The use and effectiveness of system development methodologies during the development of community based systems in South Africa

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Promoter: Prof HM Huisman

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DECLARATION

I, Ntombovuyo Wayi, declare that the study entitled "**The use and effectiveness of System Development Methodologies during the development of community based systems in South Africa"** which I herewith submit to the North-West University Potchefstroom Campus, in compliance with the requirements set for the **Doctor of Philosophy in Computer Science** degree, is my own work, has been language edited and has not already been submitted to any other university.

I understand and accept that the copies that are submitted for examination are the property of the University.

N. Wayi

DATE:

03 December 2013

DEDICATION:

This work is dedicated to:

My parents: my father, Gxalaba and my late mother, Nokamer Wayi;

My elder sister, Lindelwa Waai, for all you've been to me and our siblings;

The community of Elunyaweni village (my place of birth), at large;

and

My family: *the Mweli clan*: ooSibakhulu, ooJili, ooMasengwa.

"*For now it might be the first, let it be a seed for more to come*"

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If the Lord almighty had not been on my side, this would have not been possible. I only achieved this through God's unmerited favour.

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ABBREVIATIONS USED IN THE STUDY

AFD	Activity Flow Diagram
ANC	African National Congress
APP	Reference to Appendices
ASAP	Accelerated SAP
BEE	Black Economic Empowerment
C1	A reference to Case Study 1
C2	A reference to Case Study 2
C3	A reference to Case Study 3
CAQDAS	Computer-Aided Qualitative Data Analysis Soft
CIDA	Canadian International Development Agency
CIS	Community Information Systems
COFISA	Cooperation Framework on Innovation Systems between Finland and South Africa
CPUT	Cape Peninsula University of Technology
CSIR	Council for Scientific and Industrial Research
DFD	Data Flow Diagrams
DSDM	Dynamics System Development Method
ENOLL	European Network of Living Labs
EPWO	Expanded Public Works programme
ETHICS	Effective Technical and Human Implementation of. Computer Based Systems
GCIS	Government Communication and Information Systems
GDP	Gross Domestic Product
GEAR	Growth, Employment and Redistribution
GTM	Grounded Theory Method
GNP	Gross National Product
HDI	Human Development Index
HU	Hermeneutic Unit
ICT	Information and Communication Technology
ICT4D	Information and Communication Technologies for Development
ITU	International Telecommunications Union
IVRP	Information Village Research Project
Ledet	Limpopo Economic Development, Environment and Tourism
LimDev	Limpopo Development Enterprise
LLiSA	Living Labs in Southern Africa

MDG	Millennium Development Goals
MHTF	Muldersdrift Home Trust Foundation
MPCC	Multi-purpose Community Centres
NATO	North Atlantic Treaty Organization
NDO	Non-Governmental Organisations
OO	Object-Oriented
OOA	Object-Oriented Analysis
PD	Primary Document
PiT	Public information Terminal
RAD	Rapid Application Development
RDP	Reconstruction and Development Programme
Rlabs	Reconstructed Living Labs
RUP	Rational Unified Process
SAFIPA	South African - Finland Knowledge Partnership on ICT
SAITIS	South African IT Industry Strategy
SDLC	System Development Life Cycle
SDM	System Development Methodology
SEIDET	Siyabuswa Educational Improvement and Development Trust
SITA	State Information Technology Agency
SLL	Siyakhula Living Lab
SSADM	Structured System Analysis and Design Methodology
SSM	Soft Systems Methodology
STATSSA	Statistics South Africa (National department)
STRADIS	Structured Analysis and Design of Information Systems
SWEBOK	Software Engineering book of knowledge
TBVC	Transkei, Bophuthatswana, Venda and Ciskei
TOE	Technology-Organisation-Environment
TOC	Telkom Centre of Excellence
UML	Unified Modelling Language
UNDP	United Nations Development
USA	Universal Service Agency
USAASA	Universal Service and Access Agency of South Africa
YSM	Yourdon Systems Method

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

For the past few decades researchers, development agencies and government have focussed on the use of Information and Communication Technologies to improve the socio-economic status of people in underdeveloped rural communities. In recent years there has been remarkable recognition of the importance of developing systems that address the specific needs of rural communities. Education, health, commerce, government and agriculture are amongst the needs of rural communities that could well be addressed by these systems.

System development is a complex process and studies have shown that if poorly conducted, the process could lead to the failure of the system being developed. Due to differences in context and application, the processes followed in the development of the rural community systems need to differ from those of commercial applications. One such difference is the choice of the Information System Development Methodology (SDM) used.

Following a methodical approach to Information Systems development is important as it improves discipline, standardization and monitoring of a quality system. There are hundreds of SDM available for use during development and choosing the wrong SDM has been linked to problems such as systems being delivered late, being over budget or not meeting the needs of the users. Developing systems for disadvantaged communities is different from developing system for organisations or even affluent communities. Some of the challenges that developers encounter include lack of structure, poor computer literacy, and poor infrastructure.

Lack of user involvement during system development has been linked to system failures. A Living Labs approach to socio-economic development is aimed at involving multiple stakeholders towards improving the living standards. Developing Community Information Systems aimed at solving varying community problems is one of the objectives of the Living Labs. There are only few CISs that are fully operational from South African Living Labs, and a number of systems developed are not in use. Poor user involvement and lack of use of system development are some of the reasons for system failures.

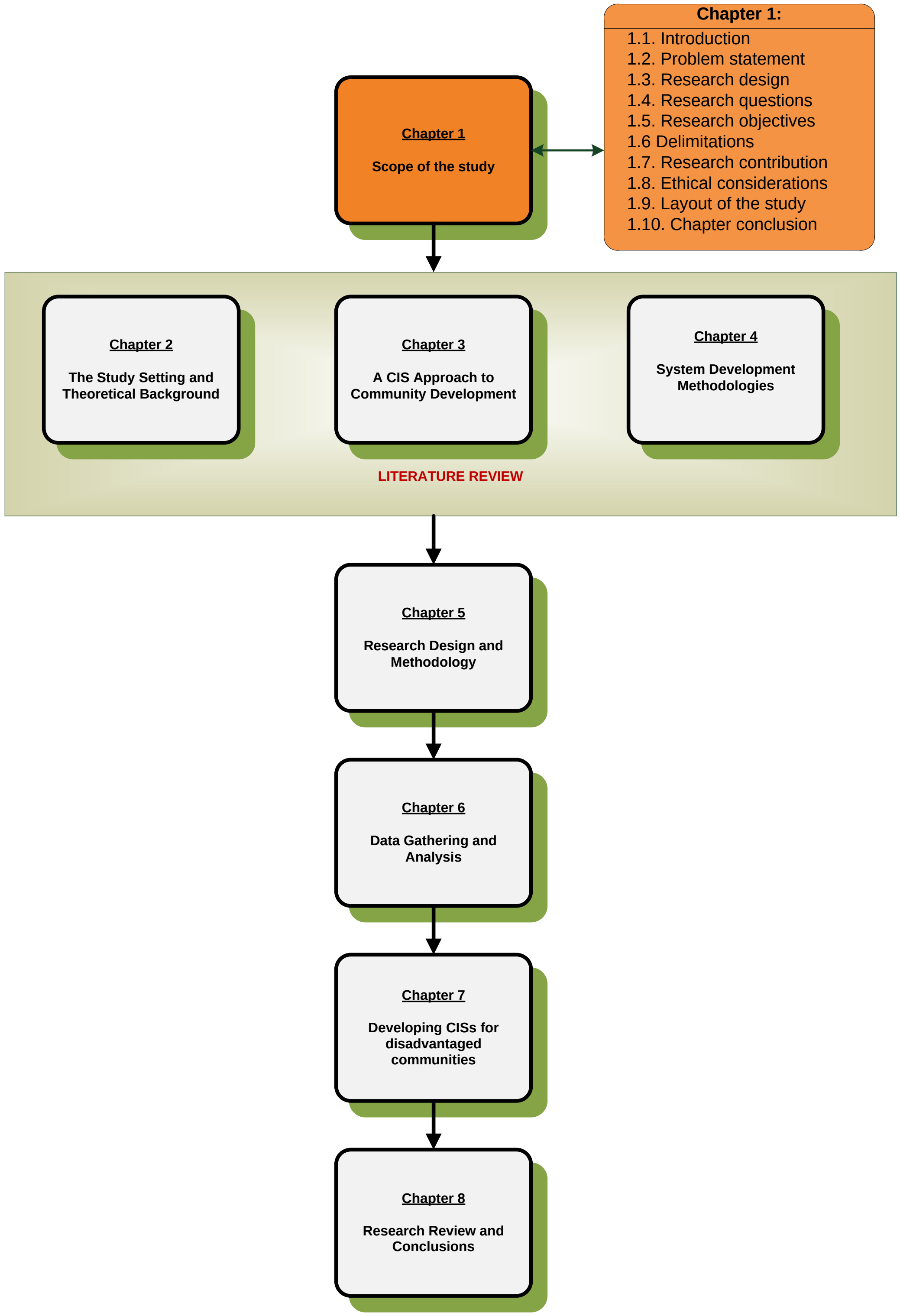
The purpose of this study is to evaluate the use and effectiveness of System Development Methodologies when developing community information systems aimed at socio-economic development of disadvantaged communities.

To achieve the objectives of this study, an interpretive, multiple case study research was conducted in three Living Labs around South Africa. To improve the chances for success during the development of Community Information Systems for use by disadvantage communities, this study proposes a framework for evaluating use and effectiveness of SDMs. The second output of the Study is an SDM framework that could be adopted specifically for Living Labs which adopts an agile approach and prototyping. These frameworks takes into account the social attributes of people in disadvantaged communities, the nature of the living lab, the nature of the systems being developed and the role of the users in the systems being developed.

Keywords

Information and Communication Technologies, Disadvantaged Communities, Information System Development Methodologies, Socio-economic development, Agile development approach, prototype.

CHAPTER 1. SCOPE OF THE STUDY



1.1 INTRODUCTION

Just over a decade ago, the availability of Information and Communication Technologies (ICTs) in remote rural areas seemed to be an impractical dream to many people. The advent of mobile technologies led to a rapid change in that mentality as innovations in ICTs make it possible for people even in the most remote areas to have access to ICTs. The last few years have experienced a considerable increase in the introduction and use of various technologies by the rural communities, defying infrastructure and economic barriers. Mobile phone (mobile or network) technologies facilitate fast connections to distant relatives, leading to a decrease in the use of the post office as the main form of communication.

The belief that ICTs are capable of aiding and improving the rate of social and economic development in the rural communities led various governments to commitment to the provision of access to technologies, coupled with a roll-out of community centres, commonly known as telecentres, to rural areas. India, South Africa and Nigeria are some of the governments across the globe that have actively facilitated the availability of ICTs in disadvantaged communities to ensure access to basic ICTs (fax, photocopying, printing and telephone) and to government systems (Benjamin, 2000; Etta & Parvyn-Wamahiu, 2003). To address the ICT skills gap, computer literacy training has been offered in most community centres as a means of improving the use of these technologies for various purposes (Fourie, 2008).

As technology evolves, particularly with the proliferation of wireless and mobile technologies, more means of meeting the needs of the disadvantaged through ICTs have been identified. In his analysis of ICT4D trends, Heeks (2009) acknowledges that ICT4D initiatives need to develop from merely ensuring access to basic computing, to specific systems aimed at addressing the social and economic needs of disadvantaged communities, hence community information systems. The high failure rate (70%) of donated medical devices in developing countries (Cunningham, Herselman, & Cunningham, 2011) is proof that more tailored systems and technologies are necessary.

In South Africa, Living Labs are at the forefront in facilitating development of Community Information Systems (CISs). The European Network of Living Labs (ENOLL) defines a Living Lab as an open innovation environment in real-life settings in which user-driven innovation is the co-creation process for new services, products and societal infrastructures (European Network of Living Labs, 2010). Living Labs started as pilot projects aimed at involving users in developing simple systems used to improve the social and economic conditions in disadvantaged communities.

Due to the complexity of communities and the scarcity of off-the-shelf applications addressing specific needs, most community systems have to be developed individually as an experiment for successive systems (Harrison & Zappen, 2005). This calls for development of CIS tailored to a particular community need and circumstances, that is, infrastructure (McIver, 2008). As expected in a new field of information systems, there is no evidence of the use of System Development Methodologies during development of community information systems for disadvantaged communities. Living Labs are at the forefront of this development and thus the use of System Development Methodologies (SDMs) in Living Labs is a focus of this study.

This research is aimed at exploring factors affecting the use and effectiveness of specific System Development Methodologies for community systems aimed at socio-economic development and developing a framework for an SDM that could be used for these types of systems.

Following this introduction, a statement of the problem is provided and thereafter a brief research design is presented. Research questions are subsequently presented, followed by outline of the research contribution and ethical considerations. Finally, the proposed outline for the final report is presented.

1.2 PROBLEM STATEMENT

A problem occurs when there is a difference between the current condition and the desired or more preferred condition. In order for one to reach a destination in research, there needs to be a clear definition and statement of the reason for conducting research. A well pondered and stated problem is a necessity for providing directions for research objectives, the research design and also a solution to a problem (Malhotra N. K., 1996; Zikmund, Babin, Carr, & Griffin, 2012).

There are currently no records on specific SDMs used when developing information systems aimed at socio-economic development of disadvantaged communities. This is not in line with practice in system development where it is believed that system methodology must chosen based on an underlying domain (Meyer, nd). When choosing a System Development Methodology, developers and analysts need to consider the context in which a particular system is developed, taking into account social and economic conditions (Harrison & Zappen, 2005). The chosen SDM approach is crucial for contextualising the circumstances surrounding the system being developed. The circumstances may relate to the organisational environment (including personnel), or the project (du Preez, Lutters, & Nieberding, 2008).

CISs are still a somewhat an innovative concept in the Information and Communication Technology for Development (ICT4D) field; there is still insufficient knowledge about SDMs being used and the effectiveness thereof. This leaves developers of these systems with limited information as to the best approach to use when developing CISs. Due to limited research in this area, there is no recorded tool to evaluate the use and also the effectiveness of SDMs when developing CISs for disadvantaged communities. This situation calls for an urgent intervention. Furthermore, there is a need for a methodology framework that will assist developers while developing a CIS system in disadvantaged communities. This framework needs to take into account the unique circumstances of the South African disadvantages communities and also the living labs, whilst ensuring that the systems developed are used as purposed. In this study these issues will be addressed.

1.3 RESEARCH DESIGN

Although a properly defined problem is a prerequisite for any research work to be undertaken, the process followed needs to be carefully selected and unambiguously outlined (Zikmund, Babin, Carr, & Griffin, 2012). A research method offers insight on how information for the intended research will be gathered and also on the necessary strategies or tools required in order to reach a conclusion on the research problem.

A chosen research strategy and methodology depends on the type and nature of the research problem at hand. The problem under discussion is social in nature, which means that the research strategy followed should contain social elements, taking into account that people are involved in the research (Walsham, 2001).

An interpretive paradigm was chosen as the paradigm for this study which was conducted through qualitative multiple case studies. More details on the research design are presented in chapter 5 of this study.

1.4 RESEARCH QUESTIONS

Research questions form the basis of research. It is only after such questions are answered that the problem is resolved. These are divided into primary and secondary questions. The primary question is what the research aims to achieve. The answers to the secondary questions will also render answers to the primary research questions.

To arrive at a holistic view of the problem at hand, the process-based research framework, developed by Roode (1993) was used. This framework helps to develop a richer understanding of the problem under investigation (Mavetera, 2011) and addresses the research problem from various angles. It stems from the belief that answering the four generic questions helps the researcher to cover all possible areas of the research at hand. Roode (1993) further states that these generic questions do not have to follow any linear model but will assist the researcher in navigating and understanding the problem under investigation. As per Figure 1.1, in order to gain an understanding of the problem, one should ask the *What is?, Why is?, How does?,* and *How should?* types of questions about various aspects of the problem at hand.

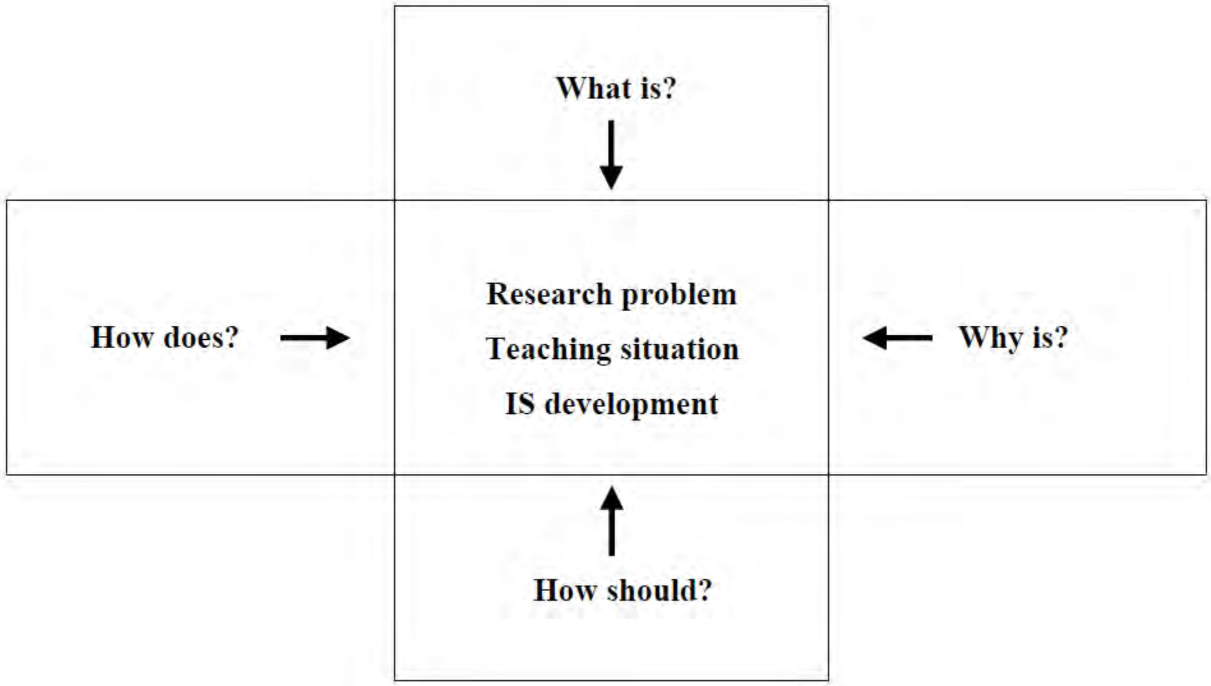


Figure 1-1: A process based research framework for secondary research questions (Roode, 1993)

In this framework, each category of questions is aimed at addressing the research problem from different perspectives. These were all used to formulate secondary research questions. The application of these is explained as follows (Roode, 1993):

- What is?

Questions falling under this part are aimed at exploring the essence of the research problem. The meaning of the concepts surrounding the problem is established. This provides an important aspect to understanding the fundamental nature of the phenomenon being studied.

- Why is?

These questions lead to an explanation of the behaviour or characteristics of a phenomenon. The essence of these questions is to gain an overview of the causes of a particular mode of behaviour or action.

- How does?

Together with an understanding of the reasons for a particular behaviour, this provides an understanding of the means or techniques applied to a particular phenomenon. This is characterised by observation and description of the reality of the problem.

- How should?

Normative aspects of the problem are the main focus of these questions. In addition, conclusions, recommendations and implications of the results of the entire research are taken into consideration.

1.4.1 Primary research question

There are two main questions addressed in this study.

1. *Are SDMs used in the development of CISs for the disadvantaged communities of South Africa?*
2. *How effective are SDMs in the development of CISs for disadvantaged areas in South Africa?*

The first research question aimed to establish the extent of use of SDMs during the development of systems for use by disadvantaged communities. The second research question explored the effectiveness of these System Development Methodologies towards achievement of system objectives.

