.) Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- 17.) Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Figure A.1: 2030 Sustainable Development Goals adapted by United Nations (2017)

## **Appendix A.6: Participatory Design**

Participatory design is a process of co-creation between users, stakeholders and designers of systems, services or products. The core idea behind this approach is that all people affected by decisions made in the design of any system or product should have the chance to influence those decisions (Hussain, Sanders and Steinert, 2012). Participatory design is a design approach which strives to create more than mere tangible solutions such as products and services, but also strives to incur intangible results that build local human capacity by empowering the community and therefore has the potential to stimulate social development (Morin, García-Sánchez and Pérez-Bernal, 2007). According to Hussain et al. (2012), Participatory design within Information System Development is able to yield empowering results, throughout and after the system development process.

Community participation in system design was born out of analysts seeking alternative methods for designing programmes and systems. The growing realization that poorly managed programmes and systems are a major contributing factor in numerous social and economic problems within the world, stimulated this quest towards alternative design methods (Sanoff, 2006) (Morin, García-Sánchez and Pérez-Bernal, 2007).

Participation in system development, specifically Information system development, can facilitate the building of local human capacity through including the voices of the excluded. In developing countries so many are silenced by poverty and lack the ability to voice their needs and opinions, when it comes to IS being developed for even them. It is thus crucial to give voices to the excluded so that effective and empowering solutions can be created together. IS initiatives that are designed to address social development is therefore reliant on effective participation during the system development process. Participatory IS design can further encourage social development by creating an awareness of the social problems and thus can gather the support of government and society to help address these problems (Morin, García-Sánchez and Pérez-Bernal, 2007).

Participation within system development holds many possibilities regarding the advancement of social development. These advantages that add to the movement of social development include aspects such as an increased sense of community. Creating a strong sense of community develops an environment from which people are eager to act positively towards initiatives taken to solve community issues, thus being more willing to offer more of their time, resources and efforts in assisting in meeting community needs. The individual advantages that collectively contributes to the overall social development includes citizen empowerment and increase of social capital (Sanoff, 2006). Social development is not the only benefit brought on by participation, another being an important determinant of the eventual success of the system (Byrne and Byrne, 2004).

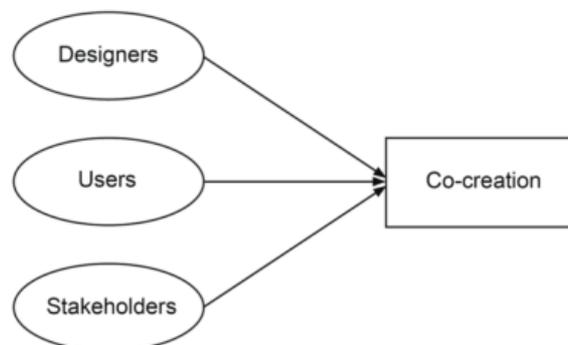
The purpose of using a Participation approach in the development of an Information system is not solely about the end product or service but also about the participation process itself. If the goal of IS development includes social development, the participation process is therefore all the more crucial in the development process (Morin, García-Sánchez and Pérez-Bernal, 2007). Hussain et al., (2012) confirms this by identifying the main advantage of using participatory design in developing countries, as the opportunity to develop empowering outcomes of two types: products that meet the users' needs as well as psychological empowerment of the participants. The Zimmerman model transferred to the context of participatory design is a supporter for an approach where the product is not seen as the only aim of the design process. Instead, designers should strive for psychological empowerment

of users and other stakeholders. By empowering participants, designers contribute to building local human capacity and enable people in developing countries to undertake their own design projects in the future (Hussain, Sanders and Steinert, 2012) ..

Even though participatory design has been researched relatively extensively in the West the last three decades , there has been limited and mostly side-lined research and discussions over participatory design approaches and techniques in developing country settings (Byrne and Byrne, 2004) (Hussain, Sanders and Steinert, 2012). There has been especially minimal research on Participatory design in IS in the context of social development. This is due to the fact that the traditional research most often zoomed in on the business context in the Western world (Morin, García-Sánchez and Pérez-Bernal, 2007). It is important to distinguish the difference between system development in western countries and in developing countries. This is because system developers will be working in completely different environments where very different obstacles and opportunities present. The same assumptions cannot be made for participatory design projects in developing countries as standard conditions in developed countries are not always present in developing countries. Some of these conditions include, lower literacy rates, very limited technological infrastructure and systems of government that are not democratic (Puri, Byrne, Nhampossa, & Quraishi, 2004).

### **Traditional model for participatory design**

The traditional model for participatory design involves co-design between system designers, users and other stake holders. This model is used mostly in the context of developed countries and aspects such as, the sufficient and adequate availability and capability of participants in the participation process, is taken for granted (Hussain, Sanders and Steinert, 2012). The diagram below depicts this traditional model for participatory design.



**Figure A.2: Traditional model for PD (Sanders & Stappers, 2008)**

### **Developing country model for participatory design**

The model above proved to be too simplistic in a study conducted by (Hussain, Sanders and Steinert, 2012) . The reason was that the study was conducted in Cambodia, a developing country and therefore the model did not take into consideration the challenges which poverty posed to the process of co-creation. Co-creation, as depicted in the model above involves all participants and designers collaborating and working together. This proved to be an unrealistic expectation in the context of the developing country, as it was never possible to facilitate true co-creation where designers worked with users and other stakeholders at an equal level. This was due to the fact that designers were not able to get the stakeholders and users together at one venue at one time. The long distance that these participants lived from each other was the major reason for this struggle. Poverty related factors such a lack in public transport and being unable to take off from work were some of the reasons that these distances could not be overcome. Participants also lacked the ability to participate to the extent which the designers hoped so designers had to lead the participatory design activities separately with either users or other stakeholders.

The model was therefore adapted by Hussain et al. (2012) and is depicted in the diagram below.

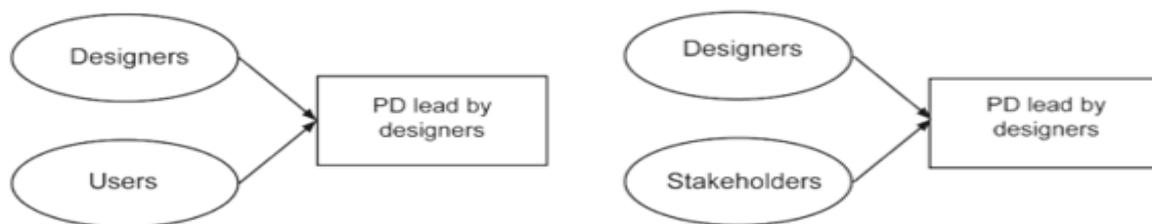
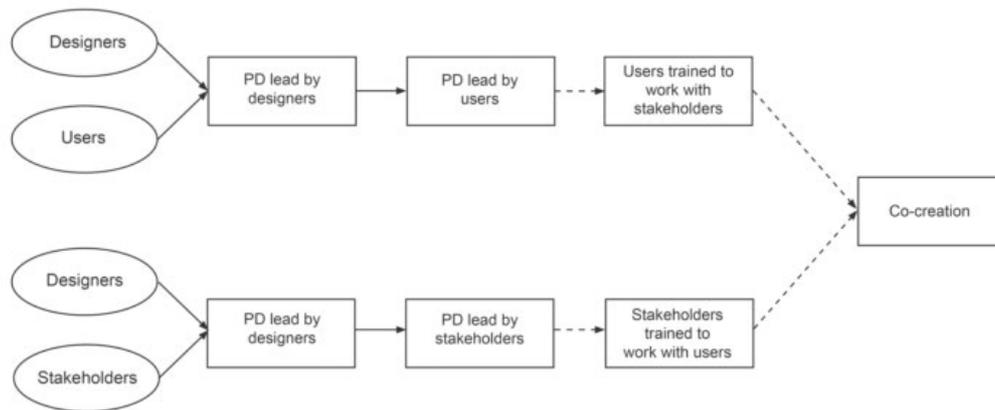


Figure 7A.3: Description of PD based on the experience gained in the field study by (Hussain et al., 2012)

In the study executed by (Hussain, Sanders and Steinert, 2012) the model for participatory design was further developed into a model that can possibly be used as a future by participatory project with a longer life span. This process needs a longer time frame as Participatory design is firstly lead by designers, users are then trained to lead in the next phase, and if time and circumstances allow it, users are trained to work with stakeholder. On the other end designers also follow the same process with stakeholders, until stakeholders are trained to work together with users, thus making users and stakeholders completely independent of designers. Co-creation will then be achieved to its fullest degree (Hussain, Sanders and Steinert, 2012).