1.4.2 Secondary questions

These secondary research questions are:

- Are there specific systems used in the Living Labs to address the needs of a disadvantaged community?
- What SDMs are used when developing CISs towards socio-economic development of disadvantaged communities in South Africa?
- How does the use of the use of SDMs contribute to success during the development of CIS aimed at socio-economic development?
- What factors influence the use and effectiveness of SDMs when developing the CISs for South African disadvantaged communities?.

Roode (1993)'s process framework was used for further refinement and presentation of the secondary research questions. This framework also made it easy to develop interview questions for the case studies. For easy reference throughout the study, each generic category of questions was allocated a unique reference. SQ represents secondary questions and they are referenced accordingly, as is evident below.

SQ1: WHAT IS?

SQ1.1 *What is ICT for socio-economic development?*

SQ1.2 *What are community information systems?*

SQ1.3 *What is the main objective of the CIS?*

SQ1.4 *What are SDMs?*

SQ1.5 *What effect does the use of a SDM have on the successful implementation of a community based system?*

SQ1.6 *What factors specific to the Living Labs affect the use and effectiveness of SDMs when developing CISs?*

<u>SQ2:</u> **<u>WHY IS?</u>**

SQ2.1 *Why are CISs important for the socio-economic development of South African disadvantaged communities?*

SQ2.2 *Why is it necessary to choose a particular SDM in the development of CISs for socio-economic development?*

SQ2.3 *Why is there still minimal user involvement during the development of CISs?*

<u>SQ3:</u> **<u>HOW DOES?</u>**

SQ3.1 *How are SDMAS chosen?*

SQ3.2 *How are CISs developed?*

<u>SQ4:</u> **<u>HOW SHOULD?</u>**

SQ4.1 *How should the use and effectiveness of SDMs for CIS in Living Labs be evaluated?*

SQ4.2 *How should SDM be selected when developing CIS?*

1.5 RESEARCH OBJECTIVES

Research objectives are the outcomes of research. They refer to what is accomplished at the end of the research by presenting and putting the purpose of the research in measurable terms (Zikmund, Babin, Carr, & Griffin, 2012). This research aims to fulfil the following main objective:

To develop a framework for evaluating the use and effectiveness of SDMs when developing CISs for disadvantaged communities in South Africa.

And

To recommend a SDM framework for developing CIS disadvantaged communities in South Africa.

These research objectives were achieved by:

- Establishing existence of information systems aimed at addressing socio-economic development issues for disadvantaged communities around South Africa.
- Identifying whether SDMs are followed when developing the CISs in South African disadvantaged areas.

- Establishing from the Living Labs the factors influencing the use and effectiveness of SDMs when developing the CISs for South African disadvantaged communities.
- Establishing how Living Labs should develop CISs for disadvantaged communities.

1.6 Delimitations

The focus of the study is on SDMs used when developing systems aimed at socio-economic development of disadvantaged communities. The Living Labs were chosen as the focus of the study as they present a structured approach to a multi-stakeholder method to introduce ICT initiatives to disadvantaged communities. Investigation for this study was limited to Living Labs that are involved in some form of development of the systems that are used by communities.

1.7 Research contribution

As stated above, there is a dearth of research about the methodological processes followed when introducing ICT4D systems in disadvantaged communities. There is still a lack of consultation with people in rural communities when systems are introduced; this impacts on the acceptance and use of these systems. It is anticipated that the results of this research will help in establishing factors to use when evaluating use and effectiveness of SDMs when developing CISs. This was achieved through a framework for evaluating the use and effectiveness of SDMs when developing systems for disadvantaged communities. Based on the results, this study also recommends an SDM framework to be used when developing these systems.

1.8 Ethical considerations

Ethical conduct is required in research to ensure that research does not result in harm or disruption of the normal activities of people, things or areas being researched (Marshall & Rossman, 2010). Ethical concerns include research participants' right to confidentiality, obtaining approval to conduct research at the site, and not coercing subjects as regards their participation.

To ensure that ethics are upheld in this study, permission to collect data was obtained from the leaders of the Living Labs and a consent form was administered to the participants.

1.9 Layout of the Study

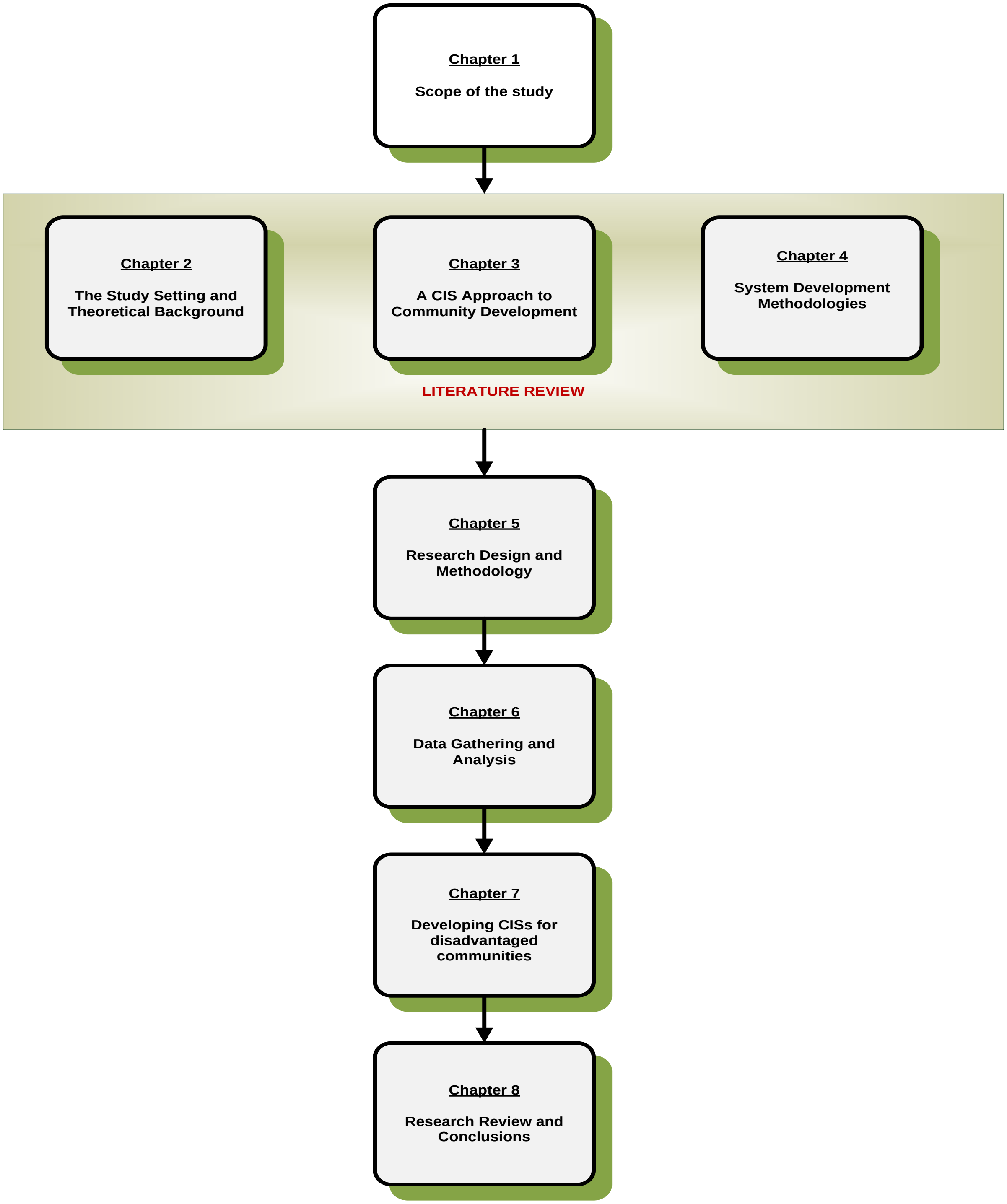


Figure 1-2 The structure of the thesis.

This study is structured as presented in Figure 1.2 above, and the outline of each chapter is presented below:

Chapter 1 Introduces the research problem, the aims of the research and provides the outline of the entire research.

Chapter 2: The background context to the study is presented.

Chapter 3: Features of community centres are discussed in this chapter, taking into account the community centres that are already in existence in South Africa.

Chapter 4: This chapter focuses attention on Information System Development Methodologies. The context of use of methodologies is discussed.

Chapter 5: Research design and the research method followed in the study are described.

Chapter 6: Data from the case studies are presented and a cross-analysis of the case studies is undertaken.

Chapter 7: From the data analysis, two frameworks are developed in this chapter. The first framework is used to evaluate the use and effectiveness of System Development Methodologies when developing systems for disadvantaged communities. The second is the SDM framework to be used when developing these systems.

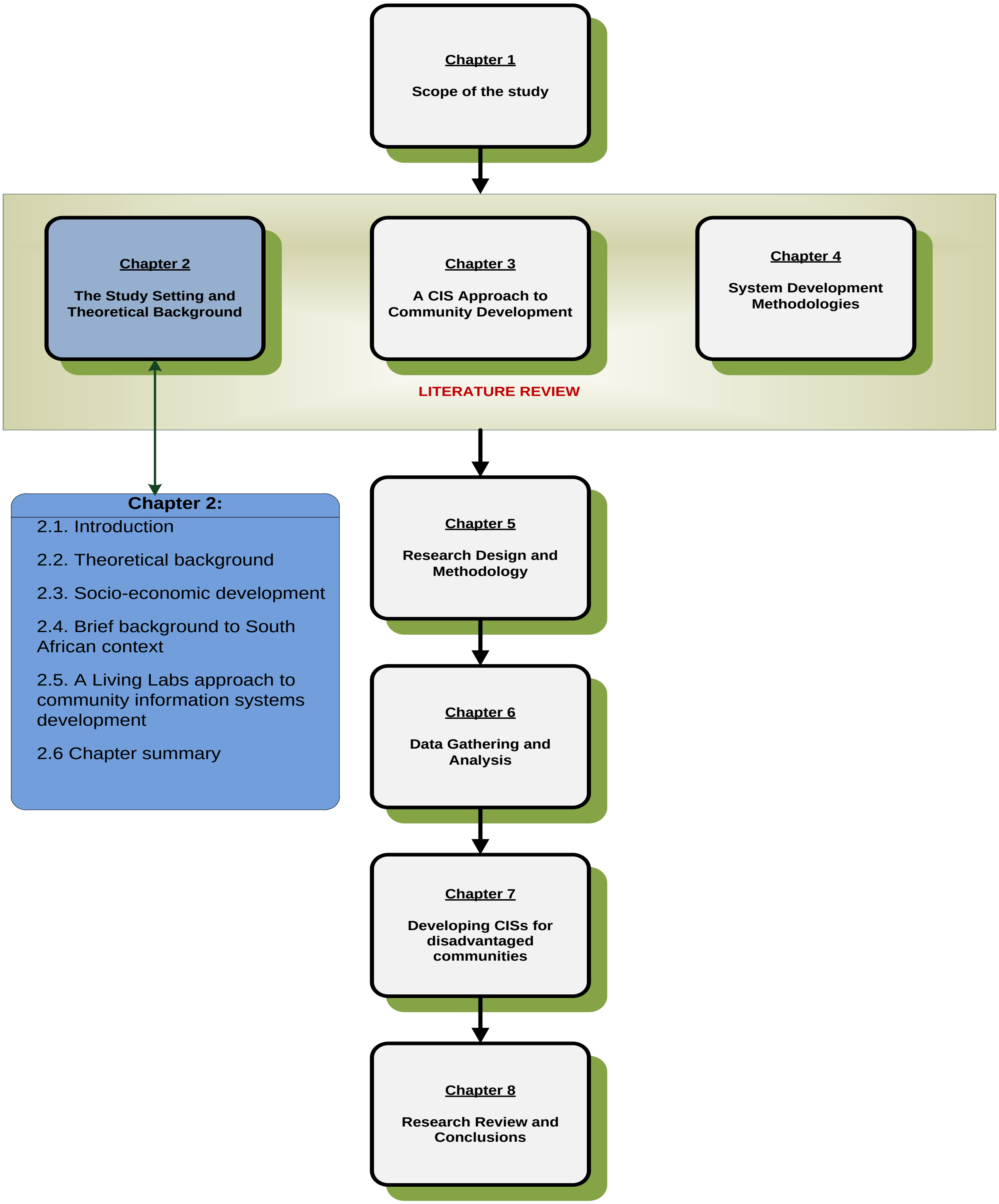
Chapter 8: This chapter undertakes a review of the study to ensure that research objectives have been achieved. Study conclusions, reflections and suggestions for future research are presented.

1.10 CHAPTER SUMMARY

This chapter introduces and gives a brief overview of the study. It outlines the identified problem, research contribution and ethical considerations. A broad overview of the research methodology and design was presented. Two primary research questions and a number of sub-questions were identified and grouped according to the process-based model established by Roode (1993). The structure of the thesis is then presented, with a short outline of what each chapter covers.

Chapter 2 presents an appreciation of the context of the study.

CHAPTER 2. THE STUDY SETTING AND THEORETICAL BACKGROUND



2.1 INTRODUCTION

This chapter presents some background information to contextualize the research problem. In order to make a significant contribution to facilitating the development and building of the human resource capacities of people in disadvantaged communities, ICT4D needs to be carefully planned and targeted to suit the needs of a particular community (Moralez-Gomez & Melesse, 1998). A number of researchers (Avgerou, 1998; Hameed, 2007; Madon, Nicolau, Roode, & Walsham, 2009) concur with this statement as they believe that information technology, as a powerful working instrument is one of the changes that require consideration in the understanding and explanation of socio-economic trends. In the long term, correctly implemented ICT for socio-economic development efforts plays a role in poverty reduction.

South Africa, in a manner comparable to many other developing nations, has introduced various initiatives in order to ensure that the average citizen has access to basic ICT activities, without having to travel long distances (Benjamin, 2000; Fourie, 2008). There are various aspects that need to be taken into account when looking at systems aimed at improving socio-economic development.

The following section presents theories applicable to this study, followed by an introduction to socio-economic development and a brief background of South Africa, applicable to ICT for development.

2.2 THEORETICAL BACKGROUND

This section provides a brief outline of theories referred to in this study. An outline of theory is important as it acknowledges the influence of existing research on the current study. Besides giving a good foundation, theory also acts as a form of guide to the nature of knowledge required for completing an inquiry and how best to carry out the study, given assumptions about reality and intended solutions. Although this is the case, there are researchers who hold the view that theories should not be taken as manuals in an enquiry. For example, Mavetera (2011) states that although theory is able to explain relationships between a natural or a social phenomenon, it should not be taken as licence for its acceptance in the study discipline. This then calls for careful thought and scrutiny by the researcher or developer as regards the most relevant method to use; a decision which should not be based on the convenience or popularity of a particular theory.

Theories are widely used in information systems research and are useful in many ways. The theoretical foundations on which this study is based are covered in the following sections.

2.2.1 Socio-technical theory

Information technology is a social science, developed for use by organizations and society. Development of ICTs should thus be suitable for use by people within a community, organization or societal structures. The form and structure of ICT development should be such that people are able to make full potential use of its capabilities without feeling constrained by the design limits of the developers. Luna-Reyes *et al.,* (2005) concur with the above statement and state that social and organizational factors play an important role in the success or failure of information systems' development initiatives.

Socio-technical theory was established as a result of the work of researchers from the Tavistock Institute in London, who saw the need for a fit between the technical subsystem and the social subsystem, which together make up an organization (Mumford, 2006). Although its origins are from the behavioural sciences, socio-technical theory has been adopted in many other fields of research, including information systems. In information systems development, the theory responds to the recognition of the importance of the two pillars of an information system: the social pillar and the technical pillar. According to Patnayakuni and Ruppel (2008), the social pillar is made up of system developers, system users, the environment, the context and the social attributes of the system being developed. In agreement with this position, Harrison and Zappen (2005) argue that the involvement of a significant number of a regular mass of community users is crucial to the design and development process. Users have a clear knowledge and understanding of community needs, the environment, norms and boundaries. The technical pillar is made up of tools, techniques, devices, artefacts, methods, configurations, procedures and knowledge used by participants to acquire inputs, and transform them into a working system (Harris *et al.*, 2000). Acknowledgement of and nurturing these pillars are fundamental to improving performance during the system development process and as part of a holistic systems approach to system development to ensure user satisfaction.

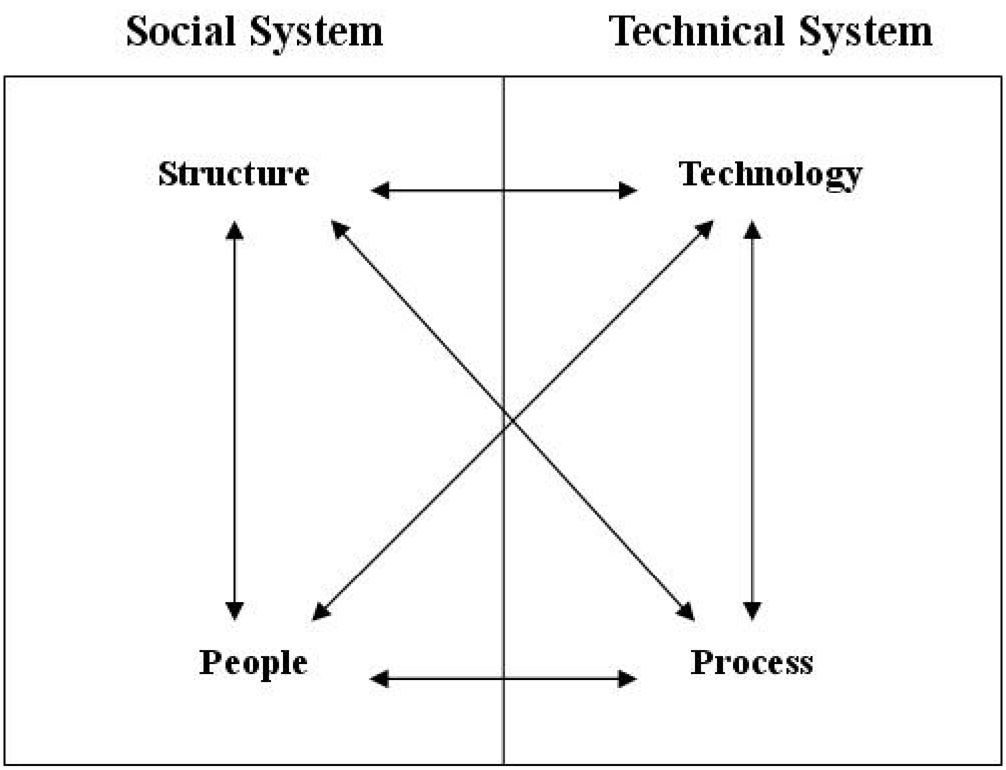


Figure 2-1 Socio-Technical Theory (Watson, 2007)

The socio-technical theory is related to Giddens' Structuration theory (Giddens, 1984), which has been used in studying the interaction between Information Technology and social aspects of human action. One popular aspect of the theory is what Giddens (1984) terms as the *duality of structure* which states that human action is simultaneously conditioned by institutional properties in social content (Pozzebon & Pinsonneault, 2001; Luna-Reyes, Zhang, Gil-Garcia, & Creswell, 2005). This means that in structuring an organization, there should be a balance between human and institutional environments.

Adopting a socio-technical systems approach in an SDM would accentuate holistic consideration of the system development environment. Boahene (1999), Avison and Fitzgerald (2006) agree on the significance of the environmental context of the intended information system.

2.2.2 Technology-Organisation-Environment framework

The Technology-Organisation-Environment (TOE) framework was initially established by Tornatzky and Fleisher (1990) to describe how technological adoption occurs in organizations. The framework comprises three elements which have an impact on an organization's extent of innovation: external environment, organizational setup and technology. The first element, the technology context, investigates the internal and external technology to which the organization has access (Peng & Kurnia, 2008). The second element, organizational context is about the organizational setup, and includes attributes like the scope, size, human resources, decision making and organizational structures (Tornatzky & Fleischer, 1990). The third element, the external environment, concerns the arena in which the organization is operating and includes factors such as industry characteristics, competition, stakeholders and regulatory framework (Peng & Kurnia, 2008). The framework is depicted in Figure 2-2.