*Figure :A.4: Evolution of participatory design in the study by (Hussain et al., 2012)*

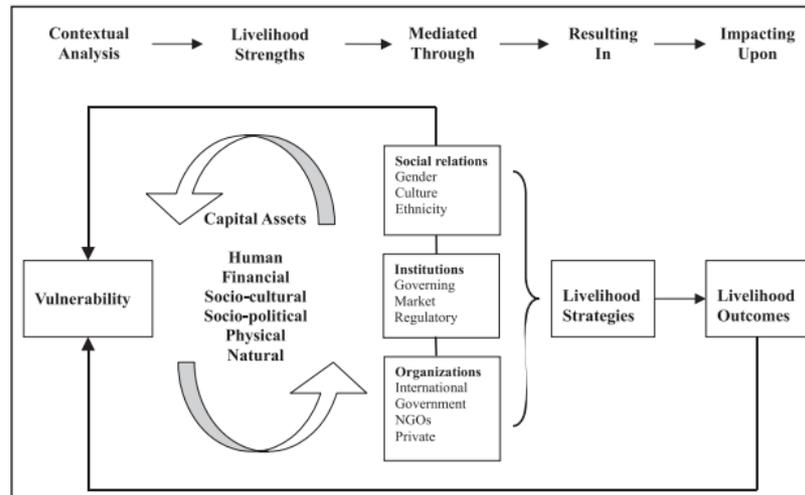
## **Appendix A.7: Sustainable Livelihoods Approach**

Chambers & Conway (1992) describes livelihoods as “as comprising of capabilities and assets, including both material and social resources, and activities required for a means of living”. Capabilities, assets and activities required to live a valuable life, are therefore the constituents of livelihoods (Walsham, 2017). The Sustainable Livelihoods approach was first proposed in the late 1980s and has gained widespread attention especially in the ICT4D arena (Heffernam, Lin and Thomsan, 2016; Walsham, 2017). The approach initially evolved as a tool to analyse complex issues surrounding the lives of the poor, providing a means to think through these issues and identify actors and influences (Duncombe, 2006).

Chambers & Conway (1992) expands onto the definition of sustainable livelihoods and describes it as livelihoods able to survive and recuperate from pressures and shocks and still preserve or increase its capabilities and assets without depleting natural resources.

The SL Framework developed from the SL approach is a tool used to understand the causes of poverty and identify the requirements for poverty elimination. The framework studies the access of individuals and communities to these livelihoods assets and activities and creates understanding by highlighting the interactions between assets, vulnerability and structural transformations (Heffernam, Lin and Thomsan, 2016) . This human-centred framework studies the actions of the poor in the context of vulnerability (Duncombe, 2006; Heffernam et al., 2016).

The framework depicts the process of creating greater benefits for the poor through the use ICTs to strengthen and widen the range of political and social assets and building improved structures and processes that can assist the poor (Duncombe, 2006).



**Figure A.5: Figure 5 Livelihoods Framework to Analyse ICT applications for poverty**

Duncombe (2006) identifies the 4 processes which constitutes the framework.

1. contextual analysis of vulnerability
2. identifying livelihood strengths or assets;
3. identifying levels of analysis according to structures and processes and
4. identifying livelihood strategies and outcomes

### **Contextual analysis of vulnerability**

The framework starts by understanding the vulnerability context through analysing the lives of the poor at the microlevel. At this level analyst study the coping strategies of individuals and communities in their environment. The level of vulnerability is determined by identifying influences of shocks trends economics, political, social and natural resource factors. The framework therefore analyses the of the lives of the poor and identifies influences, causes and strategies to overcome poverty and therefore create a sustainable model for transformation (Duncombe, 2006). This analysis is both functional and analytical. The functional role focuses on and identifies how information is used within livelihood strategies and the means of creating favourable livelihood outcomes. The analytical roles assess and accesses empirical evidence in order to understand these livelihoods (Duncombe, 2006).

### **Livelihoods strengths and assets**

One again the analysis of the assets of the poor has an analytical and functional role. The analytical role identifies the ways in which strengths and assets can be measured and the functional role identifies ways to increase and strengthen these assets (Duncombe, 2006) There exists 5 capital assets which the poor may have access to and these are financial, human, social, environmental and political assets. The access to these assets change

depending on the structures and processes influenced by policies, laws, institutions (Heffernam, Lin and Thomsan, 2016).

### **Livelihoods structures and processes**

Structures of livelihoods can be equated to hardware and processes to software. The structures, “hardware” consists of the various organisations that set and deliver goods, services, policy and other functioning’s that affect livelihoods. The processes, “software” regulates how structures interact with groups and individuals. These processes consist of social, political, economic and cultural aspects and include features such as government policies and legislation, market, trade agreements etc (Duncombe, 2006).

### **Livelihood strategies and outcomes**

Chapman and Slaymaker (2002) suggest time- dependent roles for information in contributing to livelihood strategies. The first role relates to long- term capacity building through education, training, and technical support, such as has been traditionally provided through government-run extension services. Within a livelihoods perspective a broader role should also be considered: information for enhancing the long-term rights and entitlements of the poor (their socio-political capital) in areas such as health, education, participation, and empowerment. The second role relates to information concerning short-term decision making. For microenterprise, this type of information is likely to be gained predominantly by building and extending sociocultural resources and facilitating access to (predominantly local) economic networks. In terms of livelihood strategies, therefore, information can be seen to play a dual role: informing and strengthening the short-term decision-making capacity of the poor themselves; and informing and strengthening the longer-term decision-making capacity of the infomediaries that facilitate, assist, or represent the poor. Whereas the former will be solely functional, the latter may have an analytical, as well as functional, role (Duncombe, 2006).

The roles of livelihood strategies relate to long-term and short-term strategies. Long-term strategies involve capacity enhancing processes and activities such as education, and skill development (usually provided by governmental programs). Broader strategic roles within livelihoods also include using information to enhance the long-term rights of the poor in sectors such as health, education and other sectors that promote empowerment. The long-term decision-making capacity of infomediaries to assist the poor is therefore strengthened by long term strategies. The second role of livelihood strategies involves strengthening the short-term decision making of the poor. The capacity of the poor to make short term decisions is strengthened by constructing and expanding socio-cultural resources and providing access to

economic networks. These short and long term strategies therefore have functional and analytical purposes, by informing (analytical) and equipping (functional) (Duncombe, 2006).

## **Appendix A.8: Theory of change**

Theory of change (ToC) is the theory describing the means and reason for socio-technical changes which occurs in a specific context. ToC therefore provides pathways that will allow required change to occur. ToC is used in ICT4D research applied in sectors such as migration, innovation, healthcare, education and e-government, to provide understanding of the socio-technical processes involved (Zheng *et al.*, 2018). ToC can be considered in the structural level and agency level both mutually giving existence to the other. ToC view individuals as the means or ends or both to development and as both recipients and agents of change. At a structural level examples such as the economy and research which explore institutional change exists.

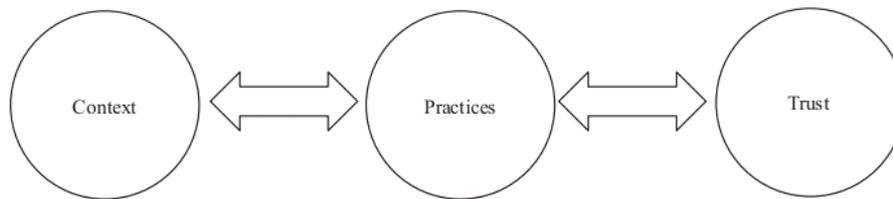
In practice is important for ToCs to be tested, confirmed and refined as ToC are often biased and focus merely on single dimensions of a situation and may incur contradictory theories (Zheng *et al.*, 2018).

## **Appendix A.9: Theory of Trust**

The Theory of trust suggests that trust serves as an emancipatory tool by encouraging people to explore new opportunities by emancipating them from other commitment relationships that might be hindering their development and therefor improving their risk taking abilities (Vaidya, 2016) (Yamagishi, Kikuchi and Kosugi, 1999) Trust serves as a tool for overcoming social uncertainty by encouraging those under its influence to be inclined to believe in the goodwill and harmless intentions of others (Vaidya, 2016). Trust is therefore important where complex situations without easy contractual relation or enforcement exist (Gomez and Gould, 2010).