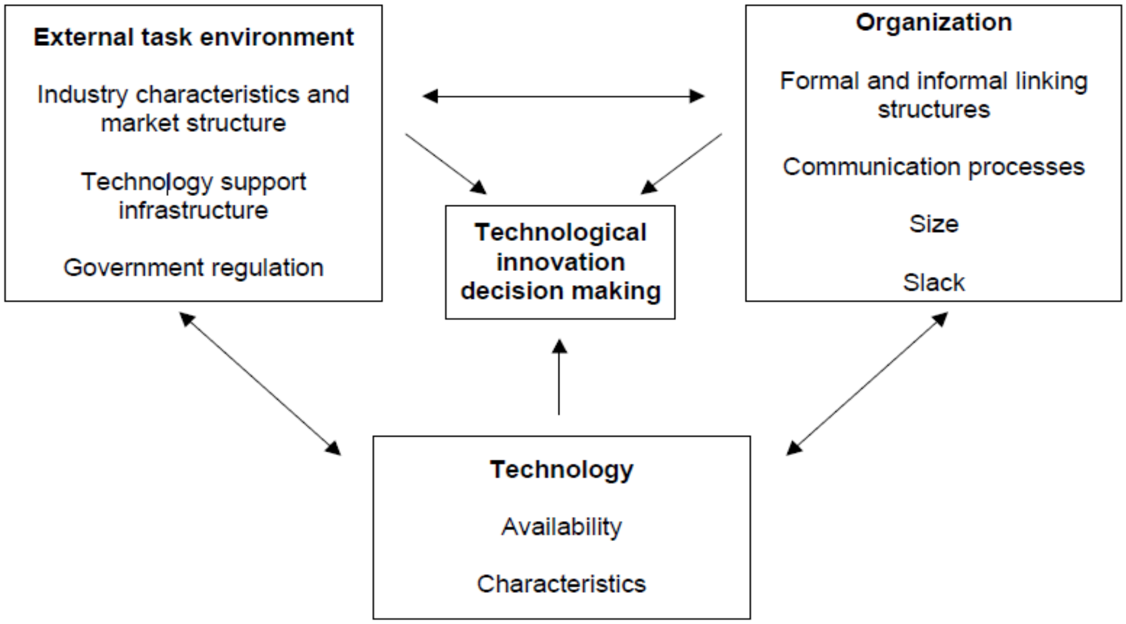


Figure 2-2: Technology-Organisation-Environment framework (Tornatzky & Fleischer, 1990)

According to Information Systems research (Peng & Kurnia, 2008; Shahawai, 2010; Angeles, 2013) the TOE framework has been widely used for adoption, assimilation and diffusion of technology and technological practises in organisations. This is due to its holistic approach in assessing the various elements affecting adoption. Bijker & Hart (2013) believe that the TOE framework has a solid theoretical basis and consistent empirical support in presenting both constraints and opportunities for technological innovation.

Consistent with the socio-technical theory, TOE takes both the technical context and the social context into account.

2.2.3 Four paradigms of information systems research

To classify sociological theories, Burrell and Morgan (1979) used a two by two matrix bordering four paradigms. As may be seen in Figure 2.3, at one end of the matrix a distinction is made between objective and subjective paradigms and at the other end of the matrix a distinction is made between those paradigms aligned towards radical and those paradigms that are about regulation. They (Burrell & Morgan, 1979) define a paradigm as the commonality of perspective which binds the work of a group of theorists together. This definition of a paradigm is an extension of an earlier work by Kuhn (1970) who defined a paradigm as the underlying assumptions and intellectual structure upon which research and development in a field of inquiry is based. In this context, a paradigm represents the way in which a particular group or society views their world.

Although initially regarded as part of the theory of sociology, Burrell and Morgan's four paradigm framework is one of the most frequently referred-to theories in information systems research due to its relevance (Roode, 1993; Alexander, 2002; Mavetera, 2011). As Information Systems is a social-technical oriented field, it is usually necessary to look at systems from various perspectives, be it in adaptation, use or development.

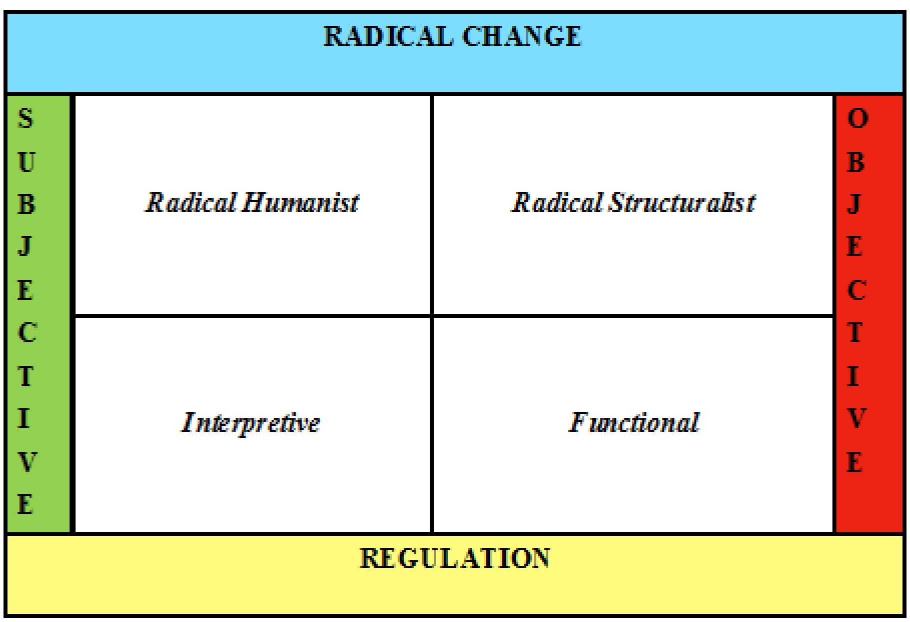


Figure 2-3: Four Paradigms framework for Social Analysis (Burrell & Morgan, 1979)

The four paradigms can be summarized as follows:

- ***Radical Humanist***: Theories in this paradigm are those that aim at using social change to emancipate human beings so as to realize their own potential. Human consciousness is dominated by ideological superstructures that produce a false consciousness, thus preventing human fulfilment.

- ***Radical Structuralist:*** This paradigm focuses on the structure and analysis of power relations. There is a focus on deep-seated internal contradictions in social structure, with socially reality being considered a fact.
- ***Interpretive:*** Interpretivists believe in deconstructing the phenomenological process through shared realities which are created, sustained and changed. The main belief within this paradigm is that observing behaviour may assist in one's understanding of a social setting. This observation may be done through speech, gestures, behaviour and actions in order to gain a better understanding of one's world.
- ***Functional****:* For a long time in information systems, this paradigm has been regarded as dominant, particularly during the process of the development of an information system. Functionalists choose to be distant from the subject matter through the rigour of the scientific method. Researchers using this paradigm are positivists who believe that they can explain or predict behaviour by searching for patterns and relationships between people.

These four paradigms were largely applied in analysing research processes, but they have been adapted by several disciplines. One adaptation is by Hirschheim and Klein (1989) who introduced these paradigms into the area of Information Systems Development (ISD). This gives support in the course of systemizing the assumptions, processes and actions of the development team. According to Flynn and Hussain (2003), the theory's perspective is that developers hold key assumptions that may be grouped together and classified into paradigms which influence the ISD process.

The process of establishing a system involves more than constructing a solution to a defined problem. There are several activities and people involved in the process. A system is a collection of complementary and interacting components characterised by properties, capabilities, behaviour and a boundary which separates it from the environment (Mihailescu & Mihailescu, 2010). An information system as a product of the system development process, emanating from a desire to bring about a working solution to a complex set of organisational, human, or in this case, community problems. These problems call for an intensive process; hence, these paradigms cannot be ignored, as there is a need to look at realities from both the interpretive and the functionalist points of view.

2.2.4 Contingency Theory

Developing community based information systems is not an easy task as the social and technical aspects must be handled with equal emphasis. A contingency approach to system development methodology has been suggested as a possible solution to the information system development problems. As with the Socio-Technical Theory, the contingency theory originated from the behavioural sciences but is being applied in other fields. The basic idea of contingency theory is that there is no ideal system development methodology that may be used in developing all organisations' systems. Zhu (2002) states that contingency approaches to information systems development came about because there is no single approach to all information systems projects and there is a variety of system development methodologies to choose from. Contingency approaches take an ad hoc approach to using system development methodologies like selection of a particular methodology based on the characteristics of the project (Kemble, 2006).

Zhu (2002) outlines three types of contingency approaches: contingency at the outset, contingency with a fixed pattern and contingency along development dynamics. According to Zhu (2002):

- *Contingency on the outset* concerns choosing a single methodology or a fixed combination of methodologies for the whole lifecycle of an ISD project.
- *Contingency with a fixed pattern* relates to choosing methodologies according to a conceived linear working sequence of human-technical issues in the ISD process.
- *Contingency along development dynamics* is about employing various methods and tools as the dynamic complexity of ISD unfolds.

Taking these types of contingencies into account, when deciding on a methodology to use, makes it easier to choose an appropriate methodology based on the characteristics of a project and the type of development organization.

2.3 Socio-economic Development

Poverty alleviation, improved standards of living, parity between poor and rich as well as gender equality are some of the prevalent topics in literature when discussing socio-economic development. Development is a concern for all countries in the world, whether the so called First World or the "Third World" (Africa, Asia, Latin America and Oceania). According to various researchers (Rapley, 2007; Chari & Corbridge, 2008; Cypher & Dietz, 2009), the origin of development can be traced as far back as the period immediately following World War II, due to wide variations in global living standards.

Various reasons for this difference in living standards exist, including colonialism and globalization (Walsham, 2001; Avgerou, 2009). The deteriorating standards of living in many countries were linked the end of colonialization; when countries attained their independence, then the need for development became apparent. Initially, development efforts were aimed at improving the dismal economic conditions in those countries, but the current focus is on improving the social standards of people in disadvantaged communities, hence the term socio-economic development (social and economic development).

Third world countries, particularly, suffer from low living standards, especially poor economic and social conditions. These countries experience a variety of frontline problems such as climate changes, social and political conflict, diseases and resource depletion (Heeks, 2009)., In an effort to address some of these issues, development agencies such as the World Bank, the United Nations Development Programme, Government structures and Non-Governmental Organisations (NGOs) drive development initiatives either in their respective countries or around the globe. The challenge is to balance the role played by these institutions and that of the developing communities to ensure success and sustainability of the development efforts.

Further discussions on development and measurement of development are presented in the following sections.

2.3.1 Defining Development

The term “development” takes many definitions, depending on the context in which it is applied. The basic premise behind development is that it should lead to an improvement from the formal status. Both academic and non-academic disciplines use the terms *economic evelopment* and *economic change* interchangeably, whereas there is a difference in their application. Change is defined by the *Oxford Dictionary* as *to cause to be different* (Soanes, Sara, & Elliot, 2009). Todaro (1991) defines economic development as a multidimensional process involving major changes in social structure, popular attitudes and national institutions, as well as the acceleration of economic growth, the reduction of inequality and eradication of absolute poverty. This definition differentiates change from development in that change is associated with any kind of movement away from the status quo to another status and even in cases where there is a move from the current situation to a less desired state, that movement is still regarded as change. Boateng, Heeks, Molla, and Hinson (2008) simplify this further by defining development as good change.

When examining definitions it is evident that there are different perceptions; the similarity in such definitions of development is that it is aimed at improving the standards of living of a particular population or community. The difficulty in providing a direct definition of development is influenced by different levels in the society. The development agenda of someone from a community classified as “rural” in a third world country is different from that of a community with the same classification but from a first world country. It is for this reason that some researchers have argued that development must be defined relative to time, place and circumstance (Ikejiaku, 2009). In addition, politics, economy and social conditions are some of the factors that have a bearing on the extent of development.

2.3.2 Assessing Socio-economic development

One of the key issues of socio-economic development raise is understanding how one can tell if a particular community or individual is being developed. Traditionally, economic measures were used to quantify the extent of a country's development using its Gross Domestic Product (GDP) as one such measure. The use of GDP to measure development has been under scrutiny from various researchers over several decades; they are of the view that GDP cannot be taken as an accurate measure of people's growth as it is focused more on monetary measures. When it comes to the basic needs of an individual, Maslow's hierarchy of needs theory (as shown in Figure 2.1) has been widely used.

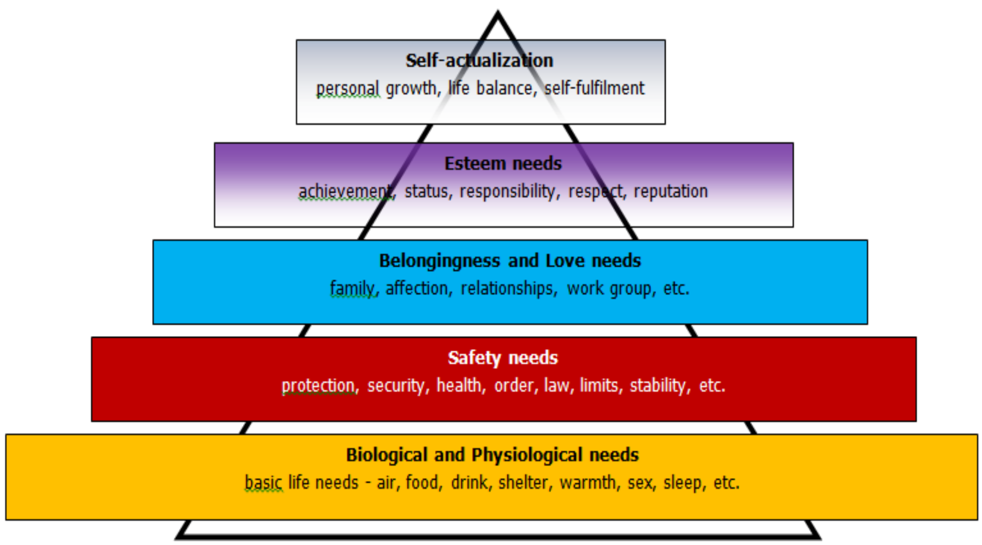


Figure 2-4: Maslow's Hierarchy of Needs (Chapman, 2007)

This theory states that there are five levels of basic human needs which progress from the bottom (Biological and Physiological) to the top (Self-Actualisation). According to Maslow, each lower level need must be fulfilled to be able to move up the hierarchy and further develop as a person

(Chapman, 2007; Magnuson, 2010). Although some lower level needs should have been fulfilled before some thoughts of further development is necessary, it is unrealistic to expect one development effort to accommodate all these levels. Socio-economic developers could instead use Maslow's hierarchy of needs to assess their particular initiative against these identified levels.

A more popular measure, in use since the 1990s, is the Human Development Index (HDI), developed by the United Nations Development Programme (UNDP). The HDI groups countries according to life expectancy, education and the GDP (Emes & Hann, 2002). It provides a composite measure of three dimensions of human development: living a long and healthy life (measured by life expectancy), education (measured by adult literacy and gross enrolment in education) and a decent standard of living (measured by purchasing power parity, income) (UNDP, 2009). The HDI data is used to distinguish whether a country is developed, developing or under-developed, and it also measures the impact of economic policies on quality of life. The countries are rated into four categories; very high HDI, high HDI, medium and low. The three dimensions of HDI can also be easily traced or aligned to the Millennium Development Goals, discussed later in this chapter.

Some academics and research bodies agree that monetary measures are insufficient as measures of development, which is not only about wealth (Rapley, 2007). Other arguments against the use of the GDP:

- Max-Neef, Elizalde and Hopenhyn (1989) and Henderson (1996) believe that developmental efforts must also consider the social context of the people being developed.
- Henderson (1996) further argues that in the emerging global village, the study of national economics has increasingly merged with the study of social and ecological issues that are far too important to be left to the economists' realm. The reality is that countries do not just develop, but rather the people within the country and the country's role itself is to devise a means for that development.

- Ikejiaku (2009) asserts that development is not just about high economic growth, but how government leaders utilize that growth in order to positively transform the lives of the people (essentially the provision of basic needs such as food, water, shelter, health and literacy).
- According to the United Nations Development Programme (UNDP, 2009), obstacles to using economic indicators to measure development include the difficulty of quantifying the economic impact in developing economies where baseline economic data is almost never sufficiently robust.
- Afsa *et al*. (2009) argue that:
  a) GDP pays little or no attention to distributional issues and to elements of human activity or well-being for which no direct or indirect market valuation is available;
  b) It measures productive flows and, as such, ignores the impact of productive activities on stocks, including stocks of natural resources.

Using quantitative means to measure development is inadequate when looking into the conditions of impoverished communities, because there is limited money available in these communities and yet there is still a need for basic services such as health and education. More socially based approaches are needed to look at the social conditions of the communities.

The debate surrounding quantifying development is, however, not as important as the challenge of devising a means to ensure that such development is achieved. Several studies have shown that some good initiatives aimed at development have failed to improve the living standards of the intended communities (Walsham, 2001; McMahon & Bruce, 2002; Heeks, 2009). The debate on causes of such failures could be linked to various aspects involved during the development process; these include factors such as the tools used for development, community involvement, and the sustainability of development initiatives. According to Todaro (1991), in order to achieve the development objective; a development agenda should fulfil the following values:

1. *Life-Sustenance:* This is the ability of the development effort to assist towards meeting the basic needs of people; i.e. food, shelter, health and protection. E-agriculture, e-Health, e-Education are some of the growing fields in ICT4D where systems are being developed to address people's needs.
2. *Self-esteem:* This is the self-respect a person achieves, but not necessarily by having material possessions. Thus, issues like culture, traditions and language should be taken into account; ensuring their inclusion in their community development is one way of doing just that. This is evident from the research conducted on several women's responses to their first experience with mobile internet, where one woman expressed extra confidence from her abilities to contribute to radio discussions via mobile email (Gitau, Donner, & Marsden, 2009).
3. *Freedom from servitude:* This last value is about a person's ability to choose. With modernization there is a belief that technological innovation provides the freedom to choose through knowledge and an understanding of how applied technology makes life easier. Technology, wealth and political freedom are some examples of factors that make people feel that they have the freedom to choose (Todaro, 1991).

As mentioned above, failure to group these concepts could be associated with people's inability to accommodate the diverse social circumstances facing communities.

2.3.2.1 Henderson's indicators

In measuring socio-economic development, the growth in people's standard of living needs to be taken into consideration. In her arguments against the use of GNP/GDP indicators to measure development, Henderson (1996) states that these economic measures completely ignore the value of natural resources, education, unpaid subsistence labour, and self-employment labour which account for over half of the world's production and nearly 80% of its capital investments. In many communities of developing countries, informal subsistence trading is still important for existence and it is difficult to measure these in quantifiable terms. Henderson's (1996) sentiments are shared by Madon (2000) who asserts that various other non-economic indicators may be crucial indicators to measuring development. Henderson (1996) recommends twelve indicators that she believes should form the crux of a country's development measurement.

Table 2-1: Complementary indicators of progress toward societal goals (Henderson, 1996)

Indicators	
1. *Poor health:* infant mortality, low birth weight, weight/height/age ratio	7. *Inequality/equality status of minorities, ethnic populations and women:* e.g., human rights data
2. *Poor nutrition:* e.g., calories per day, protein/carbohydrates ratio, etc.	8. *Environmental pollution levels*
3. *Limited access to basic services:* access to telephones, water, sanitation, electrification, etc.	9. *Environmental resource depletion*
4. *Insufficient shelter*: housing availability/quality, etc.	10. *Bio-diversity and species loss*
5. *Poor education*: literacy levels, school dropout and repetition rates	11. *Influence of political participation and democratic process*
6. Child development	12. *Cultural and recreational resources*

The issues listed in Table 2.1 (above) cover a range that, if addressed, are necessary for a meaningful life but also illustrate differences in culture and differences in a nation's perception of economic values. Non-economic measures are important mostly in third world countries with a high unemployment rate and a high rate of inequality in terms of ownership of resources and wealth. A focus on social issues, however, does not mean a total disregard of the importance of economic factors that contribute to development. Max-Neef (1991) argues that to create political order, development must nurture diversity, increase social participation and control over the environment, thus expanding autonomy and distributing economic fruits equitably. In order for this to be effective, the nature of the people who are being developed needs to be taken into consideration and the object of development should be constructed according to their needs; the notion that "the Western way" is the right way is not necessarily true and may lead to further disparities. This calls for greater wisdom amongst the development authorities to accept the plurality of these factors.

2.3.2.2 Sen's capability approach

Another influential researcher who has shaped discussion on development is Amartya Sen. Through his approach, popularly known as Sen's capability approach, he proposes a move from a utilitarian, income-based definition of development to a more integrated approach with multiple ends (Frediani, 2010). Sen's capability approach is aligned to the discussion from the researcher's mention in the preceding section to a shift towards a human-based definition and evaluation of development. The philosophy is similar to Todaro's values of economic development which are about the importance of a person's freedom to choose. This approach assists in identifying the factors that make it difficult for a person to function, given a set of capabilities. Sen, however, does not subscribe to the community based approach but rather believes in individual focus. In addition to Sen's capability, human well-being should be assessed in light of individuals' social, economic and political environments, as well as two elements: one is referred to as functionings (to put it simply, what one is actually able to do) and the other on capabilities (what one could do and be). Examples of functionings include having a healthy body, being safe and calm, having a warm friendship, an educated mind, a good job and capabilities at one's disposal.

This approach has been applied in various other development-related fields, other than that of economic development.

2.3.3 Information technology for socio-economic development

The past few decades have seen a growth in using ICT in facilitating socio-economic development. Developing countries, including countries in sub-Saharan Africa, are implementing various ICT4D based initiatives to limit the digital divide. Hameed (2007) defines the digital divide as the uneven diffusion of technology and inequality access to technologies resulting in significant social, economic and political consequences. It refers to the gap in countries and communities between those who are either able or unable to access ICTs, particularly internet technologies. This gap usually results from socio-economic factors, geographical or sometimes physical disability. A digital divide that exists amongst countries is referred to as global divide, while the divide between communities within the same country is referred to as an urban-rural divide (Bjorn & Stein, 2007). Other such divides include factors which cause digital disparities between men and women, between the young and elderly (Migiro & Wayi, 2007).

Factors such as the state of ICTs and the levels of access and utilization of the internet are evidence of the digital gap. This divide has been highlighted by significant gaps in internet access between the developed and developing worlds. More than 65 percent of the world's internet users are in the G8 countries (Canada, France, Germany, Italy, Japan, Russia, the UK and the US) which account for less than 20 percent of the world's population (ITU, 2010). There are more than eight times as many internet users in the US, three times as many internet users in Japan, and more than twice as many internet users in Germany than on the entire African continent. According to International Telecommunications Union (ITU) statistics, the entire African continent, which is home to over 50 countries, has fewer internet users than France alone. This suggests that there is no uniformity in access to the information society or to the use of information and communication technologies.

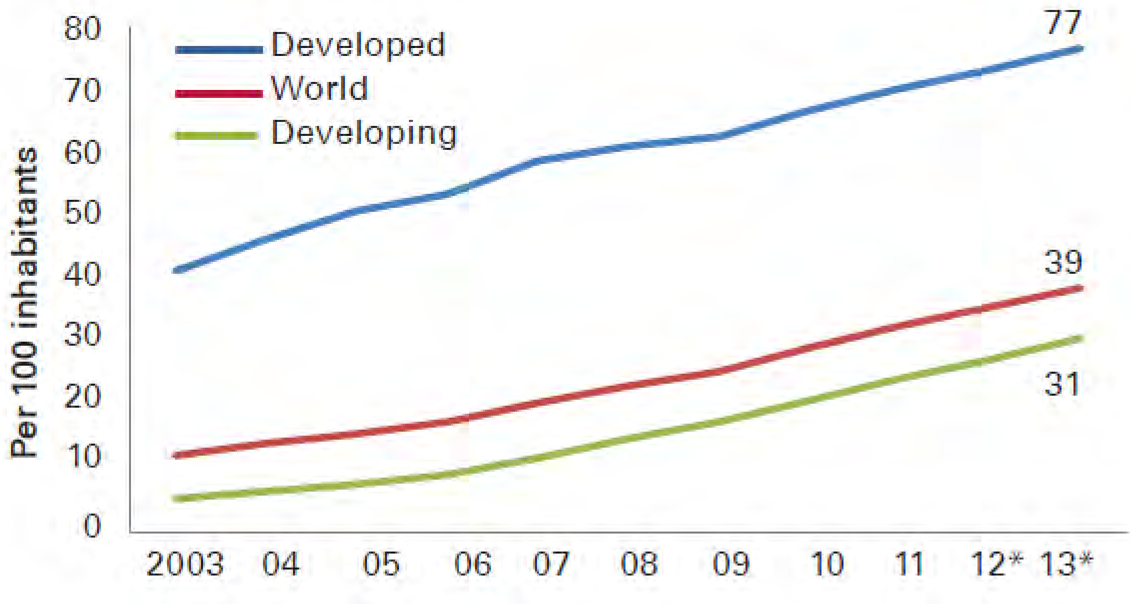


Figure 2-5: Internet users per 100 inhabitants (ITU, 2013)

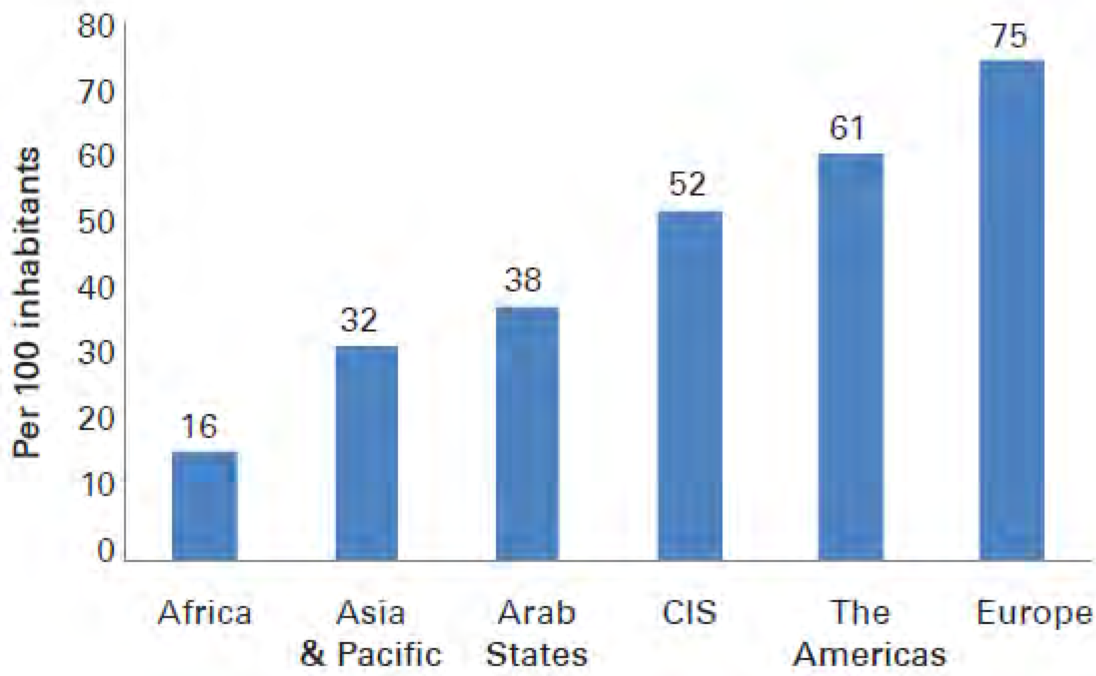


Figure 2-6: Internet users per 100 inhabitants, by region (ITU, 2013)

Information from Figures 2.5 and 2.6 above shows that considerable work is still required in developing economies in order to ensure fair universal access to ICTs. Figure 2.6 shows shrinkage in the divide, evidenced by an increased usage of mobile technologies in developing countries and South Africa in particular. According to ITU (2013), broadband subscription more than doubled in Africa from 2% in 2010 to 11% in 2013. A number of researchers such as Ojo (2006) and Van Dijk (2006) believe that it would be unwise to omit socio-economic factors, for instance, attitude towards technology, education, culture, and economic conditions in discussing a means to close this digital gap. Ignorance of any of these factors perpetuates situations where technology (or computers) is the focus when developing a disadvantaged community, instead of focusing on how a social problem could be solved by using technology. However, factors such as living standards and infrastructure tend to impact on a person's ability to choose the tools necessary for everyday living.

One of the negative effects of the digital divide is that poor communities are deprived of economic advancement as the use of ICT provides a platform for businesses and individuals to trade globally (Harris, 2002; Gomez & Pather, 2010). Businesses from the more affluent communities tend to be more connected and have more links to the international world than do local business owners. Introduction of ICT initiatives and systems aimed at socio-economic development play an important role in improving quality of life in poor communities.

Having been acknowledged for its role as an enabler and enhancer of development, ICT can assist in facilitating the process of improving social structures as well as economic growth. In the past few decades, ICT4D is one area where the focus concentrated more on bridging the digital divide through taking computers to people, rather than focusing on how computers can be used to improve development (Kivunike, Ekenberg, & Danielson, 2009). This practice led to a number of failures in implementing ICT4D projects, necessitating a need for more controlled processes, including an emphasis on user participation. To ensure that ICT4d initiatives lead to development, Heeks (2009) suggests three ways of addressing the needs of the poor:

- *Inclusive*: improving opportunities and services that cover all people, including the poor
- *Enabling*: supporting the policies or context that will improve the lives of the poor
- *Focused*: specifically targeting the rights, interests and needs of the poor

In a manner similar to that of other countries in sub-Saharan Africa, South Africa has, for decades, been involved in efforts to bring various forms of ICT to its citizens. This, however, has not been easy as there are more challenges in implementing initiatives of this magnitude in poor communities than there are in more affluent societies.

One of the most important advances in the ICT4D field is that of mobile technology. The following section presents a case for mobile phones as a potential technology of choice for ICT4D initiatives.

2.3.3.1 Mobile phones for ICT4D

What makes mobile phones a technology of choice for disadvantaged communities? Mobile technologies, specifically mobile phones, easily bridge the digital divide by leapfrogging past the infrastructural challenges of fixed technology. Mobility, ease of use, flexible deployment, and relatively low and declining rollout costs of wireless technologies enable them to reach disadvantaged populations with low levels of income and literacy (World Bank, 2007). The world mobile phone market is thus increasing at an exponential rate. A number of researchers agree that information is at the centre of ICT4D initiatives (Gurstein, 2007; Heeks, 2009; Sife, Kiondo, & Lyimo-Macha, 2010). Mobile phones present cheap, easy and dynamic technologies for development purposes.

There are several reasons why mobile phones are considered particularly important for development in disadvantaged communities. One of the key benefits of using such phones is that they may be taken or carried around anywhere. In 2009, South African mobile phone ownership grew past the 100 percentile mark (Cellur-news, 2009). Although this increase could also be attributed to a growing number of people with multiple mobile phone subscriptions, in South Africa the percentage of households without access to a mobile phone is less than 6.3 percent (Lehohla, 2012). The decreasing prices of mobile handsets also contribute to the increasing mobile phone ownership. Based on these statistics, it makes sense to use a technology platform that is readily available to the people.

With that understanding of the role played by technology in socio-economic development, the following section gives a brief background to South Africa as a country.

2.4 Brief Background to South African context

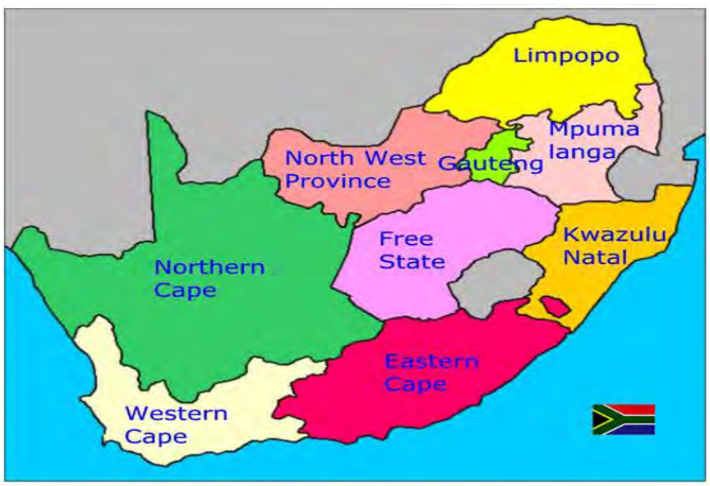


Figure 2-7: Map of South Africa (StatsSA, 2010)

Table 2-2 Country Indicators, South Africa

Indicator	Estimated Value	Report Year	Source
Government	Three spheres (National, Provincial and Local)	2012	(Lehohla, 2012)
Provinces	Northern Cape, Eastern Cape, Western Cape, Free Stare, North West, Limpopo, Mpumalanga, Kwazulu-Natal, and Gauteng	2012	(Lehohla, 2012)
Languages	11 Official Languages: English, Zulu, Xhosa, Venda, Pedi, Tswana, Sotho, Afrikaans, Ndebele, Xitsonga and Swati.	2012	(Lehohla, 2012)
Population	51 770 560 (51.3% female and 48.7% male)	2012	(StatsSA, 2011a)
Real GDP	R1,750 billion	2012	(Lehohla, 2012)
Unemployment	25.5%	Last Quarter 2012	(Lehohla, 2012)
HDI Rank	123	2011	(UNDP, 2011)
Literacy	88%	2011	(UNDP, 2011)
Life Expectancy	54,9 years for males and 59,1 years for females	3rd Quarter 2011	(StatsSA, 2011)

Table 2.2 above provides a snapshot of some indicators in South Africa. The South African government is a constitutional democracy with three structures of administration: national, provincial and local government. These structures are aimed at facilitating better management and monitoring. The National government (through the National Assembly) is the supreme law-making body with ministers of various departments and representatives from various political parties. The nine Provincial governments are bound by the law passed at national level and those developed at provincial level, specific to their needs. From the provincial government, service delivery is passed onto the local government, which is further divided into district municipalities and local municipalities for easy access to communities towards promotion of social and economic development.

With an area of 1 219 090 km^2, South Africa is classified as a middle-income country, with a GDP per capita of approximately R35 970 (or US $5 321), with GDP of R1 725.828 billion (or US $255.3 billion). The Statistics South Africa 2011 census estimates the population to be at 51.8 million (Lehohla, 2012). Although the Gauteng Province is the smallest province in terms of land area, it is the major economic hub of South Africa, and people migrate to it from all the other provinces and the rest of Africa in order to seek better living opportunities.

2.4.1 South Africa and Socio-economic Development

South Africa has a long history of human rights violations which was entrenched in the system imposed by the apartheid government resulting in total discrimination against the non- white people of South Africa. Post World War II, the minority Afrikaans government under the National Party came into power and apartheid was written into law in 1948. Under this reign, non-whites were treated as second class citizens, Africans as noncitizens and all anti-apartheid political parties were banned. To the further detriment of Africans (also referred to as Blacks) in South Africa, the 1951 Bantu Authorities Act established homelands and regional authorities which confined Africans to homelands with no basic rights, including citizenship (Harris, 2005). These homelands were known as the TBVC states, and included Transkei, Bophuthatswana, Venda and Ciskei. According to Phiri (2009), more than 31% of the country's population live in these poverty stricken former homelands, relying mostly on agriculture for survival or income augmentation. Although they were integrated back into the broad South African economy in 1994, the former homeland areas continue to experience poor living conditions and non-existent or more limited infrastructure when compared to other areas in South Africa.

Apartheid also had negative economic consequences for the nation as economic sanctions were imposed in an effort to force the National Party government to end the apartheid regime. These sanctions were lifted in 1990 when the government, under the presidency of F. W De Klerk, unbanned and entered into talks with the ANC (African National Congress) and other political parties (Laverty, 2007). Although effective towards forcing negotiations, these sanctions had negative consequences for the country's economy.

After the 1994 democratic elections, the then new South African government of national unity established initiatives aimed at improving the living standards of the country's residents as well as providing foundations for further development efforts. The Reconstruction and Development Programme (RDP) and Growth, Employment and Redistribution (GEAR) were the first amongst these initiatives, followed by initiatives like the Expanded Public Works programme (EPWO) and more recently, the Urban Renewal Strategy (StatsSA, 2010). Together with these developmental initiatives, there have been various ICT based investments that aimed at facilitating accelerated socio-economic development (James, 2010), but there is limited research to demonstrate the success of these projects. Figure 2.8 indicates that there are still severe racial disproportions in distribution of income, with Africans, who are in the majority, earning a much lower income than their white counterparts (Lehohla, 2012).

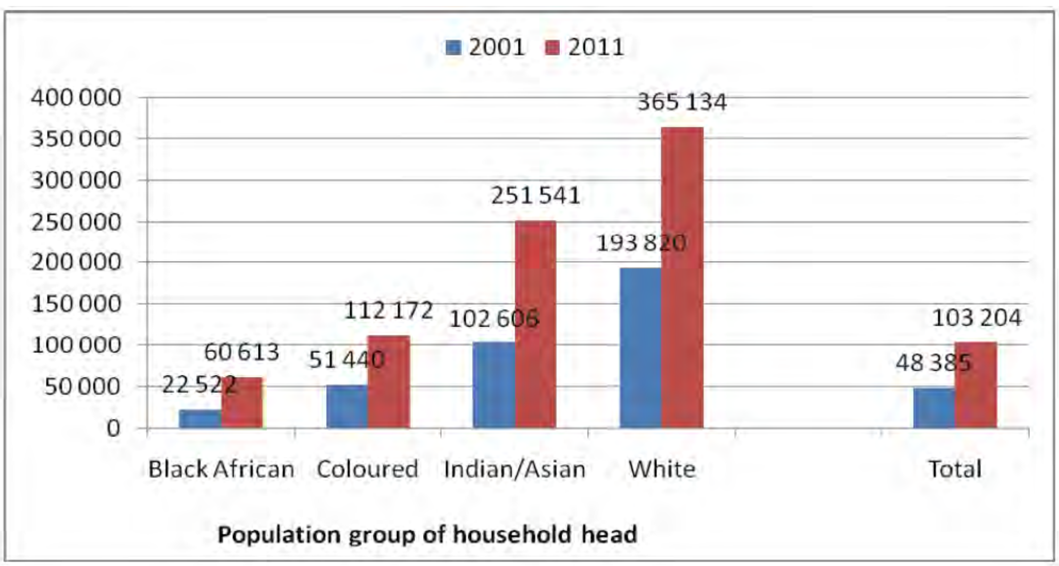


Figure 2-8: Average annual household income by population group of household head (Lehohla, 2012)

Although the political, social and the economic situation changed, the effects of segregation can still be felt in many communities as they are still facing calamitous cases of poor living standards, ill-health and drug problems. Challenges include, but are not limited to, little or no clean water supply, or electricity. Efforts like the RDP, BEE (Black Economic Empowerment), and ICT4D are aimed at identifying solutions that will lead assist in improving living standards for the disadvantaged communities.

2.4.2 The role of the South African government in facilitating ICT for development initiatives

In an effort to overcome development challenges, governments from different developing countries are establishing initiatives to ensure that government and ICT based services are brought closer to where people live (Benjamin, 2000). As one of these countries, South Africa is focusing on the improvement of ICT use by citizens of the country by rolling out initiatives like Thusong centres (formerly known as Multipurpose Community centres) around the country, with the government playing a vital role in policy formulation towards equal access to information. These centres act as one-stop centres for government and communication services. Telecentres are services within these Thusong centres, which act as channels for the provision of basic ICT services like computers, phone, fax, copiers and printers.

The following table (Table 2.3) indicates the changes in internet access in South African statistics from the year 2000 until 2009.