Culture is a big determinant in shaping abilities that form trust. These abilities are carried out in certain practices and in return shapes trust. These practices include expectation of benevolence, cultural similarities, optimum communication, expectations of altruism and individual's ethics. Benevolence is crucial for safeguarding the cooperation within groups and societies, cultural similarities breeds higher levels of commitment amongst individuals, optimum levels of communication eliminates misunderstandings, and the expectation of altruism allows individuals in groups or the society to overcome prejudice and other stereotypes regarding other individuals in the group or society and individual ethics overcome foul play. It is expected that these practices are the result of the socio-economic cultural

context and thus have a direct effect on the levels of trust within a group or society (Vaidya, 2016). The theoretical model of trust formation is depicted in the figure below.



**Figure A.6: Theoretical model of trust formation (Vaidya, 2016)**

The success of ICT4D are especially effected by trust as trust determines if these ICTs will be used (Gomez and Gould, 2010). Information systems that are intended to bring about social development will therefore have to have an integrated view of emancipation and include social and moral dimensions such as trust (Vaidya, 2016). According to the author, Gomez & Gould (2010), building trust in order to encourage the use of ICTS will require elements of safety, relevance, reputation and cool in public access venues. The risk of exchanging knowledge wile utilizing these ICTs will be lowered by the level of trust created through these specific elements (Gomez and Gould, 2010).

## **Appendix B: ICT4D Frameworks/approaches identified**

The table summarises the 33 ICT4D frameworks/approaches identified within Chapter 4, The Systematic Literature review.

**Table A.1: A Summary of Frameworks/ Approaches identified in the Systematic Literature Review**

<b>Framework Name</b>	<b>Main Authors</b>	<b>Type and context of Use</b>	<b>Description and Aim</b>	<b>Elements considered within Framework</b>
Type- ICT4D Champion Origins	Renken & Heeks 2017	Development Framework for consideration of project champions	The model is significant because it lays the foundation for future ICT4D champion research and proposes to researchers that champions can be identified, advanced and positioned in ICT4D initiatives thus allowing the potential positive contributions these individuals can make to digital development more tangible	Environmental Factors Social Networks Personal Characteristics Organizational Factors Skills and education Experience
Type- ICT4D Value Chain	Heeks 2010	Conceptual framework. An Input, process, output model	This expands on a standard input—process—output model to develop an arrangement of linked ICT4D resources and processes.	Availability Impact/ Out puts/outcomes Readiness Precursors and input
ACE Framework	Gomez and Gould, 2010	Conceptual framework (understanding)	The ACE framework is a tool to realize the effects factors such as economic, political, educational, structure, social, organizational amongst others have on the way people use ICT in public access locations.	Access Capacity building Environment
A-ICT Framework	van Reijswoud, 2009	Development and Implementation Framework	The A-ICT Framework gives guidance in assessing needs and question the solutions that are offered. The A-ICT framework delivers a flexible approach for the design and implementation of ICT in developing countries.	The following aspects of Hardware and Software Design Construction Installation Operation/Maintenance Factors such as Environmental factors Political factors Organizational factors Cultural Factors
Basic Logic Model of the CTSP (Community Technology Skills programme)	Pather and Uys, 2010	Planning stage Overview of essential elements	Assists by giving an overview of the essential elements of the program. This model therefore investigates the facilitating role of ICTs in socioeconomic development	Goals and Objectives Resources/Inputs Activities Outputs Outcomes Impacts
Benefits Framework	Uys, 2015	Evaluation Framework	The framework assembles the benefits that can be achieved through the	ICT Usage Conversion Factors

			access and use of ICTs and the development of people's abilities to use their opportunities and provides the relationships between the different concepts within development.	Opportunities and Capabilities Personal Benefits ICT Skills Communal benefits
Capabilities (Sen) Framework	Sen, 1985	ICT4D Impact Assessment Framework	Provides a human development models that is opposed to focusing merely on economic factors. It uses this paradigm to show how ICTs can contribute to freedom and empowerment.	Capabilities (shaped by) Context Differences Values Opportunities Functioning (shaped by) Choice Freedoms Development Outcomes
Capable and convivial design (CCD) Framework	Johri and Pal, 2012	Design Framework	Framework that takes Sen's idea of capabilities and Illich's notion of conviviality to guide the design of contextually relevant and user empowering ICTs.	Accessibility easiness Ability for self-expression Ability to use personal energy creatively Ability to personalize the environment Ability to interact and form relationships with other people (relational interactivity) Opportunity to enrich the environment (ecological reciprocity)
Choice Framework	Kleine, 2010	Conceptual framework for holistic analysis	The Framework provides as a way of operationalising Amartya Sen's approach and illustrating the elements present within a systemic process of conceptualisation of development. The Framework provides a guiding tool to a systemic and holistic analysis.	Structure Agency Resources Degrees of empowerment Development outcomes
Citizen-centric Capacity Development (CCD) framework for ICT4D.	Thomas, Li and Oliveira, 2017	Design, Implementation and evaluation	The framework provides a guide for the design, implementation, and evaluation of ICT for education (ICTE) specifically for artifacts in Haiti. This framework was developed for ICT capacity building with a cognizance of resource constraints in areas of Haiti and evaluates elements that influence Haitian adults to use ICTE.	Design and implementation Societal Goals Knowledge Base Citizen, stakeholder interviews Analysis User requirements Low fidelity proto type Citizen walk through Capacity Development Evaluation Achievable ICT goals Theory Review Research Design Data Collection Data preparation and analysis Results interpretation
Design-Actuality Gaps Model	Heeks, 2002	Evaluation and prediction Model	The model is based on an assessment of the similarity between local actuality and system design and is	Information Technology Processes Objectives and values Staffing and skills

			referred to the design– actuality gap. This model provides a means of understanding IS failure in developing countries	Management systems and structures Other resources
Designing for the Emergence of Sociometrical Practices	Holeman and Barrett, 2017	Designing tools	This provides six overlying activities through which designers may guide the emergence of sociometrical practices so that designers can adapt to the emergence of contextual complexities.	Implementation and situated use of prototypes Experiencing practice breakdown, Identifying material back talk as a source of practice breakdown Accommodating material back talk Reconfiguring material artifacts or/and worker routines The ongoing performance of new practices.
Empowerment Framework	Alsop and Heinsohn , 2005	Evaluation Framework	Provides a way to utilise ICTs as useful tools in development through the process of empowerment. The framework connects agency with and opportunity structure and in return identifies the degree of empowerment an individual has to achieve in order to accomplish a specified development outcome. The degrees of empowerment include existence of choice use of choice and achievement of choice	Agency Opportunity Structure Degree of empowerment Development Outcomes
Model for Ethical community entry conduct and introducing the ICT4D artefact in deep rural communities in South Africa	Krauss, 2013	Model of a visual overview of community entry and ICT4D implementation guidelines	This model presents a guide for ethical community entry conduct in rural communities within South Africa.	Policy implementation in deep rural situations Ethical research practice and appropriate and culturally sensitivity of engagement Collaborative needs analysis Appropriate alignment with local leadership Analyse individual situations Form trust relationships community representatives Collaboration with community in introducing and understanding the ICT4D Examining possible contradicting values of project stakeholders and community The emancipation and empowerment of ICT4D stakeholders and community
Ethical practice in	Mthoko and	Theoretical framework of	The framework provides a means of assessing the	Collaboration and Participation

ICT4D framework	Pade-Khene, 2013	ethical practices	numerous development challenges faced by a country and then identifies how ICT4D can be utilised effectively. The framework views ICTs from an ethical perspective and provides understanding of the effects of integration ICTs in developing countries.	Engaging all stakeholders Fostering relationships with the community Developing awareness of ICTs Understand Socio-economic Context Understand the level of development taking place in an area and determine how appropriate technology will be for that area Determine available infrastructure in the community Cost and Benefits Stakeholder Interest
Extended framework to investigate ICT-led socio-economic development at community level	Ashraf <i>et al.</i> , 2017	Evaluation Framework	The Framework guides ICT-enabled intervention at the community level. Illustrates how ICTs can be a catalyst for the process of development and investigates how social constraints hinder the process.	ICT and its goal (as Input) Approaches to understand ICT-led socio-economic development: Expanded information value chain model Sen's notion of development as freedom Identifying obstacles to development Determine output/Impact
Extended information chain model	Heeks and Molla, 2009	Assessment and application Framework	Data is used in this model as input. The data is then processed through assessing its relevance. The assessed data is then applied to a specific decision. In this model, it is important to follow all the sequences of the information chain for ICT-related activities.	Data Information Knowledge Intelligence Imperative Utility Incentives and institutions Decision Action Result Resources Capabilities
Factors of importance for successful ICT4D projects.	Mozelius <i>et al.</i> , 2009	Planning and implementation Framework	This provides nine vital thematic aspects to consider in ICT4D projects planning and implementation.	Consider authentic local needs Local ownership Realistic limitations Competence network Communication strategy (An explicit and agreed upon plan for the monitoring communication) Planning horizon Documentation/measurable results Resources and sustainability Fun/Motivation
A framework for relating user requirements and systems requirements to context	Takavara sha, Hapanyengwi and Kabanda, 2017	Assessment Framework	A guiding approach towards the creation of context specific ICT4D usable by software developers and development practitioners. Provides a platform useful for investigating the context that is relevant to ICT4D	Assess Livelihood profiles Opportunity freedoms Context Context Specific User Requirements Context Specific Systems Requirements

			and provides a systematic approach that can guide investigation.	
Good Practice for ICT4D Implementation	Heeks, 2010	Implementation Framework	The good practice guidance is intended to guide three main aspects; 1.) Design: ensure design is appropriately aligned to local realities, 2.) Governance: utilising the strengths of various actors and 3.) Sustainability: considering everything from an economic and socio-political perspective.	Actors and Governance: Multi-stakeholder partnerships Open and competitive environment Aligned Design Techniques: Participation of local users Appropriate technology for local realities Align to local development goals Consideration of project risks Sustainable Projects: Financial and social sustainability Development of local capacities Local ownership
Livelihoods-based model for analyzing ICT applications for poverty reduction	Duncombe, 2006	Analytical tool	The model specifies how Information and thus ICTs encompass an analytical role in terms of how information can be utilised within applied research to assess vulnerability, identify and measure assets, and investigate structures and processes. The model also specifies how information and thus (ICTs) encompass a functional role by applying ICTs within livelihood strategies to ensure advantageous outcomes thus strengthening assets.	Analytical Role Contextual analysis of vulnerability Micro-level-individuals, families, households, or groups Determine the extent of vulnerability through analyses of trends, shocks, and seasonality of resource factors Determine Livelihood strengths or assets Livelihood structures and processes livelihood strategies and outcomes.  Functional Role Communicate information to those that can act upon it Ensure delivery of data by providing resources such as physical and social resources
Logic Model	Taylor-Powell, 2005	Conceptual, heuristic tool for planning phase	This model is a heuristic tool to assist in systematically describing the different components of a system within ICTs.	Goals and objectives Resources Activities Outputs Outcomes Impact
Operationalising the capability approach in the context of community ICT4D	Vaughan, 2011	Evaluation tool	This operationalize the capability approach as an evaluative tool. It focuses on enhancing social inclusion through active participation in the information and	Social inclusion Maximum participation in economic, social and community life Ability to access, adapt and create new knowledge using ICT

			network society enabled by ICT.	<ul style="list-style-type: none"> <li>Dimensions of participation</li> <li>Economy</li> <li>Education</li> <li>Public/Private space</li> <li>Culture</li> <li>Politics</li> <li>Citizenship and institutions</li> <li>Capabilities</li> <li>Opportunity to capture and preserve and access traditional knowledge for future generations</li> <li>Functions</li> <li>Maintaining traditional connections across generations</li> <li>Well-being</li> </ul>
Outcome and impact assessment framework for Rural ICT4D.	Mthoko and Khene, 2018	Outcome and Impact Assessment Framework	This framework consists of three main elements that guide the assessment of rural ICT4D programs. The key elements include the evaluation guidelines, the key themes of rural ICT4D outcome and impact assessment, and the preceding domains of evaluation	<ul style="list-style-type: none"> <li>Strategic value</li> <li>Measures what is being added in order to achieve community objectives, grow the project and to stimulate more development</li> <li>Most significant change</li> <li>Allows unexpected outcomes and impacts to emerge</li> <li>Empowerment</li> <li>Enhancing an individual's or group's capacity to make influential choices and to convert those choices into desired outputs.</li> <li>This capacity to make choices is influenced by agency and opportunity structure</li> <li>Livelihoods</li> <li>Livelihoods are the means of making a living and including food, income and assets</li> <li>Sustainability</li> <li>Sustainability aims contributed toward sustainable development</li> </ul>
Quantitative Scenario-Based Assessment of Contextual Factors	Talantsev <i>et al.</i> , 2014	Assessment framework	A model for common ICT4D contextual factors which is an undefined condition with either a positive or a negative effect on the desired results of the ICT4D initiative.	<ul style="list-style-type: none"> <li>Contextual factors</li> <li>Political</li> <li>Governmental/municipal support for ICT development</li> <li>Efficiency and Transparency of national/local governance</li> <li>ICT legislation maturity</li> <li>Economic</li> <li>Recipients disposable income</li> <li>Employment rate</li> <li>Affordability of ICT services</li> <li>Socio-cultural</li> <li>Recipients general education level</li> <li>Socio-cultural</li> </ul>

				<p>IT literacy of recipients</p> <p>Personal motivation of recipients</p> <p>Recipients cultural and ethical support</p> <p>Health Safety</p> <p>Technical</p> <p>Accessibility of ICT infrastructure</p> <p>Accessibility of public infrastructure</p> <p>Availability of skilled technical support</p>
Rural ICT Comprehensive Evaluation Framework (RICT-CEF)	Padekhene and Sewry, 2009	Evaluation Framework	The framework provides a means of understanding the impact of ICT4D projects in developing countries. It establishes the impact and effectiveness throughout the life of ICT4D projects in marginalized communities	<p>Baseline Study, Serves as a form of market research</p> <p>Needs Assessment</p> <p>Process Assessment, Assesses how well the project is operating to implement its intended functions</p> <p>Outcome and Impact Assessment</p> <p>Efficiency Assessment</p> <p>Assesses ICT intervention costs associated with project effects or impact</p> <p>Scalability Assessment</p> <p>Assesses whether a pilot ICT4D project should be scaled</p>
Rural ICT Project Process Assessment Framework (RICTP-PAF)	Osah, Padekhene and Foster, 2014	Assessment tool for implementation phase	A tool for assessing the implementation phase of a rural ICT project. It constitutes three elements, guiding principles for directing process assessments, critical themes of process assessment and methods and procedures for assessing critical themes	<p>Collaborative Evaluator/Stakeholder Relationship</p> <p>Programme Theory Specification</p> <p>Validate Assessment Questions</p> <p>Quality Control throughout</p> <p>Data Collection and Ethical Consideration</p> <p>Critical Themes of Process</p> <p>Service Utilization</p> <p>Organizational Function and External Project Factors</p>
Sein and Harindranath Conceptual framework	Sein and Harindranath, 2004	Conceptual framework	Provides a comprehensive view of ICT4D by combining concepts from the development and information systems literature	<p>Considers ICT through different Views</p> <p>A Tool</p> <p>Computational Ensemble</p> <p>Consider 3 orders of ICT Impact</p> <p>First order: substitution of old technology with new</p> <p>Second order: people are able to enhance whatever is allowed by technology</p> <p>Third order: Technology develops new structures, industries and behavior</p> <p>Considers ICT Use</p>

				As a commodity As supporting development As driver of the economy
Information Chain	Heeks, 1999	Process model	A model that illustrates how to turn raw data into usable information within a staged process consisting of 4 A's	Access Assess Apply (Adapt) Act
Rural ICT project development framework.	Mamba and Isabirye, 2015	Development Framework	The framework identifies key areas wherein ICT4D project failure occurs and provides a guide to project implementers to move away from these pitfalls.	Goal determination Planning for sustainability Appropriate Implementation
The unified ICTD evaluation framework	Pandey and Gupta, 2017	Impact Evaluation Framework	This framework considers the impact of ICTD interventions and considers other key aspects of project life cycle in the evaluation process.	Stage 1: needs assessment Goal assessment Capability assessment Identifying the development approach Stage 2: program theory Agency of intervention Design approach Innovation approach Stage 3: process evaluation Implement ability Sustainability Stage 4: impact evaluation Primary impact Secondary impact Tertiary impact
Virtuous spiral – Empowerment/Capabilities and Sustainable Livelihoods and ICT	Grunfeld, 2007	Conceptual model	Assessing if and how ICT is contributing to individuals capabilities. The model illustrates The expected outputs that will emerge when ICT4D projects are implemented with attention to human capabilities.	Basic ICT literacy skills Capability to innovate scarcity conditions Empowerment Establish project and obtain initial funding External linkages for education Obtain ongoing finding Partnerships Skills to maintain ICT infrastructure

## **Appendix C: Presenting Framework to Participants**

Appendix C includes the documents presented to participants when approached to take part in the interviews described in Chapter 6.