Table 2-3: South African populations and corresponding internet usage (ITU, 2010)

YEAR	Users	Population	% Penetration
2000	2,400,000	43,690,000	5.50%
2001	2,750,000	44,409,700	6.20%
2002	3,100,000	45,129,400	6.80%
2003	3,283,000	45,919,200	7.10%
2004	3,523,000	47,556,900	7.40%
2005	3,600,000	48,861,805	7.40%
2008	4,590,000	43,786,115	10.50%
2009	5,300,000	49,052,489	10.80%

In 2010, Statistics South Africa reported that the country was working hard towards achieving the MDGs (Millennium Development Goals) on time, including ensuring the use of technology to improve people's lives (Lehohla, 2010). The country has reported an increase in internet usage, with a reported estimate of 24% increase in 2011 (SAinfo, 2012). This could be attributed to the growing mobile phone usage, which enables easy access to the internet. However, Figure 2.5, shows that according to the 2011 census, about 65% of the South African population still do not have access to the internet. Of the 35% with internet access, 16%, access it from their mobile phones.

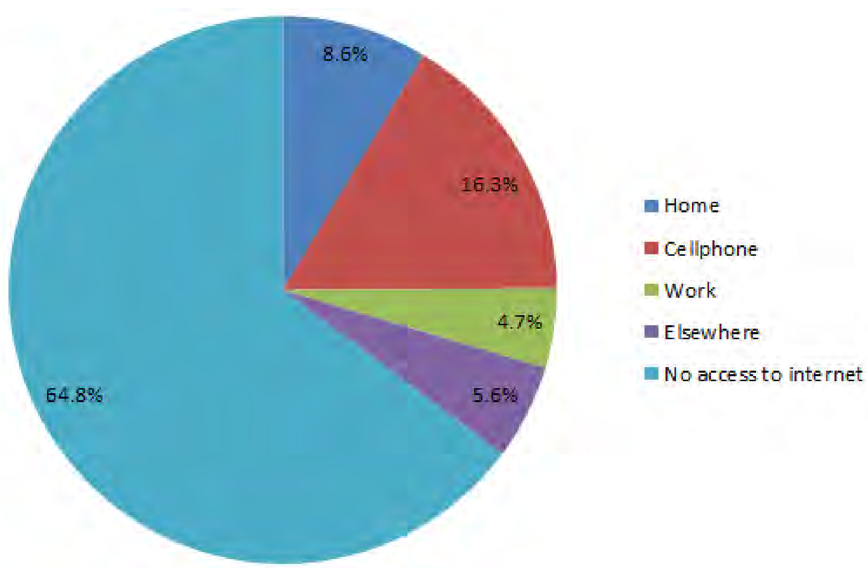


Figure 2-9: Percentage of households with internet (Lehohla, 2012)

The Universal Service and Access Agency of South Africa (USAASA), formerly known as Universal Service Agency (USA), the Presidential National Commission on Information Society and Development (PNC on ISAD) and the Living Labs are some of the initiatives by the South African government towards narrowing the digital divide and ensuring that all citizens have access to ICT.

2.4.3 Evolution of ICT4D Initiatives in South Africa

Looking back to the beginning of the 1990s at the role that ICT played in disadvantaged socio-economic development, it is evident that the South African nation is committed to the application of ICT to improve living standards. It was during the transition to the new governement (post-apartheid) that significant differences between the poor and the more affluent became apparent. The following are certain initiatives from government and other parties that form an account of how South Africa has participated in the movement towards using ICT to improve socio-economic conditions in the country.

2.4.3.1 Early Government Commitment

When the ANC government under the presidency of Nelson Mandela came into power, one of the focus areas was the use of ICT to close the wide gap between the rich and the poor (James, 2000). The government undertook to introduce, at policy level, strategies and structures to ensure that there was a solid ICT foundation in the country. In 1999, the Department of Trade and Industry and the Canadian International Development Agency (CIDA) commissioned a research project, the SAITIS (South African IT Industry Strategy), to develop an Information Technology (IT) Industry Strategy for South Africa (James, 2000). The research/survey was undertaken and carried out using interviews and workshops; its focus was firstly to establish the status of the ICT industry in South Africa and secondly to scan ICT jobs and skills. Amongst other things, it included identification of the major ICT players, geographical dispensation by province and city, use of ICT as a development tool and the overview of political and regulatory situations for the IT industry in

South Africa. The survey also looked at the perceived barriers and made recommendations for development of the IT industry in South Africa.

As discussed in the previous chapter, the government also established structures like the PNC on ISAD, SITA and USAASA. These structures are instrumental in ensuring South Africa's competitiveness in ICT implementation.

2.4.3.2 Phone shops

The early 1990s saw the introduction of what became known as phone shops, which were mobile pay phones made available even in remote areas where there was limited network availability. The phone capability was provided mostly by Vodacom, MTN, Cell-C and to a lesser extent Telkom (in SA) and paved the way for ICT access to most communities (Benjamin, 2001; James, 2000). These phone shops make use of the already available infrastructure by the aforementioned service providers.

During this period, personal mobile phones were still scarce and very expensive. As a form of income, emerging entrepreneurs would purchase a mobile phone (as a form of a franchise), load it with airtime and then charge people a specified fee to make calls to any phone.

People started using phones as the main form of communication, rather than writing letters to distant relatives. As mobile phone prices began decreasing, more people started owning mobile phones. If one person in a community owned a mobile phone, the neighbours and relatives had access to that mobile phone as people could receive calls and sometimes even make calls at a charge determined by the mobile phone owner. With the advent of affordable mobile phones, more and more people could afford them and thus phone shops became less popular.

2.4.3.3 Internet Cafés

Initially, internet cafés or kiosks were established in large cities and were mostly used by students and working-class people, as the data connection prices were high. When the telecentres (discussed below) were introduced in South Africa, internet use charges became cheaper; consequently, people in poor communities could use the internet to search for jobs and for information on various topics of interest (Infodev, 2009). An attendant usually assisted people who were unable to use the computer or the internet.

Another form of internet kiosk is the public information terminal. Public information terminals (PiTs) are an initiative of the Department of Communications and the South African Post Office. PiTs are standalone units through which the public can access information from the government and business via the internet (Zama and Weir-Smith, 2006). These terminals are placed in post offices and internet labs. Internet labs were later incorporated into what became known as internet kiosks or citizens' post offices for previously disadvantaged areas (Snyman, 2008).

The Council for Scientific and Industrial Research (CSIR)'s Meraka Institute, together with the Department of Science and Technology, also established what is called the Digital Doorway. According to Herselman, Smith, Gush, Cambridge, Botha, and Marais (2010), this refers to a robust single and multi-terminal digital doorway device that provides both cached and direct internet experiences in public locations to underserved, poor populations. Freely accessible computer equipment and skills transfer are the focus of the digital doorway projects, where people can experiment and learn (unsupervised) without formal training and minimal external input (Meraka Institute, 2009).

2.4.3.4 Thusong Service centres

The Government identified Multi-purpose Community centres (MPCCs) as a primary vehicle for bringing developmental communication and information programs closer to the people (Fourie, 2008). Initially called MPCCs, Thusong Service centres may be thought of as community information portals which offer services relevant and usable to a particular community. Hosted by the Government Communication and Information Systems (GCIS), the Thusong Service centre programme was initiated in 1999 (GCIS, 2007). For the purpose of this study, the definition adopted for a Thusong Service centre is that it is a one-stop, integrated community development centre within an underdeveloped community, where there is community participation and people's needs are addressed by the provision of relevant services aimed at their own development (Benjamin, 2000).

At least six Government departments, for instance, Home Affairs, South African Police Services and Social Development are among services that can be found in a Thusong centre. Other services include telecentres, a library and Youth Programme. (James, 2000).

2.4.3.5 Telecentres

Many authors agree that telecentres can be defined as strategically located facilities providing public access to ICT-based services and application, usually equipped with telecommunication services (telephone, fax, internet and email), office equipment (computers) and training facilities (Benjamin, 2001; Fourie, 2008; Infodev, 2009). It is believed that the telecentres were around as early as the mid-80s, although in different forms with the first telecentre in Africa being recorded as having opened its doors in 1998 (Etta & Parvyn-Wamahiu, 2003). The primary goal during their estblishment was to ensure access to computers for people in disadvantaged communities who did not own computers and were far from urban areas. Since then it has been possible to introduce ICT into disadvantaged communities through telecentres.

These initiatives have faced various challenges, including financial sustainability, theft of equipment, computer dumping, unskilled people running the telecentres, unavailability of the network amongst others. Meanwhile people from the disadvantaged communities complain about ICT4D initiatives as they feel that there is no tangible benefit in terms of job provision and hunger eradication. This reaction was not unexpected as it does not make sense to focus on having state-of-the-art computers in a village without meeting the basic needs in terms of electricity, safe drinking water, a poor education system and where the majority of households have no source of income. This demands a solid interaction with communities in order to first determine the needs of the people and decide on a better strategy for implementing an ICT4D initiative (Hameed, 2007; Snyman, 2008).

2.5 A Living Labs Approach to community information systems for Development

The basic premise behind the Living Labs approach is the early involvement of the user communities in their development initiative and adopting a learning cycle approach to accelerate innovation. A Living Lab approach to community development takes advantage of the diverse creativity of the participants and end-users to bring relevant, usable ICT products and solutions to communities in need. In South Africa; institutions of higher learning, the Meraka, SAP consulting, the public sectors and some Telkom Centres of Excellence are some of the participants in the development of community systems (Chaffers, Guzman, & Merz, 2009; Herselman, Marais, & Roux, 2009). The multi-stakeholder technique is instrumental in ensuring that development initiatives are not only aimed at meeting the needs of one party, but are also inclusive enough to take into account the needs of the various parties involved. Involvement of multi-stakeholders also brings hope that disadvantaged communities will indeed be the core beneficiaries of these initiatives. This, according to Bergvall-Kåreborn, *et al.,* (2009), is possible because Living Labs draw on the notion of external ideas as a resource to support innovation processes that lead to usable community products and services.

The systems that have been developed through Living Labs include enterprise based, logistics, agricultural and health based systems for communities. Some systems developed are aimed at ensuring the effectiveness and efficiency of processes and accountability amongst the stakeholders involved.

Bergvall-Kåreborn, *et al.* (2009), identified the following components of a Living Lab:

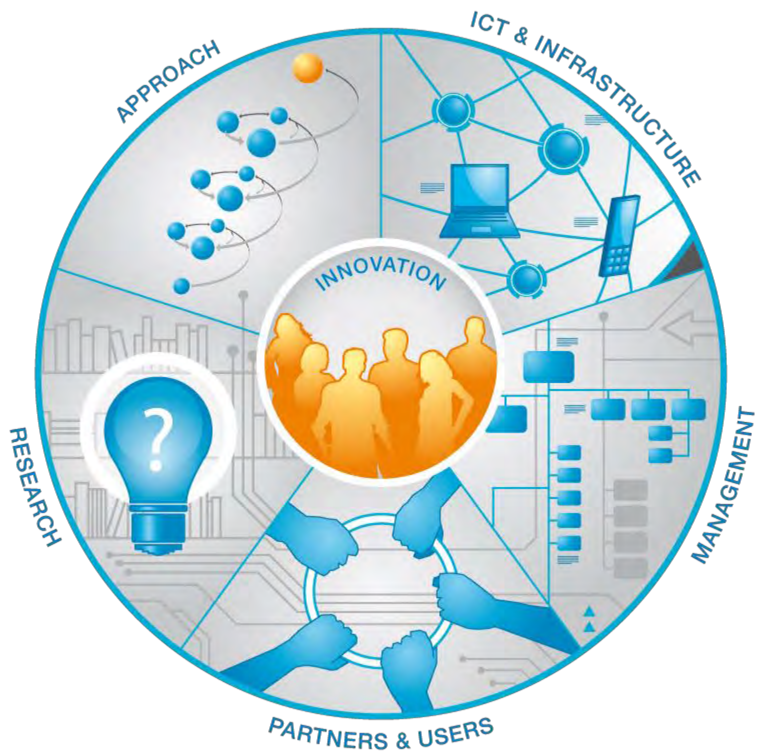


Figure 2-10: Key Components of a Living Lab (Bergvall-Kåreborn, Ihlström Eriksson, Ståhlbröst, & Svensson, 2009)

In summary, Figure 2.10 presents the actors and structures involved in the Living Lab:

1. The *ICT and Infrastructure:* this is about how use of technology can facilitate development through innovation.
2. *Management:* represents the ownership, organization and policy aspects of a Living Lab.
3. *Partners and Users:* parties involved and responsible for the Living Lab
4. *Research:* symbolizes the collective learning and reflection that takes place in the Living Lab, and should result in contributions to both theory and practice.

5. *Approach:* stands for methods and techniques that emerge as best practice within the Living Labs environment.
6. *Innovation:* the focus of all these components is to facilitate innovation towards improved living standards by facilitating user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values.

Table 2-4: Examples of some Living Labs found in disadvantaged communities in South African (Herselman, Marais, & Roux, 2009; Llisa, 2013)

LIVING LAB	INFORMATION
Limpopo	This Living Lab was planned by the Provincial Government. A feasibility report completed in 2007 proposed four focus areas for the Limpopo Living Lab namely, community projects (in technology and innovation), innovation solutions, business development and incubation of technology and innovation enterprises as well as training and development which are also part of the Limpopo ICT Institute.
Siyakhula	This came about through a partnership in the Eastern Cape between the Universities of Rhodes and Fort Hare. Rural ICTs focused on software applications, e-Services, Web 2.0, empowerment and community engagement.
Moutse	Partnership between the Ndlovu Medical centre, Elandsdoorn Development Trust, INTEL and Meraka. Education, telemedicine and rural connectivity.
Sekhukhune	Partnership between the Meraka Institute and SAP Research. Rural Micro-Service Enterprise creation and the development of ICT enabled collaborative work environments (e.g. collaborative procurement and logistics, collaborative stock management).
Soshanguve	Planned by Tshwane University of Technology (ICT Faculty); focusing on education, research, community development, and job creation.
Bushbuck Ridge	Partnership between SAP Research and Wits University. This system is an Electronic Patient Health System for chronically ill patients in rural areas.

Table 2.4, above, shows some Living Labs found in rural communities around South Africa. Other Living Labs are Reconstructed Living Labs (RLabs), SAP research Living Lab, awareNet Living Lab and North West Living Lab (Cunningham, Herselman & Cunningham, 2011). Each Living Lab is differently managed and addresses the needs of a different community. Some of the Living

Labs have already developed a community system/s whereas some are still planning to introduce the systems.

2.6 CHAPTER SUMMARY

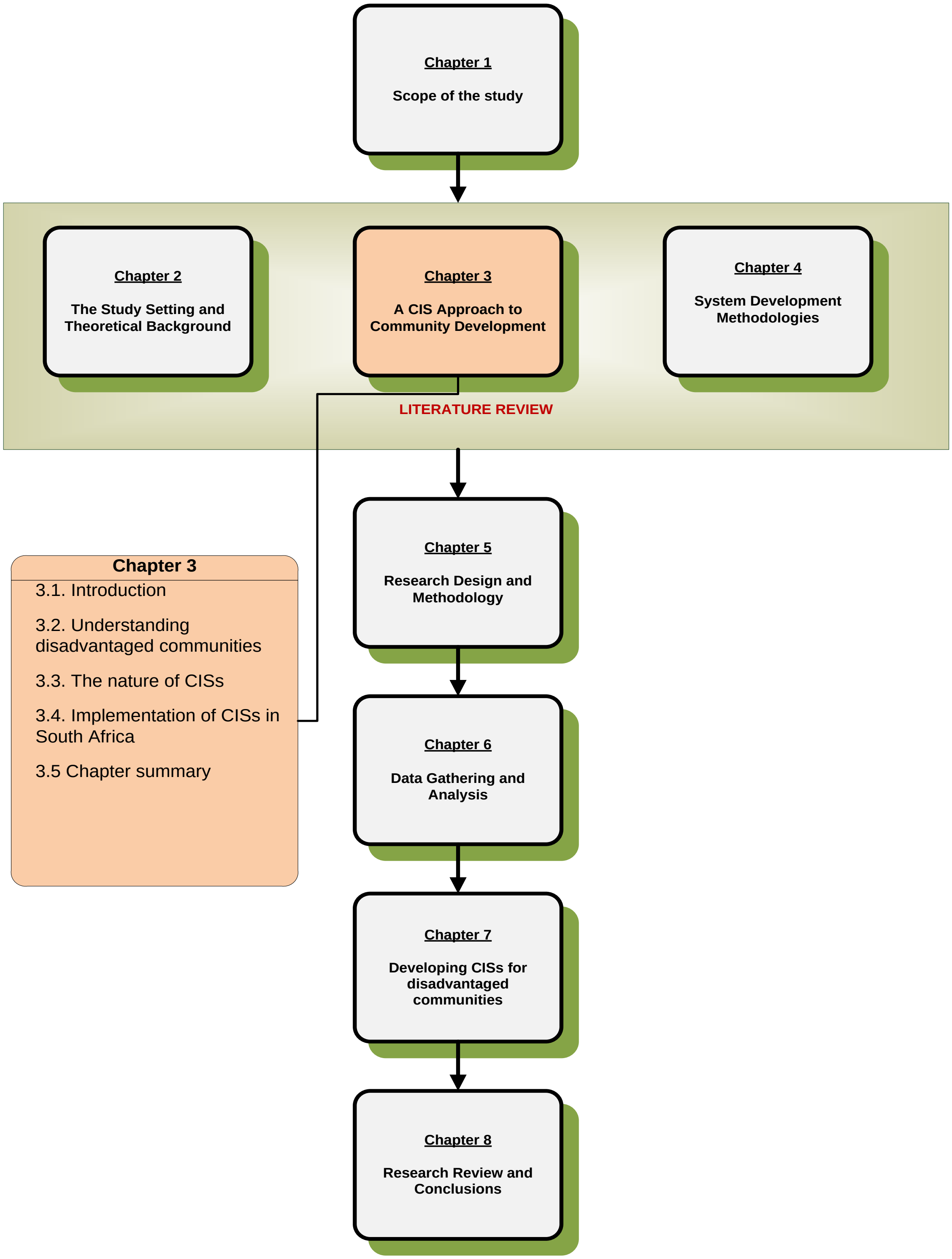
This chapter provided some foundational references to the study. The purpose is to make it easier for the reader to make connections to various chapters by using this chapter as a reference. This study covers socio-economic community information systems development in South Africa. A brief understanding of socio-economic development followed, where development was defined and an outline of development theories presented, including a discussion on the measurement of development. Various perspectives on measuring development have been presented, with arguments against the use of qualitative data as sole measures of living standards. A discussion has been offered on the role of ICT in improving living standards, including mobile technologies as appropriate technologies for disadvantaged communities, given infrastructural challenges.

A background to South Africa was also discussed, including an outline of some key statistics and the efforts made by the South African government in improving socio-economic development.

A Living Labs approach to community development was also introduced. A number of such labs have been established in South Africa to facilitate a participative approach to socio-economic development. The key components of a Living Lab have been established as ICT infrastructure, management, partners and users, research and approach (Bergvall- Karebom, Holst, & Stahlbrost, 2009).

The next chapter furnishes an understanding of the nature of community information systems as tools towards improved living standards in disadvantaged communities.

CHAPTER 3. A CIS APPROACH TO COMMUNITY DEVELOPMENT



3.1 INTRODUCTION

People living in disadvantaged communities still live in impoverished socio-economic conditions with very low per-capita income, inadequate education, minimal infrastructure and very limited access to telecommunication services. ICT4D that are not carefully targeted according to the needs of a disadvantaged community would face challenges and might ultimately be unused. A number of ICT initiatives have been implemented, not only as a means of narrowing the digital divide, but also to address various challenges and needs in disadvantaged communities. ICT initiatives provide resources and tools that serve individuals and communities by delivering access and empowering communities in areas such as local economic development, cultural affairs, civic activism and community based health and environmental initiatives (Harris, Songan, Khoo, & Bala, 2000; Donner, Gandhi, Javid, Madhi, Ratan, & Toyama, 2008).