### **Appendix C.1: Application for Institutional Permission**

Before the participants were approached their institutions of employment were contacted. Application for institutional permission forms were sent to the institutional contact persons asking permission to interview specific employees. The form is depicted below.



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jou kennisvenoot • your knowledge partner

**APPLICATION LETTER FOR INSTITUTIONAL PERMISSION**

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**INSTITUTION NAME & ADDRESS:**

**INSTITUTION CONTACT PERSON:**

**INSTITUTION CONTACT NUMBER:**

**INSTITUTION EMAIL ADDRESS:**

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**TITLE OF RESEARCH PROJECT:** Towards a framework to guide the development of ICT4D: A South African Perspective

**ETHICS APPLICATION REFERENCE NUMBER:** ENG-2018-1234

**RESEARCHER:** Lauren Coetzee

**DEPT NAME & ADDRESS:** Department of Industrial Engineering, Stellenbosch University

**CONTACT NUMBER:** 072 204 1404

**EMAIL ADDRESS:** 16100107@sun.ac.za

Dear

Kindly note that I am a MEng student at the Department of Industrial Engineering at Stellenbosch University, and I would appreciate your assistance with one facet of my research project.

Please take some time to read the information presented in the following three points, which will explain the purpose of this letter as well as the purpose of my research project, and then feel free to contact me if you require any additional information. This research study has been approved by the Research Ethics Committee (REC) at Stellenbosch University and will be conducted according to accepted and applicable national and international ethical guidelines and principles.

**1. The purpose of the project:**

This study explores the potential of using Information Communication Technologies to bring about social-economic development. The purpose of this study is to develop a framework to guide Information System Developers in the development of Information Communication Technologies that will be used to address social and economic problems within a community

**2. Your assistance would be appreciated in the following regard:**

I require institutional permission from you to conduct an interview with yourself or another staff member(s). The information I require is not in the public domain and is qualitative in nature. I will require feedback regarding the conceptual framework that has been developed regarding ICT4D and its functioning. The feedback will validate whether the framework is realistic representation of what the institution has experienced practically as well as touching on areas that need to be revised and improved upon. The data gained during the interviews will be reviewed and implemented as required. The data will also be used in the further development, validation and verification of the framework.

### **3. Confidentiality:**

Please note that the findings of this study will report in the public domain and as a result, I require a permission letter from your institution that specifies that you are aware of this. If the institutional/organisational information or archival data/archives that is not in the public domain needs to be kept confidential please specify this. The data obtained from the interview will be password protected online and will only be accessible by the principal investigator and the supervisors. The data from the interviews will be stored online in a Dropbox folder which is password protected. The confidentiality and terms of engagement as well as the company confidentiality will be discussed prior to the interviews between all parties. Participants will be anonymised throughout the study documentation. No personal information of any participant will be disclosed. Each participant will be given an identification code to ensure anonymity. Interviewee direct quotes will only be used in the thesis document with the complete permission of the interviewee.

If you have any further questions or concerns about the research, please feel free to contact me via email ([16100107@sun.ac.za](mailto:16100107@sun.ac.za)) or telephonically (072 204 1404 ). Alternatively, feel free to contact one of my supervisors, Prof Saartjie Grobbelaar, via email ([ssgrobbelaar@sun.ac.za](mailto:ssgrobbelaar@sun.ac.za)) or Wouter Bam, via email ([wouterb@sun.ac.za](mailto:wouterb@sun.ac.za)).

Thank you in advance for your assistance in this regard.

Kind regards,  
Lauren Coetzee  
Principal Investigator

### ***Figure A.7: Application for Institutional Permission***

## **Appendix D: Introduction to Interviews**

The following Research Protocol Document was sent to the Participants, explaining the framework and depicting the questions that will be asked in the three phases of the interview procedure.

Dear Participant

Thank you for volunteering to participate in this interview which will form part of the research towards my master's degree in Engineering Management at the University of Stellenbosch. The title of my research project is "Towards a framework for the development of ICT4D: A South African Perspective".

The framework provides a set of requirements that are intended to guide developers in the design and development of Information Communication Technology for Development (ICT4D). The semi-structured interviews will be used to equip the researcher with practical insight from the ICT4D field. These will be used to make improvements to the framework and provide validation on the completeness and usability of the framework.

The semi-structured interviews consist of three phases.

The first phase forms the basis of the interviews and opens up discussions pertaining to the validity of the framework as a whole. The first phase consists of asking the participant 10, mostly open-ended questions. The list of questions is included in this document on page 2, and a copy of the framework is also attached starting on page 6. This serves to familiarize participants with the questions that will be asked in the semi-structured interviews and the framework which will be under analysis. It would assist the process if these questions and the framework could be reviewed before the interview commences.

The second phase of the interview process involves the participants filling in or answering in person, the questionnaire (table 2) starting on page 3. Participants are asked to comment on each activity within the framework and provide additions and modifications to each activity.

The third phase aims to establish priority amongst the activities mentioned within each phase of the framework. These questions ask the participants to rank how applicable and relevant each of the activities are. A ranking scale is provided in Phase 3.

The proof of institutional permission for conducting interviews for the research project is also attached. There is no obligation to answer any of the questions presented in the interview and if you feel uncomfortable with any questions, you may feel free to stop the interview at any time. Questions are also welcomed during the duration of the interview. The interview will be recorded for the purpose of referring back to the information. The researcher will type out the completed interview and the document will be sent to the participant to ensure that all the information is correct and appropriate for use. The participants' personal information, such as names will be kept anonymous.

Thank you again for participating in this interview and for providing insight and feedback on ICT4D in order to validate the framework.

### ***Figure A.8 Introduction to Interview Procedures***

## Appendix D.1: Phase 1

### Phase 1 of interview procedures

The following probing questions form the basis of the interview schedule:

1. In your opinion is it necessary for an Analysis and Design Framework for the Development of ICT4D in South Africa
2. Have you experienced any difficulty in specifically the design and analysis phases of system development within the field of ICT4D?
3. Does the framework address any of these challenges?
4. Is this framework appropriate for the Analysis and Design of ICT4D in South Africa?
5. Is the structure logical?
6. Is the structure of the framework appropriate to accomplish the goal of providing a guide for developers to develop ICT4D in South Africa?
7. Do you agree that many ICT4D project failures occur within rural and developing settings within South Africa? (By ICTD failure it is implied that the implemented ICT4D did not achieve the goals and objectives it was developed to achieve) If you do agree what are the reasons for most ICT4D failure?
8. Do you make use of any specific guides/tools to design and develop ICT4Ds?
9. What changes or improvements would you make to the framework. Please explain.
10. Are there any other comments you think are useful to bring up?

*Figure A.9: Questions in Phase 1 of Interviews*

## Appendix D.2: Phase 2

The following table was presented to participants within phase wo of the interview procedures

	Activities	Additions to activity and its procedures	Modifications to activity and its procedures
<b>Analytical Phase</b>	Community entry phase		
	Analyse socio-economic context		
	Identify authentic local needs		
	Determine conversational factors		
	Determine program theory		
	Determine opportunities and project risks		
	Define goals , objectives and targets		
	Define context specific user requirements		
	Define context specific system requirements		
	Define resources inputs		
	Define intended and expected outputs		
	Define impact		

Design Phase	Design of Appropriate Technology	Design Technology for Accessibility easiness		
		Design for Ability to adapt technology		
		Design Technology to Allow Expressive creativity		
		Design Technology for High output		
		Design Technology so that it is Understandable to local people		
		Encourage Local Ownership of technology		
		Allow relational interactivity within use of technology		
		Design Technology for Ecological reciprocity		
	Design System	Process Design		
Functional Phase	Capacity building			
	Emancipation			
	Trust formation			

**Figure A.10: Questions within Phase 2 of Interviews**

## Appendix E: Interview Feedback

The responses received from participants during the interview process is depicted below.

### Appendix E.1: Interview Feedback Phase 1

The interview questions form phase 1 and the answers from the 10 participants are depicted in the table below

**Table A2: Question 1 Responses**

		Question 1	
		In your opinion is it necessary for an Analysis and Design Framework for the Development of ICT4D in South Africa?	Themes Identified
		Yes	*Validation for the necessity of an ICT4D framework
Interviewee	1	Yes, it is needed from the purpose of an economic analysis and to make sure that the influence of the system has been magnified to the maximum possible extent. In other words, such a framework is needed to ensure maximum return for investment. It is important to analyse the scope of the system that you are designing to make sure there is a balance between the focus on the technology component of a project or the human development component of a project. The system in focus should be the system that I call the system that "owns the problem". For instance, in the case of education it would be the department of provincial education that owns the problem of any ICT4D based intervention that is focused on schools. In my opinion frameworks have been designed mostly on the level of projects. The frameworks can focus on projects if it acknowledges the system that owns the problem. Therefore, it must consider the important actors in the system.	*Validation- focus on technology component and human development component *Consider all actors within the system
	2	Yes, it would be valuable	*Validation for the necessity of an ICT4D framework
	3	Yes	*Validation for the necessity of an ICT4D framework *Validation for the necessity of an ICT4D framework
	4	Yes, there is very little support and knowledge around the development of ICT4D in South Africa therefore an Analysis and Design Framework would be immensely supportive to established and growing businesses	*Validation for the necessity of an ICT4D framework
	5	Yes	*Validation for the necessity of an ICT4D framework
	6	Yes, especially in the healthcare sector, where my experience lies. There is an immersive lack of healthcare workers in the healthcare industry. The appointment and training of more manpower is mostly not possible due to the lack of resources within our government and thus an alternative must be found to meet this need. It is here where we need to utilize technology to bridge this gap. Frameworks such as these are very important to provide a guide to utilise technology in	*Validation for the necessity of an ICT4D framework

		order to address these shortfalls. I think your framework is spot on for addressing these needs and is therefore is very needed	
	7	Yes	*Validation for the necessity of an ICT4D framework
	8	Yes	*Validation for the necessity of an ICT4D framework
	9	Yes	*Validation for the necessity of an ICT4D framework
	10	Yes, that could have value	*Validation for the necessity of an ICT4D framework

**Question 2**

**Table A:3 Question 2 Responses**

		Question 2	Themes
		Have you experienced any difficulty in specifically the design and analysis phases of system development within the field of ICT4D?	
		In my experience in this field there are a lot of passionate people who come together to solve problems but there is not necessarily a structured process that is being followed. This is due to the nature of the diverse stakeholders who come together in these projects along with the complexity of the communities in which these ICTs are being developed. Compare this to commercial ICT development projects, where there is more agreement amongst stakeholders regarding goal and success definition. There is therefore often no clarity regarding the ultimate goals and the definition of the success of the projects which is shared amongst stakeholders within ICT4D projects. Therefore, there exists a lack in agreement regarding goal clarity and expected impact. In IT development there are clear procedures being followed but in development initiatives it does not seem as if there is much structure to solving the problems.	*Validation-Need for more structured approaches *Need for goal clarity
Interviewee	1	The lack of the capacity in the system to continue of follow up training of the teachers. Therefore, teachers are not trained to teach the next 'generation' to use the ICT. There is not enough focus on training and adoption, developing the capacity of users and teachers. About 80% must be invested in skills and training (capacity building) and only 20% in the technology itself. At present most in most ICT4D projects there is 99% investment in the technology and as a afterthought 1 % of training. Capacity building needs to be focused on more. Capacity building is essential for sustainability. There needs to be two phases, the first phase works with a more resource rich environment, where stakeholders are directly involved. The second phase the (where project developers usually leave) sustainability needs to be ensured and therefore capacity building is crucial for this stage. There have been several attempts at creating frameworks by groups coming together and saying, lets break the monopoly of the commercial Telekom providers by going open source and establishing our own community owned networks and figuring out ways of doing. So, there are frameworks which says lets re-think the whole commercialization of telecom monopolies'. There has also been a lot of work on sustainability frameworks which look at maintaining expensive IT equipment and devices like mobile phones	*Need for capacity building *Over focus on technology and not enough on capacity building

2	Yes, the client doesn't necessarily know what they want. Getting the right project champion is usually also a big problem	*Need for-Identifying needs correctly *Identifying a project champion
3	Yes – it is common for some project planners to omit phases - particularly the exploration phase and even to plan project components without consulting stakeholders.	*Need for the exploration phase
4	Yes, a lot of difficulties have been experienced in these phases. The biggest challenge in our experience was being agile and adaptable in your approach. In our experience there was no examples to follow in the industry we were in, we had to make new ground, we had to innovate and test things. Therefore, we had to learn as we went along. We had to learn from similar projects and take the best pieces from these projects and consider this in our projects. (Knowledge share)	*A need to be agile and adaptable in the development *Need for knowledge share
5	Yes. Drawing interest is usually a problem with any type of development of ICT. ICTs developed for business are much readily adopted as the employees must use the technology, but in a community context where ICTs are developed for a community, they must decide to use it. Therefore, community needs to be interested in it, be attractive and very simple to use, this is automatically a factor to being interested in the technology. Therefore, a lot of these technologies get developed and not being used due to no need or interest for the technology. The challenge is developing an ICT relevant to the community and which attractive to the community	*Need to develop ICTs which communities are attracted to and interested in
6	In my experience and research one the most important thing is to design for sustainability and scalability and there are very few of these projects which are truly sustainable and scalable. This is evident in projects where the funding dries up after implementation. The second thing there is a lack of knowledge in the design and analysis phase. Third, equipping the community is lacking. Fourth, there often is no development plan and fifth the local needs of the communities are not truly being identified. Therefore, you need to focus on skills development and making community aware of the technology. You need to look at, how to incorporate things that can address these issues early on.	*Design for scalability *Need for knowledge share *Need for capacity building *Need for identification of local authentic needs
7	From experience when working with clients in unknown fields especially it becomes challenging. The reason being, for you to develop a system that caters for the specific need, you need a knowledge dump. The client thinks they know what they want, but in my experience, a client has never known what they wanted once development starts. There are always hundreds of changes along the road. As a software consultation and development company, it is difficult for us to design a solution that is efficient and meet all the requirements if we do not understand the field and the process included in the domain. Even for inhouse projects where we have knowledge in the field, it's difficult to cater for the end user if they are not technically inclined	*Need for a in depth understanding of the context
8	In my experience, with ICT development for business, when you design a system you design according to a standard, where a specific level of sophistication of the system needs to be attained. It's It is therefore much easier to develop such system which environments are much more isolated and their requirements much easier to identify. Developing for community involves developing a system in a very volatile environment. There is no general spec and thus much more unknowns exist. The difficulty is understanding the local needs and designing technology appropriate to the community and to not develop technology that is too far advanced	*Need for an ICT4D framework
9	Yes	
10	Yes, in prioritizing requirements and constraints and in keeping the 'big picture' in mind.	

**Table A4: Question 3 Responses**

		Question 3	
		Does the framework address any of these challenges?	
Interviewee	1	Yes and no. Fundamentally the framework addresses these challenges. The structure is very logic and engineering like but in the logic, there is some factors missing and it is highlighted mostly by the terminology you use.	*Need for terminology appropriate for development approached
	2	Yes	*Validation for usefulness of ICT4D
	3	Yes, the framework encourages participation within the development. Identifying the needs which the community themselves have highlighted is central to your framework. This is highlighted by the concept- identifying authentic local needs and the co-creation phase, which is seldomly used. The co-creation phase shows that the community champions are being utilized so that the appropriate needs are identified and in return the appropriate system is developed. It is good that you specify- Encouraging local ownership in your co-creation phase already. Many times, ownership is only given over to the community after implementation and this can open space for design of the system that is not truly sustainable. If local ownership can be encouraged from an early stage the design of the system can so be adapted from an early stage to ensure true sustainability.	*Validation for usefulness of ICT4D *Validation-participation *Validation-identifying local needs *Validation-Co-creation phase *Validation-encourage local ownership
	4	Yes	*Validation for the usefulness of the framework
	5	Yes, it does. If someone had to use this the learning curve would be much quicker and the process would be much more cost effective, especially for new companies. New companies often do not have this type of skill sets in house and they must source from outside. But sourcing people who have this knowledge costs money. I think it would make the entire process from ideation to a product or service much more efficient and less costly	*Validation for the usefulness of the framework
	6	The framework addresses many challenges. We can discuss it as we go and look at each concept	*Validation for the usefulness of the framework
	7	The framework does address many of these challenges, especially things like encouraging local ownership. I do think you can also look at concepts such as, measuring impact, and defining what the parameters of success are. This will validate weather the money being spent on this project is more valuable than investing it in other projects. It is very difficult to measure impact and thus could be useful to look at more within the framework. The concepts within the framework such as co-creation (which focuses on participatory design) does address this to some extent. But the key is to follow those iterative design steps, to design and redesign and then to continually present the design to the community. The more cycles are followed within this iterative design approach, the greater becomes the probability of success. Another factor addressed within the framework is identifying the local needs of the community. Many times, incorrect assumptions are made in identifying these needs. Your community entry phase is practically investigating the current context within the community so that you can develop appropriate technology.	*Validation for the usefulness of the framework *Validation-encouraging local ownership *Look at Measuring impact *Validation-iterative approach *Validation-identify authentic local needs *Validation-design appropriate technology
	8	Yes, I like the way the goals, objectives and targets are laid out. I feel it helps a bit with the knowledge gap from the company side. The approach you use creates a solution only after you understand the problem properly, which is good.	*Validation for the usefulness of the framework