ICT4D initiatives have evolved, with the initial focus being on reducing the digital divide by ensuring that people from disadvantaged communities have access to technology (Benjamin, 2001). There have, however, been various challenges associated with the implementation of ICT for socio-economic development initiatives. The past few years have thus seen a change in focus in the recognition of the role of ICT from ensuring access to addressing specific needs of communities through Community Information Systems (CISs). This focus has led to the growth of a fresh discipline commonly known as Community Informatics, aimed at designing and implementing ICT based projects for communities. Due to the complexity of the relevant communities and the scarcity of off-the-shelf applications, most community systems have to be individually developed as an experiment for successive systems (Harrison & Zappen, 2005).

This chapter presents discussions on CISs. A background discussion on different types of communities, as it applies to this study, is presented first, followed by a more detailed examination of CISs.

3.2 UNDERSTANDING DISADVANTAGED COMMUNITIES

The term “community”, is quickly becoming one of the sociological concepts that is difficult to define due to its broad nature. Traditionally, a "community" has been defined as a group of interacting people living in a common physical location. Network technologies have changed this tradition as more and more communities without physical boundaries are being established. Soanes, Sara, and Elliot (2009) defined a community as a body of people living in one place or united by one origin or interest. This definition covers some essential aspects about 21st century communities.

The definition of a community is no longer limited to people belonging to the same geographical location; with new definitions of community, people may live at opposite ends of the world but still be part of one community; such a community is known as a virtual one. A virtual community differs from other communities in that its common space is the internet. “Virtual communities” therefore describes the union between individuals or organizations who share common values and interests using electronic media to communicate within a shared semantic space on a regular basis (de Moor, 2007). Virtual communities are becoming even larger, due to the popularity of social networks and the growing mobile phone industry, which makes it possible for people in the most disadvantaged communities to interact with those from more affluent communities.

This research focuses not only on a community as a physical structure, but also one which becomes part of a virtual community through interaction with the CIS. The adapted definition of “a community” for this study is: “….a *group of people facing similar socio-economic challenges, with ongoing interactions and common interests”*. This definition does not confine a community to any particular physical space.

3.2.1 Distinction between Rural and Peri-Urban Communities

There are still challenges in distinguishing between different types of communities: rural, urban and peri-urban. This is probably due to the relative nature of the descriptions of various living conditions. For example, a small town could be defined as either rural or urban depending on its socio-economic status. In the United States of America an urban population is defined as all persons living in urbanized areas as well as places of 2,500 or more located outside urbanized areas; all populations not classified as urban constitute the rural population (Rios, 1988; US Census Bureau, 1995). These measures would not be useful in South Africa as they would mean that most overcrowded townships would be classified as urban. The current (South African) municipal demarcation is blurred because the dividing lines between city, peri-urban, large town, small town, farm and deep rural areas are unclear, working to the disadvantage of people in poor communities (DOH, 2009). The following classification is used by StatsSA (2009), with the first two being regarded as urban and the last two rural:

1. *Metropolitan area*: Metropolitan municipality, i.e. Cape Town.

2. *Other urban area*: Local municipality that includes a city or large town and has mostly tarred roads, piped water and flush sanitation, and a wide choice of services.

3. *Close rural area*: Local municipality that has small towns, > 50% of people live within 5 km of a tarred road, most have piped water but a limited choice of services within that local municipality.

4. *Deep rural area*: Local municipality that has small towns and/or old "resettlement areas", > 50% of people live more than 5km from a tarred road, > 25% of people use water from streams, rivers, dams or rainwater tanks and people have a very limited choice of services within that municipality.

This classification is not detailed enough to allow for a distinction between living areas in various communities of South Africa. Firstly, the use of a distance from a tarred road is no longer a distinguishing factor as the road infrastructure is being developed to allow easy connection between towns. This overlooks those people in deep rural areas whose houses are closer to the tarred road. The second omission is a further distinction of dwellings within the metropolitan and urban areas, peri-urban communities which are commonly known as townships. According to Macagnano (2002), peri-urban areas are characterized by:

1. Uncontrollable rise and growth of massive informal settlements, on any type of land, including farmland and nature reserves, established by people escaping the countryside, foreign oppression or simply poverty.
2. Unplanned road infrastructure created by informal users "as needed" and not according to a city plan.
3. Uncontrolled ad-hoc traffic circulation, through a natural habitat, dry riverbeds, delicate wetlands and city nature reserves.
4. Indiscriminate and badly located informal small enterprise developments.
5. Illogically and ad hoc distributed services, such as schools, crèches, shopping outlets, clinics (Located both as emergency and permanent provisions by metropolitan councils.)
6. Uneconomical and ad hoc distribution of infrastructure (sewage, water, electricity, telephone and roads reticulation).

The Muldersdrift Home Trust Foundation (MHTF) share similar views; it summarizes the plight of peri-urban communities as follows:

> *Although in close proximity to the Metropolitan cities or urban towns, the peri-urban townships lie officially outside the urban edge. Poor people here live in mixed-use settlements, essentially villages. Here they can benefit from having relatively close access to urban work opportunities, schools and health facilities while being able to also venture into farming and small business activities. The peri-urban black population in South Africa is composed largely of current and former farm workers and workers in allied service industries. This group, as the term peri-urban suggests, is neither fully rural nor urban in orientation and aspirations* (MHTF, 2007).

Various social and economic challenges confront people in these peri-urban communities. Poverty, unemployment, crime, violence, substance abuse are common in these areas (Macagnano, 2002; MHTF, 2007). These could be attributed to massive over population in some of these areas and the sub-standard conditions in which inhabitants live.

The following points are some characteristics of South African disadvantaged communities:

3.2.2 Attributes of disadvantaged communities in South Africa

Whether a peri-urban or a rural community, the following are some issues that affect the living conditions of people in these areas. There are some differences in the extent of prevalence of a particular issue, depending on whether a person resides in a rural or peri-urban community.

3.2.2.1 Very low income per capita

Per-capita income means the income per head or per person of the population and is accepted as a global indicator of poverty and wealth of a population (ETU, 2004). Rural people have low levels of income per capita as compared to the general population, with high levels of unemployment (Akinsola, Herselman, & Jacobs, 2005). Most disadvantaged areas are characterized by massive reliance on social grants as the main source of income. The South African rate of poverty is 45%, but in rural areas this figure rises to more than 50% (Fourie, 2008). Education and employment are some factors that improve income per capita because there would generally be a reduced number of heads per household, since women would have more opportunities to work.

3.2.2.2 Dependence on natural goods

The lifestyle of the community often depends mainly on agriculture and livestock farming (Fourie, 2008); this is more applicable to the rural communities where a large percentage of rural people are reliant on subsistence farming (Phiri, 2009), as opposed to commercial farming because of poor access to markets.

3.2.2.3 Poor access to essential services

Poor education and health are some of the challenges for those who live in rural communities. The majority of people in disadvantaged communities have low literacy levels and some have never received formal education (Rao, 2004). In some instances, schools and health facilities are at a distance and learners are forced to walk a number of kilometres to reach their school or clinic, particularly in rural communities. In addition, social problems such as HIV/ AIDS, drug abuse, crime and violence are also very prevalent in these communities and support centres are insufficient.

3.2.2.4 Poor infrastructure

Both rural and peri-urban communities are hard hit by a lack of good roads, electricity (power/ energy), telecommunication infrastructure (Wayi, 2006; Fourie, 2008; Akinsola, Herselman, & Jacobs, 2005) while access to good education and health infrastructure is also a challenge for rural communities. Moreover, poor roads mean that it is difficult for citizens to access suitable transport; thus transportation becomes expensive. This results in a great loss for small business owners such as farmers, because gaining access to a broader market is therefore difficult for them (Phiri, 2009).

Related to the issue of poor road infrastructure is that most disadvantaged communities still do not have access to electricity. Unavailability of electricity poses a threat to the establishment of community information initiatives as computers cannot be distributed to a community without power; however, use of an alternative means of power might be a solution. For instance, in Malaysia the e-Bario telecentres implementing team resorted to solar panels and diesel generators to ensure a stable power supply at the telecentres (Songan, Hamid, Yeo, Gnaniah, & Zen, 2004).

Access to telecommunication infrastructure is another challenge for disadvantaged communities. Non-existent and under developed telecommunication infrastructure remains a serious impediment to the expansion and use of ICTs in disadvantaged areas. While computer prices have declined, telecommunications continue to be costly and of limited availability. As stated in the preceding chapter, the developing countries still fall behind in the use of the internet. The financial cost of introducing ICTs into rural areas becomes costly (Ojo, 2006) due to poor telecommunications infrastructure and literacy training that must be undertaken; the use of wireless and mobile technology is proving to be a better and more affordable alternative for the disadvantaged areas.

These infrastructure challenges cannot be ignored when looking at a need for specific community based systems. Akinsola, Herselman and Jacobs (2005) agree that the success of ICT4D initiatives depends on availability, sustainability and the deployment of suitable infrastructure. This means that various government entities have a vital role to play towards ensuring that disadvantaged communities benefit from CISs.

3.2.2.5 Information systems illiteracy

Information literacy is a transformational process in which the learner needs to find, understand, evaluate, create and use information in various forms for personal, social or global purposes (Abilock, 2004). Although it is reported that basic language literacy[1] in South Africa is more than 50% (Gashi, 2010; UNDP, 2011), the same cannot be said for the levels of information systems literacy. Due to the infrastructural challenges described above, most people in rural areas have not experimented with ICT, and are ill-informed about the potential benefits they could reap from

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[1] *Literate*- People aged 15 years and above who are able to read and write are considered literate (Lehohla, 2010).

making use of ICT4D. Limited knowledge exists about information systems and the role these can play in a rural community (Rao, 2004).

3.2.2.6 Traditional Leadership

Traditional leadership is one of the attributes of a rural area (Kodua-Agyekum, 2009) and is an important aspect to be considered when establishing development initiatives in a rural community. These leaders exercise control over what is happening in and around the rural areas, and are significant stakeholders in any development initiative. Due to the communal land ownership systems where a traditional leader has control over the land, it becomes necessary to obtain the "go-ahead" from the community leader for any kind of development.

3.2.3 Information System Needs of Disadvantaged Communities

Existing socio-economic conditions in many disadvantaged areas are daunting, such that it becomes difficult even to commence sustainable development initiatives (James, 2010). As per the various views on socio-economic development (Todaro, 1991; Magnuson, 2010), development efforts should be linked to the needs of the community based on the living conditions and characteristics outlined in the preceding sections. This, however, does not suggest that the burden of satisfying the community's hierarchy of needs should be placed on the shoulders of developers, but that developers need to work with communities to identify a solution to their pertinent needs.

People in rural and peri-urban areas have aspirations for a better life in the same way as everyone else, but the challenges outlined above make it difficult to realise their ambition. The following are needs that are able to be addressed by information systems in disadvantaged communities. Addressing these needs is fundamental towards supporting the achievement of the Millennium Development Goals.

3.2.3.1 Social Needs

The socially related needs of people in disadvantaged areas are:

1. *Community Information:* Lack of access to information is one of the major challenges still facing people in disadvantaged communities (Infodev, 2009; Benjamin, 2001). Crime fighting, market information, job opportunities and information about community news would assist people in disadvantaged communities (Chigona & Licker, 2008). ICT4D makes it easy to access information that would otherwise be received through word-of-mouth, leading to delays or even message distortion.

2. *Education*: Education is one of the most important areas requiring attention for any country serious about development. It is acceptably used as one of the measures of socio-economic development in a country (Henderson, 1996; ITU, 2010). Provision of electronic assistance education programmes will go a long way towards helping learners in rural communities who have limited exposure to learning material and also poor laboratory equipment. This calls for a systems' approach to socio-economic development, which would see a number of government departments working together to bring education opportunities to rural communities.

3. *Health*: Health is a major challenge in rural communities. The fact that clinics from these areas are far from hospitals and other major health centres makes diagnostics challenging; the people could benefit from integrated memory management functionalities to assist the elderly to remember their chronic medication (Turker, et al., 2007). Another health issue is the difficulty in relaying information about new, threatening diseases and the action that people need to take. Social health issues such as substance abuse or HIV/AIDS become difficult to manage when services are far from people.

4. *Indigenous Knowledge:* The African communities have a rich knowledge about how to run their lives on a daily basis but that knowledge is not well documented. Documenting knowledge about the culture, the norms, the general way of living of people in rural communities has gained popularity as one of the important aspects of socio-economic development (Nyong, Adesina, & Osman, 2007).

5. *Access to Government:* Disadvantaged communities are usually the last to receive any kind of government developmental benefits due to infrastructural challenges. Due to long distances and lack of knowledge about the state programmes, people in disadvantaged communities tend to fall behind in accessing government services, including grants and other government subsidies.

6. *Risk Management Systems*: As people in these communities mostly rely on the radio for information, it becomes difficult to pass information on imminent risks to a particular village community. There is a need for systems that warn people of risks such as storms, outbreaks of disease, of fire and other impending dangers.

   As citizens become informed about what is happening in a country, their political awareness is improved and thus they can play an important democratic part in policy building (Fourie, 2008). People in rural communities need access to information that would assist them to make informed choices about their development.

3.2.3.2 Economic Needs

Facilitating means to ensure that people in rural communities are able to create and sustain their own wealth is an effective method to improve living standards and improve employment conditions. The following are two identified areas that could benefit rural communities if CISs were implemented.

1. *Agriculture:* Agriculture is one of the key sectors that could play a role in reducing poverty levels in South African rural areas (villages). Most village farmers are uneducated and thus only use cheap, informal markets (ConMark, 2006).

   Rural farmers could then use an agricultural-based CIS to access information about the current market prices and risks, customer needs, government assistance programmes, as well as establishing relationships with commercial farmers and livestock auctioneers. There is also a need for information concerning preserving the land for future production.

2. *Commercial Systems*: A further electronic need is a system which will link the small businesses in community to buyers whom they would otherwise be unable to access. The development of e-businesses platforms offers many possibilities for wealth creation and marketing opportunities, particularly for small and micro enterprises. An example would be that of a rural subsistence farmer wanting to sell a cow; all s/he would have to do would be to put information about the animal and the price on a particular portal so that people looking to buy a cow would have information about what is available in the market.

The information system needs outlined above could be fulfilled either by one system that deals with a specific problem, for instance, health, or a system could be developed that addresses the various needs of community. The dynamics of CISs are discussed in the rest of this chapter.

3.3 THE NATURE OF CISS

As mentioned above, ICT4D initiatives have been in existence since the late 1980s and have evolved over time. The realisation of the need to reduce the digital divide led to a flurry of initiatives aimed at bringing information technologies closer to the people and later, a need to provide systems customised to people's needs.

CISs become instrumental tools towards community development as they address an identified challenge from the community. Based on the e-government architecture by Heeks (2001), Figure 3.1 below illustrates the basic model of a CIS.

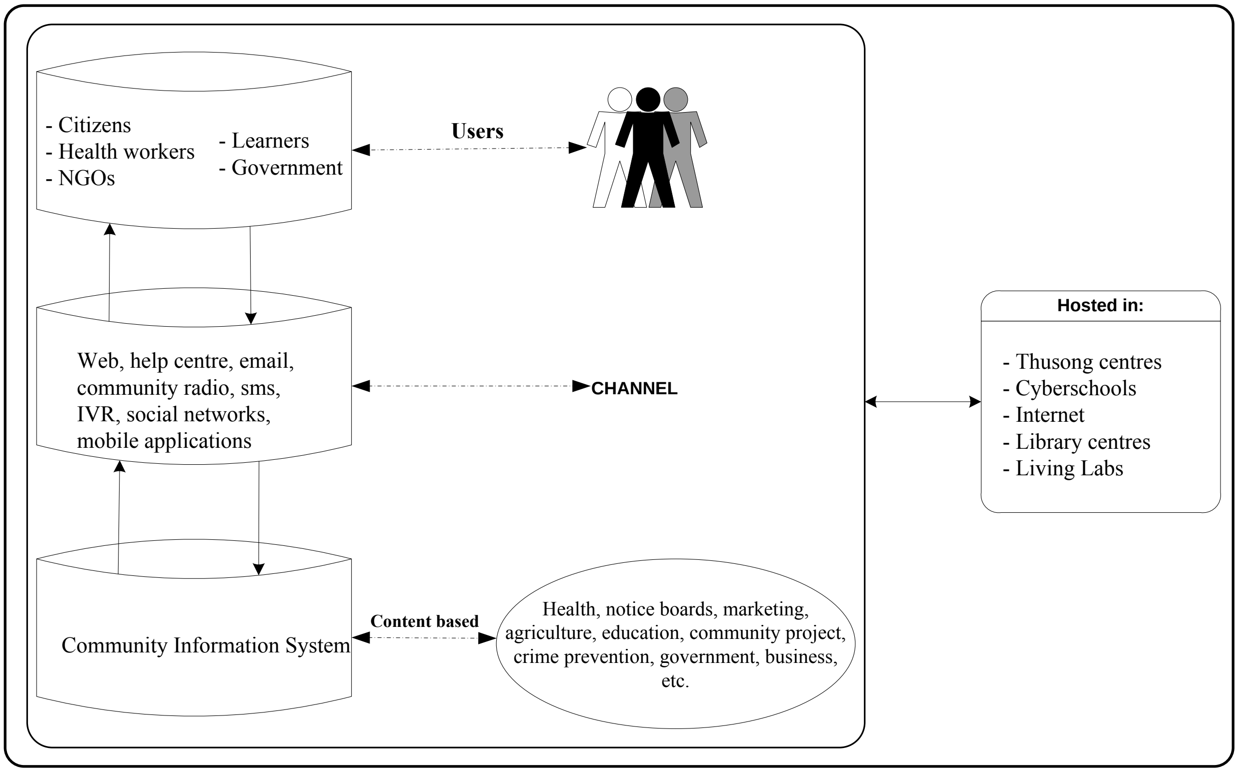


Figure 3-1: A basic model of a CIS development, adapted from Heeks (2001)

As depicted in Figure 3.1, CIS is content-based with information on various aspects of the community (see CISs examples later in this chapter) and information is available through channels like the web and help centres. The users in the systems are both recipients of and contributors to the content of the system (Donner, *et.al*, 2008).

CISs evolved from various other attempts by governments and agencies to bring ICT services closer to the people. The following section presents an outline on the evolution of CISs from across the globe.

3.3.1 History of CISs

A brief history of community systems is presented to depict the trends in CISs. According to Heeks (2009), the ICT4D initiatives started out with governments using ICT for the internal administrative functions of the public sector while multinational companies used ICT for delivering economic growth in the private sector. According to trend analysis, it was in about the 1980s that ICT4D started being a focus, mainly in first world countries.

The following are examples of some global community based information systems initiatives that were introduced in the period between 1986 and 2010.

Table 3-1: History of Community Information Systems

Year	Community System and Purpose	Source
1986	On July 16, 1986, Governor Richard Celeste of Ohio and Mayor George Voinovich of Cleveland opened the Cleveland *Free-Net,* which is believed to be amongst the first free, open-access, community computer systems.	(NEJM, 1986)
Late 1980s	During the late 1980s researchers at the University of Pittsburgh´s University Center for Social and Urban Research (UCSUR) established a CIS when they began experimenting with various sets of government and social data to assist decision making in the areas of crime prevention and neighbourhood improvement.	(PNCIS, 2013)
1996	The St. Louis Development Corporation in the United States of America and MORENet executed a contract to provide community networking services. MORENet is a branch of the University of Missouri, aimed at bringing the State of Missouri, public schools, libraries and communities online.	(CIN, 1996)
2000	In United Kingdom, a Bloxham Village website was created in March 2000 as a source of community information, including: local events, a notice-board, photographs of the village and useful links to village organizations.	(Banbury-Cross, 2000)
2010	Analytic mapping in geographic information systems was practically applied in the primary care setting, to track trends in healthcare, tracking child immunisations, conducting health policy research, and identifying potential health risks.	(Bazemore, Phillips & Miyoshi, 2010)

Table 3.1 indicates how community systems have evolved from a focus on access to technology to systems aimed at bringing community services online, and in 2010 to advanced GIS systems which are used for alerting communities about disease outbreaks in remote areas. According to Gurstein (2007), Community Informatics goes beyond the “Digital Divide” to examine how and under what conditions ICT access could be made usable and useful to disadvantaged populations and communities by supporting local economic development, social justice and political empowerment utilizing the internet. In an earlier work, Gurstein (2000) however makes particular mention of internet-based technologies, indicating there are systems that could be used both on and offline to support the needs of a particular community. The following section discusses how community challenges could be solved by using systems aimed at communities.