			*Validation-exploration phase
	9	Yes, it considers the needs of the community and focuses on appropriate technology which ensures these challenges are addressed	*Validation for the usefulness of the framework *Validation-design appropriate technology
	10	Yes, it is helpful in providing an overview.	*Validation for the usefulness of the framework *Validation-design

**Table A5: Question 4 Responses**

Question 4			
		Is this framework appropriate for the Analysis and Design of ICT4D in South Africa?	Themes
Interviewee	1	Yes, as it includes most of the necessary concepts there is however need for some other considerations	*Validation for the usefulness of the framework
	2	Yes	*Validation for the usefulness of the framework
	3	Yes	*Validation for the usefulness of the framework
	4	Yes	*Validation for the usefulness of the framework
	5	Yes	*Validation for the usefulness of the framework
	6	Yes	*Validation for the usefulness of the framework
	7	Yes	*Validation for the usefulness of the framework
	8	Yes	*Validation for the usefulness of the framework
	9	Yes	*Validation for the usefulness of the framework
	10	Yes	*Validation for the usefulness of the framework

**Table A.6: Question 5 Responses**

Question 5			
		Is the structure logical?	Themes
Interviewee	1	Yes very logical. But it may appear to logical to many researchers in this field. In many of these type of community projects there are a group of people who do not agree with structured processes at all. This feeling stems from the philosophical debate where researchers argue that these type of development projects evolves as the community participates and cannot be defined in the beginning of a project. As I mentioned I believe there is a massive lack in structure as many of these projects end up being very unorganized, thus the question is how to make these processes more relatable and digestible to the group of people in this field who believe strongly in an evolving process.	*Validation for the usefulness of the framework *Provide more flexibility
	2	Yes. The fact that you start with the exploration phase shows that you are seeking a sustainable solution and calibrating	*Validation for the usefulness of the framework

	your intervention with what is possible. The Co-creation phase is also very important as the next step, but I would modify the framework so that the enablement phase occurs within your exploration phase. The iterative process you depicted within the framework makes sense and is very important. To make it clearer you can map the process over time to indicate the effect of the iterative process, see explanation in question 6.	*Change structure-enablement run parallel to exploration *Mapping process over time to make more clear iterative effect *Validation for exploration phase *Validation-Co-Creation phase *Validation-Iterative approach
3	Yes, it makes sense to me the steps I am following especially the 3 overarching steps make sense to me	*Validation for exploration phase *Validation-Co-Creation phase *Validation-Enablement phase
4	Yes	*Validation for the usefulness of the framework
5	It's difficult to comment on it as I have not specifically used it. Once you start using a tool do you only really figure out what is missing. From an outsider's perspective it does seem logical. One thing I do see, when it comes to technology, one must think of being agile, flexible, shorter connections of communication and shorter sprints. What I have also seen in these types of projects is that developers basically just design a functionality which they can tick off, so they never really change their root based on new information coming into the scope. Even though many people do follow an agile development approach, they stretch one cycle out too long and then they do not really have a service or product that appropriately addresses the needs. They were never truly agile as they were never willing to pivot and make changes to what they were focusing on. Therefore, it is important to constantly monitor, review and evaluate whether change is needed. If you follow the iterative approach on a smaller scale and continually monitor and evaluate and continually make a merited decision about the step forward. You need to keep on improving. The fact that you have iteratively included going through the concept of defining goals and objectives, also holds merit and allows the developers to be truly flexible and adaptive.	*Structure more flexible through shorter sprints *Constantly monitor, review and evaluate *Validation iterative approach
6	Yes, in the business sector we also use this flow for the process of developing IT systems, this process is therefore very similar to system development approach used in the business/private sector. The iterative approach is what is essential in our design approaches, and to continually gather more detailed information regarding the project, to go through cycles more than once is NB	*Validation iterative approach *Structure more flexible through shorter sprints
7	Yes, it is logical, it is easy to understand. The steps follow on logically.	*Validation for the usefulness of the framework
8	It is definitely logical.	*Validation for the usefulness of the framework
9	Yes very logical and step by step. Each step prepares you for the next step. As a developer I could easily follow the flow of the framework. The solution will be much easier to see with aid of this framework	*Validation for the usefulness of the framework
10	Yes	*Validation for the usefulness of the framework

**Table A.7: Question 6 Responses**

Question 6
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	Is the structure of the framework appropriate to accomplish the goal of providing a guide for developers to develop ICT4D in South Africa?	Themes	
Interviewee	1	Yes	*Validation for the usefulness of the framework
	2	Yes	*Validation for the usefulness of the framework
	3	Yes, I think the steps explained in each phase will add value to the process of developing a system. It encourages developers to discover more than the specs but encourages them to include the community in every step. I think it's a very extensive list of concepts to include in each phase which will definitely aid developers.	*Validation for the usefulness of the framework
	4	Yes	*Validation for the usefulness of the framework
	5	I would say it is appropriate for SA. There are entities who believe SA is a fantastic entrepreneurial and business growing environment, therefore ICT4D projects would be appropriate as we are a growing economy. You should be looking at SAs mean population age because that's where our future lies for innovators, if we do not have such structures in place is going to have a long-term impact on all types of innovation and industries and the economy. It is appropriate and necessary for SA, but it also depends on how it is embraced by the individuals. A framework like this could be a bridge between someone who has domain expertise and someone who has technical expertise or technical development skills. It can therefore allow the one entity to move into the world of the other and vica versa. So, a framework like this, if its appropriately managed and adopted could be a very good framework to bridge this gap. Bridging this gap, I believe holds the potential for more efficient and cost-effective solutions.	*Validation for the usefulness of the framework *Appropriate framework to bridge the gap between those with technical expertise and domain expertise *Need for ICT4D framework
	6		
	7	Yes definitely. In most such projects within SA, local authentic needs are not being identified, the donor is being considered above than community and your framework addresses these issues and focuses on sustainability. These factors can be a large reason for project failure if they are not addressed	*Validation for the usefulness of the framework *Validation-identify authentic local needs
	8	It is a very specific framework and very extensive. In practice time and money is the issue thus most solutions involve developing something simple, and then getting feedback from the users and re-designing. In most of our projects the needs identification is specified by the client and the exploration phase will not be so extensive.	*Shorter less extensive sprints
	9	Yes, it bridges the gap between the developers and the community very well	*Validation for the usefulness of the framework
	10	The goal is ambitious since there are many different projects, but the structure is good in providing a point of departure	*Validation for the usefulness of the framework