3.3.2 Addressing community needs through CISs

CISs systems have an important role to play in improving conditions faced by people in developing communities (Heeks, 2009; von Braun, 2010). One of the CISs noted for sustainability in South Africa is the Smart Cape Access Point Project, a City of Cape Town initiative aimed at ensuring that citizens of Cape Town have access to basic information about Cape Town, accessed through public libraries. The Smart Cape website offers various categories of information relevant to the people of Cape Town with its citizens only needing library membership in order to access the internet for free for a maximum of 45 minutes a day (Chigona & Licker, 2008). Although there are mixed views about the success of this project in achieving its objective, what cannot be ignored is that it has been running continuously since its inception in 2002.

CIS is the umbrella term that refers to ICT applications implemented to address the social, economic, political or cultural goals of a community (Stillman & Henry, 2009). Relevant ICT systems, if well implemented, could offer a platform from which these communities would benefit. Disadvantaged communities, as in South Africa's rural areas, are still lagging behind in terms of participation in global activities. This could be attributed to challenges related to successful implementation of telecentres as mentioned above.

Progress towards a more articulate theory is still very deficient in the area of CISs development (de Moor, 2007). This deficiency may be attributable to the complexity and diversity of the CISs field as the development of specific systems is very challenging, because the system should be linked to community problems and be usable by the people faced with the problems. One of the challenges of the development processes for CISs is difficulty in ensuring availability of the same individual stakeholders and beneficiaries throughout the process (Vercon, 2009). Involving community stakeholders is important as it improves continuity, thus ensuring computers not only serve their purpose as community technical tools but also as tools used to emancipate disadvantaged communities.

The advantage of having a CIS is that people may access systems that are able to meet their needs with whatever is available at that time. Government, education, health, agriculture, indigenous knowledge preservation and micro-entrepreneurship are at the forefront of the information based development needs in disadvantaged communities. In order to achieve the MDGs, CISs could play a vital role in meeting the information needs of the community by providing solutions to both the social and the commercial needs discussed above.

McIver (2005) sums up the social and commercial needs by stating that CISs enhance the opportunities of disadvantaged communities by:

1. Improving their access to market information and lower transaction costs (for poor farmers and traders);
2. Increasing efficiency, competitiveness and market access for micro firms in developing countries;
3. Enhancing the ability of developing countries to participate in the global economy and to exploit their comparative advantage in factor costs (particularly skilled labour);
4. Managing and improving health conditions; and
5. Improving education.

3.3.3 Categories of CISs addressing Socio-economic Development

South Africa has implemented a number of ICT4D initiatives with community specific systems. Living Labs located around the country offer potential in terms of systems developed with the needs of the community in mind. Below is an outline of some Living Labs and some CIS initiatives already in existence in South Africa.

3.3.3.1 Community Information Pages

Some CISs provide web-based, local directories with information on events and news happening around the community. Some even act as portals for all businesses, much like the Yellow Pages, providing information about a business; for example, someone looking for a TV repairer or for someone selling livestock would find those facts or details through the information system at the community centre. These sites provide information about various activities in the community and sometimes users can take advantage of interactive content like Smart Cape (http://www.smartcape.org.za) and Cosmo city (http://www.cosmocitynews.co.za/home.htm) systems. The Cosmo city community website covers information related and relevant to the community. The information covered includes a notice board, crime reporter, community policing forums and information on meeting dates.

3.3.3.2 The Government information gateway

The Government's Gateway programme is aimed at ensuring access by citizens to government services and information. The information is available in a website format and is available in several South African languages. According to Moshapo and Hanrahan (2004), geographic distance is the most significant barrier to people's acquisition of effective services which may only be accessed in affluent urban areas. This has been a major challenge to people in rural communities as they have had to travel long distances for government services. An example is that people would travel long distances to the city only to be informed that the services they require are unavailable on that particular day.

In South Africa, the government gateway enhances electronic access to government information and service, thus reducing the geographical, language and income barriers (www.gov.za).

Government to citizen communication refers to information shared between the government and the citizen and does not only apply to citizens in urban areas. According to the South African State Information Technology Agency (SITA), the e-government gateway creates opportunities to establish multi-functional, technology-enabled urban centres, which provides access to all government services, as well as other related commercial activities in a single facility.

The government gateway supplies a platform where, through access to government information, local communities may pose their questions to government, using these facilities. This means that without physically interacting with government, access to information would enable people to participate more in government policy and legislation making.

3.3.3.3 e-Health

These are health based systems that assist with improving health management in rural communities. An example is a Tele-health system in Tsilitwa, a rural village situated 50km north of Mthatha (Eastern Cape, South Africa). It is an initiative of the University of Cape Town to help nurses in clinics to communicate with doctors who are in a hospital 20km away from the village. Through this system the clinic sister is able to interact with the doctor at the hospital through data, voice and video communication via a wireless system. This facilitates cost-effective healthcare for patients who would have had to travel long distances (Turker, *et al*., 2007).

Mobile technologies have opened a major platform for using CIS to solve various social challenges.

3.3.3.4 e-Agriculture

In most of the rural communities of developing countries such as South Africa, people in the community are still dependent on agriculture as their main economic activity and the lack of necessary infrastructure (like roads) means that people stay far from the major centres and health or government information services. The centres are therefore used by the communities to obtain information on how to better their agriculture, and also to gain advice on different health issues such as disease outbreaks, that could be a threat to their trade (IVRP[2], 2001).

3.3.3.5 e-Education

The extent of a country's education is one of the measures of a country's Human Development Index, and education is a core element contributing towards a country's globalization efforts. Education is amongst those needs considered as basic in any community and education based systems could play a vital role in improving the quality of education in rural communities. International development agencies have also emphasized the potential of ICT to improve the performance of state organizations, the delivery of health and education services, and democratic participation (Luna-Reyes, Zhang, Gil-Garcia, & Creswell, 2005).

The Siyabuswa Educational Improvement and Development Trust (SEIDET) project in Mpumalanga is an example of a prominent community based ICT project that has made inroads into the education field for disadvantaged communities (Phahlamohlaka, Braun, Romijn, & Roode, 2008). SEIDET is amongst some education community initiatives regarded as successful in South Africa. Siyabuswa is a village located in Mpumalanga, about 150 kilometres from Pretoria. The SEIDET project was formed in order to help the disadvantaged children of Siyabuswa with regard

[2] IVRP- Information Village Research Project

to mathematics and science education that prevented them from entrance to tertiary institutions and education. Phahlamohlaka *et al.,* (2008) attribute the success of the SEIDET project to the united commitment and participation from the community of Siyabuswa, who took ownership of it.

3.4 Implementation of CISs in South Africa?

It is interesting to note that more than two decades after the first recorded ICT4D initiatives, there are still serious challenges regarding the implementation of ICT4D in South Africa. CISs are also not immune to these challenges. According to Heeks (2009), failure of ICT4D initiatives has been downplayed and suggests that the majority of ICT based initiatives end in:

1. *Total failure* of a system that never works
2. *Partial failure* in which major goals are unattained or in which there are significant undesirable outcomes
3. *Sustainability failure* that succeeds initially but then fails after a year or so
4. *Replication failure* of a pilot scheme that cannot be reproduced.

There are several challenges regarding the implementation of ICT for development initiatives in South Africa. At this point there is still a dearth of studies about the extent to which these systems achieve their goal and their impact as experienced by people in rural communities. It seems that from the point of view of research, there is sufficient research output both in terms of papers and postgraduate students (James, 2010; LLiSA, 2009). The closed nature of the projects aimed at socio-economic development, however, creates barriers to outside researchers who would like to evaluate the success or failure of these initiatives. The establishment of Living Labs promises a more open, accountable approach to research and innovation in disadvantaged communities.

There is no single universal reason that can be attributed to failure of the CISs. Insufficient community participation, poor system development and sustainability seem to appear frequently. Some of the challenges are related to characteristics and challenges facing disadvantaged communities (discussed above). In South Africa, specifically, these systems seem to have been overwhelmed by challenges like financial stability and maintenance of the systems. The Living Labs approach to ICT4D, however, promises a more defined, learning-based and accountable method to the design and development of systems aimed at development. Some of the general challenges facing the implementation of community systems and possible solutions are outlined below.

3.4.1 Lack of awareness about the benefits of ICTs

This may be attributed to insufficient consultation from developers about how people could benefit from the system. Community based intermediaries are important from a language perspective in explaining the benefits of the CIS (Heeks, 2009b).

3.4.2 System not addressing the needs of the community

A number of researchers agree that the lack of a local champion in driving the development of a rural community is the main reason for the failure of the ICT4D initiatives (Chigona, 2006; Heeks, 2009a; McIver, 2005). A local champion has a deep understanding of the culture and the norms of the community and is capable of promoting any community development initiative. According to Bieber, McFall, Rice, and Gurstein (2007), stakeholder involvement is vital for the successful implementation of a community based information system.

3.4.3 Infrastructure challenges

People in many of the disadvantaged communities, especially those in rural areas, remain impoverished due to a lack of access to basic infrastructure, enabling economic growth and development (Merz, De Louw, & Ulrich, 2007). This means that a CIS will be confined to a community centre where there is usually a special allocation of electricity. This means that even if there are funds available for a CIS in an unwired village, lack of electricity would mean that a particular rural community would not gain access to the CIS.

Government intervention and use of available infrastructure are possible solutions to this challenge, by provision of new, low-cost devices for local electricity generation and better ways to store, and transmit electricity (Heeks, 2009a). Access to mobile phones has increased at an accelerated rate in developing countries, (Rashid & Elder, 2009) and developers could use this phenomenon as an opportunity for developing mobile applications.

3.4.4 Language Barrier

Recently there have been increasing numbers of discussions about exaggerated illiteracy in rural communities. According to research, adult literacy even in the very poorest countries of the world is still greater than 50 percent (Heeks, 2009a; Donner & Escobari, 2010). Although this is the case, it does not mean that people in rural communities are English literate and thus language does affect user perceptions about successful implementation of a CIS.

According to research conducted in Ganyesa (a rural village in South Africa) (Heeks, 2009a; Donner & Escobari, 2010), about 78% of the respondents stated that language was one of the factors affecting the use of the PiT system (Coleman, Herselman, & Jacobs, 2008). James (2010) adds that the lack of a shared understanding, language and culture of innovation and innovation systems in South Africa further complicates implementation of ICT4D initiatives.

3.4.5 Poor System Development

There is a general tendency by the developers of a community system to assume that a formal process is not necessary when developing a community based information system, leading to omissions such as minimal user participation and a system that does not meet the needs of the community (James, 2010). A proper system development methodology is necessary to reduce chances of a system failure.

3.5 Chapter summary

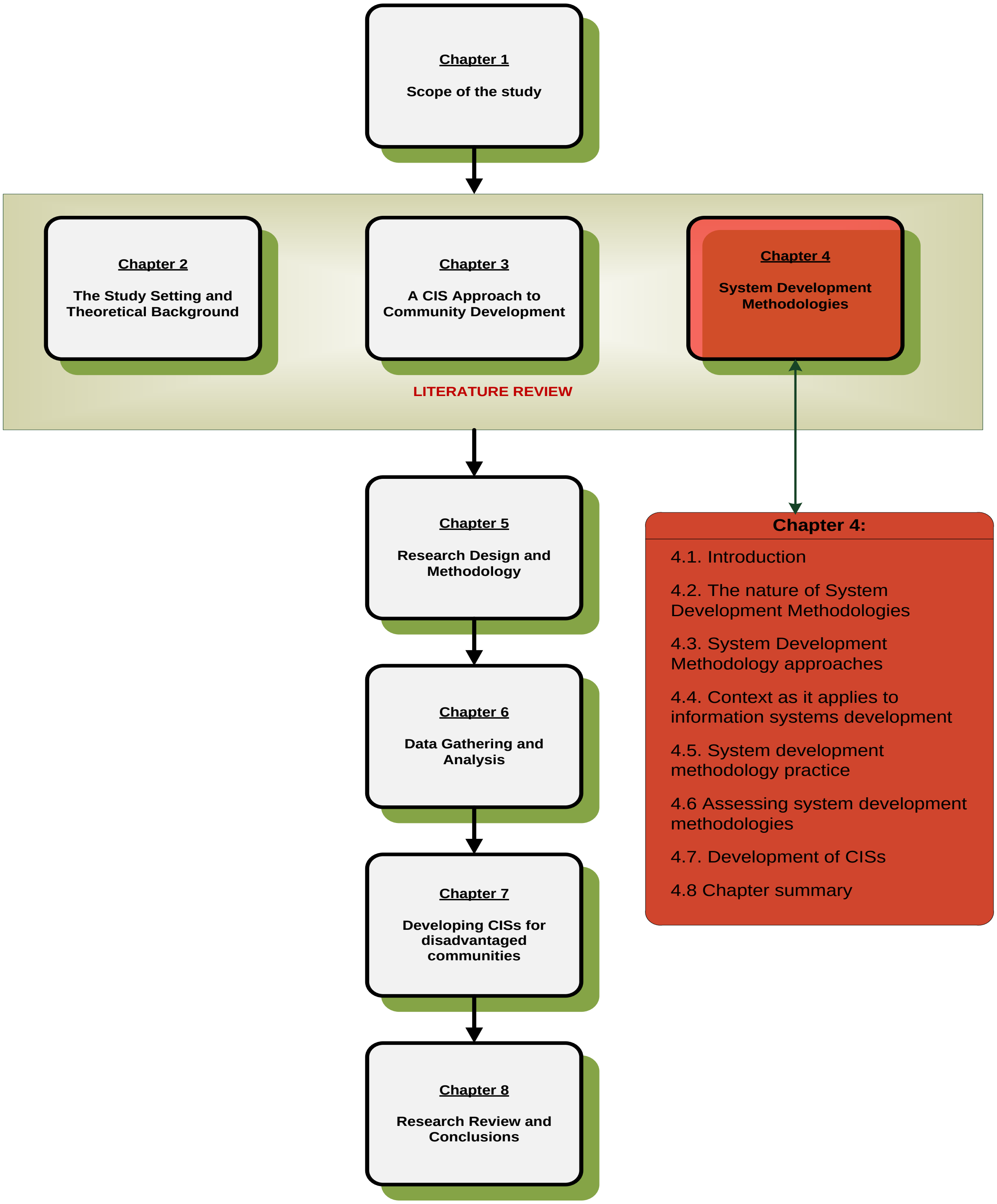
This chapter presented a background on community information systems. Community, as a concept, was defined and the distinction between various community sectors was established. The chapter also presented an outline of the history of ICT4D and community information systems. From the discussions it is evident that there are still challenges to the implementation of ICT initiatives and systems aimed at social and economic development of poor communities.

Developing a community information system is very different from developing a normal organization due to complex community dynamics. The nature of users of a rural based CIS necessitates that a development process different from the normal organisational process has to be undertaken. The social dynamics of rural communities cover a far wider spectrum compared to the usual limited structured social interaction found in organizations (Stillman & Henry, 2009).

Unlike that of an organizational setting, a system developed for a disadvantaged community is usually conceived from the identification of a need by the developers, not the users (community) as is usually the case in organisations (Donner, *et al.*, 2008). This means that from their inception there is a distinct chance of systems being developed only from the developer's point of view. Use of specific system development methodology that takes into account the social aspect of computing would minimize this mistake, as users would be taken into consideration. Creating specific development methodology suited for disadvantaged communities, whether physical or virtual, is at the core of bridging the gap between technology and community dynamics (Oyugi, Dunkley, & Smith, 2008). A need for a SDM as a solution to challenges concerning developing and implementation of CIS aimed at socio-economic development has thus been established.

The following chapter presents discussions on system development methodologies.

CHAPTER 4. SYSTEM DEVELOPMENT METHODOLOGIES



4.1 INTRODUCTION

The main focus in any information system development project is the satisfaction of the users when a system meets their requirements. This becomes a primary determinant of the success of the system. In the recent years its attraction has not only been due to the fast evolution of technology, but rather to problems that emanate from the prevalence of ICT product failures (Schwalbe, 2010). Research shows that failures in system development projects may be traced back to as early as the 1950s and software problems still exist.

In the early years of computing, information systems were developed with little or no use of a formal system development methodology (Walters, Broady, & Hartley, 1994). This led to problems as the developers' focus was placed more on the technology while ignoring the needs of the users (Avison & Fitzgerald, 2006). With the rapid increase in the use of information and communication technologies, there has been a swift evolution of development methodologies. The default usage of traditional system development methodologies has been blamed for failures in systems. The rigid nature of these methodologies made it difficult to fit and use them for various project situations (Harris, Songan, Khoo, & Bala, 2000).

Proliferation of new systems development methodologies to accommodate different projects and user circumstances continues unabated and is encouraged by emerging technological fields and trends. ICT4D is one such field and due to its unique social nature, context based SDMs have been recommended (Roque, Almeida, & Figueiredo, 2002).

There is a dearth of studies on the use of SDMs when developing community based systems. This makes it difficult to construct a tool measuring the effectiveness and efficiency of these methodologies (Mavetera, 2009).

This chapter presents a discussion on system development methodologies; understanding of system development methodologies; categories of system development methodologies and then a presentation of various approaches that have been established on choosing a correct system development methodology for a project.

4.2 THE NATURE OF SDM

The information systems industry has experienced unprecedented growth in recent years with people using software-based solutions in solving everyday problems. People from all walks of life are directly or indirectly exposed to some information system, be it through using public telephones, mobile phones, automatic teller machines or the army's intelligence apparatus. In order to exist and function, these systems must be developed and there are people and structures responsible for doing so.

Avison and Fitzgerald (2006) define information system development as a way of conceiving, analysing, designing and implementing information systems. A system development project is initiated when a need for a particular system is identified. According to Pressman (2007), projects could be preceded by an identified need to:

1. Correct a defect to an existing application
2. Adapt a legacy system to changing business conditions
3. Extend the functions or the features of existing applications
4. Create a new product, service or system

Information systems' researchers agree that system development is one of the core areas in the Information systems field (Fitzgerald, Russo, N & Stolterman, E, 2002; de Vries, 2004; Avison & Fitzgerald, 2006). For any computer-based tool or system to be initiated, several activities have to take place which involve management, a development team, clients and other stakeholders. Project management activities include items such as creating schedules and budgeting; system development includes activities such as choosing a methodology, and performing requirements analysis and doing the programming. During the process of ISD, methodologies are applied to ensure that certain chosen principles are adhered to by the development team. The definition and purpose of SDMs are presented in the following sections.

4.2.1 Definition of SDMs

There are many definitions of the term "system development methodology" due to the amount of research on the topic. The confusion with a generic definition may be attributed to the number of SDMs used and their differing applications. Iivari & Iivari (2011) conclude that a methodology offers a systematic procedure for a system. Various stages are followed within a methodology to reach the desired result. An outline of methodology definitions proposed by various authors is presented in Table 4.1 below:

Table 4-1: Various definitions of SDM

	AUTHOR/S	METHODOLOGY DEFINED
1.	Soanes, Sara, & Elliot (2009)	A body of methods, rules, and postulates employed by a discipline.
2.	Charvat (2005)	A set of guidelines or principles that can be tailored and applied to a specific situation: it is a specific approach, templates, forms, and even checklists used over the project life cycle.
3.	Avison and Fitzgerald (2006)	A collection of procedures, techniques, tools and documentation aids which help the systems developers in their efforts to implement a new information system.
4.	Veryard (1987)	Is a generalized set of methods and procedures used in projects.
5.	Granger and Pick (1991)	A system of technical procedures and notational conventions for the organized construction of software.
6.	Russo, Wynekoop & Walz (1995)	A general framework of phases or activities.
7.	O'Docherty (2009)	Is a systematic way of doing things, a repeatable process that can be followed from the earliest stages of software development through to the maintenance of an installed system.
8.	Schach, (2010)	Methodology is the science of methods.
9.	Walters, Broady, Hartley (1994)	An information systems development methodology can be defined as a collection of procedures, techniques, tools and documentation aids that will help the systems developers in their efforts to implement a new information system.
10.	Rambaugh (1995)	A system development methodology should consist of a set of fundamental modelling concepts to capture semantic knowledge about a problem and its solution, a set of views and notations for presenting underlying modelling information, a step-by-step iterative process of constructing models and implementation of them and a collection of hints and rules of thumb for performing development.
11.	Satzinger, Jackson and Burd (2008)	A system development methodology provides guidelines to follow for completing every activity in the system development lifecycle, including specific models, tools and techniques.