**Question 7**

**Table A.8: Question 7 Responses**

Question 7			
	Do you agree that many ICT4D project failures occur within rural and developing settings within South Africa? If you do agree what are the reasons for most ICT4D failure?	Themes	
Interviewee	1	Yes. A big reason is poor design or lack in design and poor understanding of the context of the community and resource rich solutions are developed in resource poor environments. In IT development there are clear procedures being followed but in	*Factors that need to be addressed in ICT4D frameworks

	development initiatives it does not seem as if there is much structure to solving the problems. A lack in goal clarity is another big reason.	*A design plan with clear procedures needs to be followed *Appropriate resource solutions for poor resource environments *Goal clarity amongst stake-holders
2	Yes we have discussed this within the previous questions	
3	Yes, one of the major reasons for failure is the fact that the identification of the goals by the developer is not in line with the local authentic needs of the community. Many failures also occur due to drop and go solutions. Most of these solutions require intensive change management. You implement a type of change management through your enablement phase, where you focus on capacity building before implementation, ensuring the community is equipped and that you form relationships. It is however very important to monitor this after implementation and to maintain these relationships so that you can address the issues that arise after implementation and to ensure the community stays equipped, so that the system stays within a sustainable environment.	*Factors that need to be addressed in ICT4D frameworks *Goal identification needs to be in line with community needs *Solutions require intensive change management *Monitor after implementation and maintain relationships (not in my scope) *Validation enablement phase
4	Yes – many implementers do not make enough effort to familiarize themselves with either their targeted beneficiaries nor the details of their needs.	*Validation-exploration phase
5	I can't speak to actual statistics but in my opinion, I do think there are a lot of failures. The reason I am saying this is because if you look at the successes they are very few and far between. Big reason is that there is not yet that community drive within ICT4D projects. What you see are many incubators driving these projects, but they mostly focus on events. They do this for sponsors, but they aren't truly following through with the community and teaching them skills or creating real opportunities to make sure there is sustainable opportunities. There is a need for more of a community and mentor driven approach. This involves investing into people and not merely investing money. This requires follow through by nurturing the community and focusing on their interests and needs. The real success of such projects is therefore sustainability and not really a lack of opportunities or events.	*Factors that need to be addressed in ICT4D frameworks *Need for community drive (community or mentor driven approach) *Need for capacity building and creating sustainable opportunities *Identifying authentic local needs
6	Yes, as mentioned in the other responses	
7	I can only speak from experience in the health sector. Here a major factor for failure is sustainable funding, where the donor's money dries up after implementation. Another factor is that many companies do not have access to such frameworks and the companies that do have access to such frameworks are not sharing their experience with other companies. There is therefore a big need for knowledge sharing within this sector. If there was more knowledge sharing and collaboration between companies, the wheel would not have to be re-invented each time and the same mistakes would not continually have to be made. Local authentic needs are usually also not being identified as the donor is being considered above than community and thus as, mentioned hinders sustainability and adoption.	*Factors that need to be addressed in ICT4D frameworks *Need for sustainable funding *Need for knowledge share *Need to identify authentic local needs
8	Ye from my experience failure occurs due to poor needs assessments, where too many assumptions are made regarding rural areas. Understanding the local context is very important as developers usually do not come from the same areas they are developing for and thus might miss obvious needs of the community. A one size fits all solution does not apply for such projects. Basic infrastructure is not even in place in most rural	*Factors that need to be addressed in ICT4D frameworks *Need to identify authentic local needs *Need to understand local context

	areas and this changes your design dynamics extremely. Project risks or hinderances can also be missed through poor needs assessments and cause failure, for example crime in an area can destroy your project or even putting people in danger by using the technology needs to be considered	*Need for accurate identification of project risks
9	Many times, government or NGOs enter communities and introduce technology that is too far advanced. Introducing technology that is appropriate to the local context is very important. Introduce technology that may even seem “outdated” but this will be more relatable to the locals and will ensure greater probability for adoption of the technology. Taking a community one step forward instead of trying to bring them to your technology level is important. Introduce technology that is more effective than what is available within the community but does not have to be high output higher end technology. Rather introduce a minimum viable product and equip the community to use and improve on it. This will ensure for sustainability. This framework emphasises developing appropriate technology and encourages local ownership. This s ensures self-sustainability of the technology which is so important.	*Need to identify authentic local needs *Design technology appropriate t local context *Need enabling local ownership *Need for capacity building
10	Yes as explained in question 2	

**Table A.9: Question 8 Responses**

Question 8			
	Do you make use of any specific guides/tools to design and develop ICT4Ds?	Themes	
Interviewee	1	No not specific tools but I have made use of things such a s decision and cost models but not specific analysis and design tools as specific as this. There will never be a single tool you need a package of tools. Frameworks are scarce in this field. And generic frameworks are also scarce, but they are important, there is a generic direction needed therefore make sure you highlight the fact that each concept is a guide and needs to be considered but not necessarily applied, this will give you a definite generic guide	*Need for ICT4D framework *Need for a package of tools
	2	Not exactly like this one, but similar	
	3	Not necessarily a structured guide. We usually start with a workshop to determine the needs of the community together with the client. We then design the product on paper. We then meet with the client again and introduce the product to get feedback. Once feedback is given the minimum most viable product is built, it's not completely functional and it won't completely solve the problem. It's to be used by the client/community to get final feedback and therefore we use an iterative (agile) collaborative design model.	*Need to identify authentic local needs *Need for ICT4D framework *Include field testing
	4	Yes – we have always followed an implementation strategy and a framework for professional development (the national Department of Education has recently (2017) published a Professional Development Framework for Digital Learning – this folder includes the framework and the supporting documents and links to apps: <a href="http://bit.ly/DBEFramework">http://bit.ly/DBEFramework</a> ).	*In house framework, need for collaboration
	5	We do not follow a set ICT4D framework but something like it, more specific to our business.	
	6	There are tools to create workflows in the business sector, but I don't know anything specific to the ICT4D field. We would adapt our work flows used in the commercial sphere, if we use a work flow diagram, we would adapt it being more sensitive to resource inputs and community needs.	*Need for ICT4D framework
	7	I have only developed similar such a thing in research but not practically used one	
	8	Nothing other than the standard IT development guides. We usually only work with the design guides available within the platform we are working on	*Need for ICT4D framework
	9	The process used to develop ICTs for impoverished communities involved a lot of background research, a specific tool was not used. A systematic	*Need for ICT4D framework

	business model is usually adapted for the project. These models are usually adapted to focus more on community engagement. The feedback loop was at the core of the development process. Therefore, continually engaging and bouncing everything of with the community.	
10	There are many guidelines, but those depend on the domain (e.g. health) and the technology (e.g. mobile phones).	

**Table A.10: Question 10 Responses**

		Question 10	
		Are there any other comments you think are useful to bring up?	Themes
Interviewee	1	<p>Readiness needs to be addresses within the beginning phases already and not later in the functional phase, I suggest making the functional phase run parallel with all the other phases, as ensuring readiness is a process that occurs throughout the development process. Therefore, change structure so that enablement phase runs parallel to whole process.</p> <p>As mentioned, look at terminology. Change words such as analyse to explore. Change functional phase to enablement phase (its less scientific and explains exactly what is happening in the phase. Creation phase does not highlight participation and suggests the developers are removed from the community, therefore to highlight co-creation, change design phase to co-creation phase. Let go of your structure somewhat but not completely, therefore introduce more flexibility.</p>	<p>*Chane structure, so that functional phase runs parallel with other phases</p> <p>*Change to more appropriate terminology</p> <p>*Introduce more flexibility</p>
	2	<p>Sustainability is crucial in these projects and thus when designing ensure the community can carry the project forward. Sustainability must lie within the community and not externally. You need to decide between a champions approach (representative from the community) or a participatory design where the community is involved in the design phase (broad based participation)</p> <p>You can include a diagram illustrating the iterative process of this framework and on the one axis depict the number of iterations over time and on the other axis, depict the level of mutual understanding. Then showing how your level of understanding increases with each iterative process (this will highlight the importance of the iterative process).</p> <p>On another diagram you can have the iteration number on one axis and risk of failure decreasing as the number of iterations increases. The iterative process is important for developing a high level of mutual understanding sustainable plan and in return you are reducing risk and improving the quality of the plan.</p>	<p>*Need to choose between champions approach vs broad based participation</p> <p>*Depict iterative approach on axis to illustrate mutual understanding and risk of failure</p>
	3	No	
	4	No	
	5	No	
	6	No	
	7	<p>One thing which I think could make your framework very valuable is making such a framework available to a company. The guiding questions within your framework make it possible for companies to document what works and what does not within the framework. The framework can then be passed on to the next company and through this type of knowledge sharing you can create an environment with knowledge sharing within ICT4D. Therefore, the projects I have been involved in, which have been successful have tapped into this concept of knowledge sharing, even before the exploration phase started. To find out what has been done, what works and what does not work. Measuring impact could be beyond your scope but consider this as it is important for sustainable development. Even looking at how a country such as south Africa can put policies in place that</p>	<p>*Include knowledge share</p> <p>*Include measuring impact</p> <p>*Include policy development</p>

		encourages and creates a favourable environment for implementation of ICT4D projects.	
8	No		
9	No		
10	Is this framework based on existing literature? If so, some credit is due. What about resilience? Consider the work of Dr Mario Marais from the CSIR on sustainability and resilience – he also provides guiding frameworks.		*Resilience