There is a superfluity of other definitions of system development methodologies. The selected definitions are aimed at showing that although the processes are not very recent, there is still no universally accepted definition of the system development concept. However, most of the definitions concur that the concept of system development methodologies consists of procedures followed in developing a system of good quality.

A discussion of the differences between "*Methodology"* and "*Method*" would probably call for a separate chapter, supported by clear and unequivocal volumes of empirical or philosophical evidence. There are differing views in the research spectrum (including information systems) on the distinction and the relationship between the concepts of methodology. Some researchers are of the view that a method is a part that occurs within a methodology to ensure that objectives are met. A number of researchers believe that the two concepts mean the same thing and that their application is similar. As an example, Jayaratna (1994) argues that the term methodology is pragmatically well established within the field of information systems to mean the same thing as method. The English language, however, tells a different story. According to English linguists, whenever '*ology*' is added to a word it means that there are theories associated with that particular word. The same applies to methodology as a concept.

For the purpose of this research, the terms "methodology" and "method" are treated as differing in meaning from one another. "Methodology", here, is defined as a as a *combination of a system development approach, a system development method, a system development process model and a system development technique* whereas "method", here, is defined as *a systematic way of conducting at least one complete phase of system development* (Huisman & Iivari, 2006). It might be observed from the definitions presented above that although there are various authors, there is a constant reference to a SDM as an approach, a process, model and a technique. These concepts are briefly outlined in the following subsections.

4.2.1.1 System development approach

An approach is a philosophical view of the methodology. Iivari and Iivari (2011) share a common view and define a system development approach as a class of specific system development methodologies that share a number of common features. The most common approaches to development are socially based approaches or technically based approaches. A more detailed discussion on system development is presented in section 4.3.

4.2.1.2 System development models

A SDM could be thought of as a way of developing information systems. The following sections discuss traditional, agile and prototyping models used during system development.

4.2.1.2.1 Traditional Systems Development model

This SDM is based on the belief that a particular phase during development must be completed before the next phase starts. Users of traditional models of development follow a linear process from problem identification to the delivery of implementation of the system. Avison and Fitzgerald (2006) consider this as a strength in this model as it ensures better control of the system development process. Checkpoints are usually used for review of each phase to ensure that all aspects that need to be covered in that phase are fully covered. This model assumes that "normality" prevails during development, with less consideration of many changes that might be necessary. In cases where change is required, a formal change process is then followed (Schwalbe, 2010). The graphic representation of these phases in software development resembles the downward flow of a waterfall (Schach, 2010), as shown below.

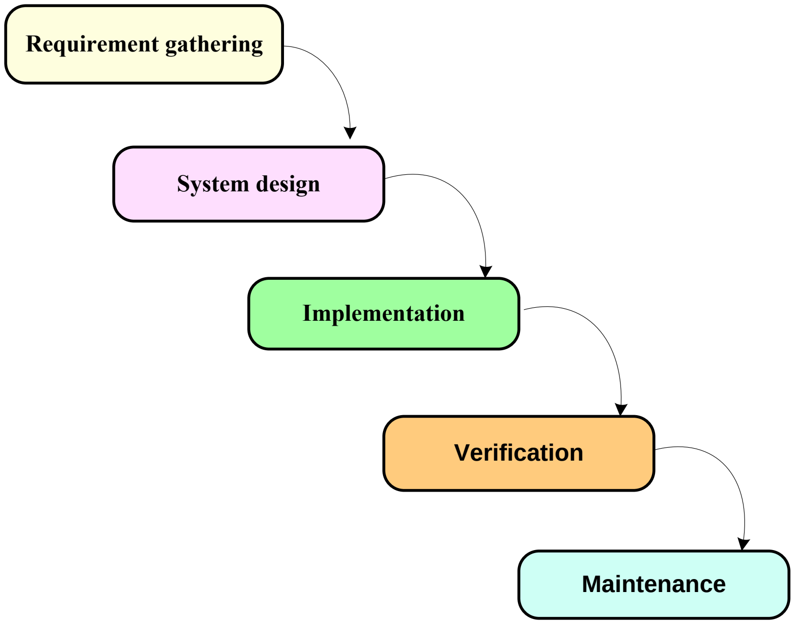


Figure 4-1 SDLC model (Schach, 2010)

As depicted in Figure 4.1, a preceding stage has to be completed for the following phase to occur. There are various SDMs that fall under the traditional model of development. Regarded as heavyweight methodologies, traditional models are usually suited for software projects where there is stability and predictability in terms of project goals or requirements (Charvat, 2005; Faridani, 2011). Although they might differ in application, these methodologies are based on phase-to-phase development; some are better used when the system developed is small, while some do not cover all the phases, such as the Structured System Analysis and Design Methodology (SSADM) (Avison & Fitzgerald, 2006).

The traditional system development methodological model is characterized by:

1. Top-down, phase-to-phase development
2. Emphasis on documentation
3. Emphasis on processes and tools
4. Phase-review carried out at the end of each stage

5. May be used for large systems

4.2.1.2.2 Agile approach to system development

As systems gained in sophistication, it became apparent that the traditional way of development could not be applied to all system development situations. Challenges related to poor quality, schedule and budget overruns were attributed to the rigidity of a traditional model of system development. The development community experienced a strong need for more lightweight methodologies that would be more adaptable to the customers' requirements, whilst ensuring constant interaction between the development team and the users (Faridani, 2011). This need led to the establishment of agile methodologies and in 2001 a meeting held by a group of seventeen agile "initiators" resulted in the signing of an agile manifesto (Fowler and Highsmith, 2001). The manifesto consists of principles and values that characterise an agile model. The values, according to Fowler and Highsmith (2001), are:

1. *Individuals and interactions* over processes and tools.
2. *Working software* over comprehensive documentation.
3. *Customer collaboration* over contract negotiation.
4. *Responding to change* over plan follow-throughs.

These values and principles opened up a wave of new SDMs such as eXtreme programming, which made famous the concept of two programmers working together in one code, known as pair programming (Faridani, 2011).

Agile methodologies adopt a test-driven approach to developing systems through various iterations of the system. In a traditional development model, the entire system is built and then tested and a change process is followed if there is a need for modifications. This is different from the agile model where each developed portion of the system is tested with more flexibility in the modification. Flexibility and customer involvement at each stage is the crux of agile approaches to system development. It is wasteful and counter-productive only to consider the original requirements, without considering changes in customer needs (Koch, 2011). Agile methodologies are also more applicable to situations that are highly uncertain and unpredictable. This calls for constant interaction with the users of the system; in some cases the presence of user representation in the development team is required throughout the project.

4.2.1.2.3 Prototyping

This is a SDM based on the premise that it is not always possible for the users or developers to know all the requirements of the intended system. When the prototype is demonstrated users have an opportunity to see a mock-up of the system, or parts thereof and are able to comment and suggest further changes or improvement to the system. Through high levels of user involvement, prototyping attempts to present the users with an early view of the proposed system by presenting a version of it (Walters, Broady, & Hartley, 1994). When the needs of the user are not well defined, it, the prototype approach, is frequently used; it is built in order to try out some of the functions of the finished product (O'Docherty, 2009). Acceptance and possible use of the finished product by the users is thus highly likely as they have contributed to its development.

Prototyping addresses some of the problems of traditional system development, where the users only get to experience the system during implementation when it is too late to make any changes (Avison & Fitzgerald, 2006; Kendall & Kendall, 2010). According to Avison and Fitzgerald (2006) prototyping is most beneficial for the following projects:

1. Unclear or unstable requirements
2. High innovativeness
3. High system impact on the organisation or users
4. Relatively small project or relatively small number of users
5. Relatively short project duration and
6. Where commitment of users to a project is required

There are various reasons why prototyping might be a preferred model for the users and developers. Some of the reasons are that it:

1. Enables the development team to better understand the environment and the problem being addressed (Green & DiCaterino, 1998). Sometimes the development team might not be familiar with the dynamics of the institution or the community for which the system is being developed.

2. Demonstrates what is actually feasible with existing technology (Green & DiCaterino, 1998). User experimentation with the system is able to give the development team ideas on how better to address the problem at hand.

3. Gives the team a potential for changing the system early in its development and an opportunity to stop development on an unworkable system (Kendall & Kendall, 2010).

4. Does not need to be elegant (O'Docherty, 2009). This is because the intention is to quickly show the user possible functions and controls of the new system.

5. Enables quick development as it is often developed with specialised tools such as screen painters and report generators (Avison & Fitzgerald, 2006). Development of the final system is also much quicker as the development team is clear about what is needed.

Over and above the points mentioned above, one benefit of prototyping is ensuring user participation during system development.

Green & DiCaterino (1998) and Avison & Fitzgerald (2006) identify two types of prototype; a throw-away and an iterative prototype. The throw-away usually uses toolkits and focuses on quickly building an artefact for experimental purposes, whilst with an evolutionary prototype, the system goes through iterations until the final product is achieved (Green & DiCaterino, 1998) (Avison & Fitzgerald, 2006).

4.2.1.3 System development process

Satzinger, Jackson and Burd (2008) define an information systems process as an action or series of actions which produce a change or development by transforming data from one state or form. A process is thus a series of activities undertaken in order to reach a certain goal. Processes represent the progression of activities from the beginning until a desired goal is reached. There are various processes used in information systems; a Data Flow Diagram (DFD) and an Activity Flow Diagram (AFD) are the most common to show the flow of events from the beginning to the end of the process (Pressman, 2010).

A system development process is made up of the following phases, commonly known as a system development life cycle (SDLC), (Avison & Fitzgerald, 2006; Schach, 2010; Maguire, 2000).

Table 4-2: Software Development Lifecycle Phases

PHASE	DESCRIPTION
Feasibility Study	This phase occurs immediately after the need for the system has been identified. The feasibility study checks if it will be practical to develop the identified system as a solution to the problem at hand taking into account the technical, legal economic and organizational circumstances in the information system's organization or division (Avison & Fitzgerald, 2006).
System Investigation	Also regarded as the requirements definition stage, this phase concerns finding information about the proposed system. Functional and non-functional requirements of the system are identified during this phase (Schach, 2010).
System Analysis	Systems analysis is all about obtaining a detailed understanding of information relating to a proposed system collected previously (Avison, Shah, Powell, & Uppal, 1992; Pressman, 2010).
System Design	This phase is concerned with how various components of the system will interact to bring about the desired outcome (Pressman, 2010).
Implementation	The actual coding and development of the system takes place during this stage. A completed system is delivered to the user for operation.
Review and Maintenance	This is regarded as the final stage of SDLC. The system is reviewed to ensure that it conforms to the requirements as stated by the user (Avison & Fitzgerald, 2006) and relevant maintenance is carried out based on the outcome.

The table above indicates that a common process of developing a system includes analysis of the current situation, solicitation and specification of requirements, design of the system, implementation, and ensuring that the system continues to serve the needs of the customers (Pressman, 2010). Some methodologies only cover certain aspects in the process, like analysis

(Soft Systems Methodology (SSM)) or the analysis and the design of the system as covered by the SSADM. Some methodologies use different tools like object oriented analysis and design in Object Oriented Methodology (Avison and Fitzgerald, 2006). Although processes differ depending on the team and the chosen methodology, there are some similarities in the rationale for use of a certain development phase.

4.2.1.4 System development technique

A methodology consists of phases, themselves consisting of sub-phases, guides the systems' developers in their choice of techniques that might be appropriate at each stage of the project and also help them plan, manage, control and evaluate IS projects. A technique can be thought of as a way of doing something, helping the users to understand how certain activities and processes need to be carried out.

Satzinger, Jackson & Burd (2008) define a technique as a collection of guidelines that help an analyst to complete a system development activity or task. One of the popular techniques used in information systems is a data-modelling one which organizes data on the database for better usability. Techniques make use of various models or diagrams to represent data and activates, such as Data Flow diagrams or Entity Relationship diagrams.

4.2.2 Purpose of SDMs

Developing a system without applying any kind of methodology increases the probability of system failure (Pressman, 2010). However, the use of a methodology in system development should in no way be regarded as a short-cut to business solutions. Development personnel should rather consider a chosen methodology as a regulator throughout the project. According to Ramsin and Paige (2008), software development methodologies provide the means for timely and orderly execution of the various finer-grained techniques and methods of software engineering. When a

SDM is applied effectively it is much easier to trace problems that might occur during development and the team is able to check its progress against any set criterion.

The common purpose of any SDM is to provide a series of phases and activities carried out during development (Avison & Fitzgerald, 2006). Differences amongst SDMs used in the industry do not imply superiority of one methodology over the others, but could be aligned to differing contexts of application. One SDM could be more pertinent, for instance, in addressing social issues, organizational issues, engineering issues or a combination of issues. A need for a new or updated system is a common trigger for the use of a system development methodology irrespective of the nature of the issues addressed.

Schach (2010) states the following as reasons for the deployment of a methodology during system development:

1. A methodology may assist in imposing discipline on the coding effort, thus leading to a code that is more extensible, usable and easier to read.
2. Going through even the basic steps of a methodology increases our understanding of the problem, improving the quality of our solution.
3. At every stage, a methodology specifies what should be done next, such that developers know the next action to be undertaken.
4. Help developers to spot conceptual and practical errors before committing them to source code.

Avison and Fitzgerald (2006) believe that the choice of a SDM depends on and is guided by a need to address certain objectives. This means that information SDMs are themselves tailored to meet certain objectives, making one SDM different from another. A development methodology devised for primary school lessons is different from a system devised for a retail business. Avison and Fitzgerald (2006) identified the following possible objectives for SDM selection:

1. To record accurately the requirements for an information system.
2. To provide a systematic method for development so that progress may be affectively monitored.

3. To provide an information system within an appropriate time limit and at an acceptable cost.
4. To produce a system which is well documented and easy to maintain.
5. To provide an indication of any changes that need to be made as early as possible in the development process.
6. To provide a system that is acceptable to those people affected by the system.

These objectives, as identified by Schach (2010) and Avison and Fitzgerald (2006), are further summarized in Table 4.3 below:

Table 4-3: Objectives of SDM from various authors

	Objective	**Cross Reference to stated objective**
1.	Provide a structured way of developing software	▪ To record accurately the requirements for an information system (Avison & Fitzgerald, 2006). ▪ To provide a systematic method for development so that progress can be effectively monitored (Avison & Fitzgerald, 2006). ▪ At every stage, a methodology specifies what should be done next, such that developers know the next action to be undertaken (Schach, 2010).
2.	Limit probability of failure	▪ To provide an indication of any changes that need to made as early as possible in the development process (Avison & Fitzgerald, 2006). ▪ Help developers to spot conceptual and practical errors before committing them to source code (Schach, 2010).
3.	Improves System maintenance	▪ To produce a system which is well documented and easy to maintain (Avison & Fitzgerald, 2006). ▪ Impose discipline on the coding effort, thus leading to a code that is more extensible, usable and easier to read (Schach, 2010).
4.	Development of system that meets user requirements	▪ To provide a system that is liked by those people affected by the system (Avison & Fitzgerald, 2006). ▪ Increase understanding of the problem, improving the quality of the solution (Schach, 2010).
5.	Limit resource wastage	▪ To deliver the information system within an appropriate time limit and at an acceptable cost (Avison & Fitzgerald, 2006). ▪ Impose discipline on the coding effort, thus leading to a code that is more extensible, usable and easier to read (Schach, 2010).

4.2.3 History of SDMs

System development is as old as the history of computing. There are vast differences in how systems were developed in the early stages of computing compared to current development practices. This is partly due rapid growth in the software industry and the realization of the importance of business principles during development. Growth in the software industry may be understood as a response to an ever-growing technical hardware industry. The difficulties with software development could thus be attributed to the complex nature of software relative to hardware (Pressman, 2010).

Avison and Fitzgerald (2006) identified the following “eras” in software development methodologies:

4.2.3.1 The pre-methodology era

This is the era from the beginning of computing to the early 1970s. Programming and solving technical problems was the emphasis, with less understanding of business needs (Avison & Fitzgerald, 2006). To illustrate this, Jayaswal and Patton (2006) use the example of 1950s/1960s models of Volkswagen automobiles which were manufactured and then sold to customers without much testing; a user would then take back the faulty system for repairs at no cost and the cycle would continue. This would not last long in the software industry where time, scope, costs and quality are regarded as equal determinants of success. A product and a company would have lost clients whilst waiting for the software developer to fix problems.

4.2.3.2 Early-methodology era

The focus on technical details of the system led to substantial failures in the software being developed in the early 1960s. The early methodology era was characterized by a growing need to build computers through phases and stages (Avison & Fitzgerald, 2006). There was a concomitant growing need for controlling the process of software development.

According to Schach (2010), emergence of software engineering as a practice in information systems dates as far back as 1968 when a decision was taken by a NATO conference delegation that due to failures, software development would have to be treated as an engineering discipline. This was probably one of the most important paradigm shifts in the industry.

Since the 1970s, the System Development Life Cycle (SDLC) followed in the development of systems (Avison & Fitzgerald, 2006). SDLC, commonly referred to as the waterfall model, is a phased approach consisting of sequentially ordered stages. Other traditionally-based methodologies such as the SSADM were also introduced (Dahiya, 2010).

4.2.3.3 Methodology era

The rigid nature of the SDLC stages and some associated limitations, including that of too much emphasis on the documentation as well as a technological focus, led to the continued proliferation of "new" SDMs. These beliefs led to the proliferation of various information SDMs from which system developers could choose. Avison and Fitzgerald (2006) state that from the 1980s throughout the 1990s practice and theory paved the way for the proliferation of methodologies in almost any software being developed.

Many ways of developing software ensued, hence the many categories of SDMs which are addressed later in this chapter.

4.4.3.4 Era of methodology reassessment

The last stage is what Avison and Fitzgerald (2006) regard as the review of methodologies by organizations from the 1990s. The review was a response to failure in software projects, attributed to a choice of bad methodology or "inappropriate" use of a particular methodology. A focus on object oriented development and agile methodologies characterizes this era (Wirth, 2008; Iivari & Huisman, 2007). Outsourcing of development efforts has become popular as organizations try to shift responsibility to an organization that deals specifically with developing systems.

4.2.4 Categories of SDMs

One of the difficult decisions facing the system development practitioner is to find a methodology appropriate to a particular system, environment or an organization. There are a number of organizations and people who are involved in the development of information based systems, and each development is characterised by differences in system needs and also differing beliefs about the concept of system development. This makes it difficult for one developer to adopt the exact SDM used by another developer. Avison and Fitzgerald (2006) mention that SDMs are usually based on some philosophical view and developers do not hold the same views about systems or system development. A system aimed at achieving similar objectives may go through different development processes, depending upon the people involved and the circumstances surrounding the development.

Various researchers (Boahene, 1999; de Vries, 2004; Avison & Fitzgerald, 2006) have generated differing theories on selecting a system development methodology. Avison and Fitzgerald (2006) advocate the use of seven elements in a framework for categorizing SDMs. These elements are:

1. Philosophy: They define a philosophy as a set of principles underlying the methodology; the conceptual underpinning of a particular methodology. Social informatics could be the philosophy surrounding the community based information systems. Four factors are used to further explain this element:

Table 4-4: Philosophy as a methodology principle

Principle	Explanation
Paradigm	This is a specific way of thinking about problems. In software development two main paradigms are the scientific and system ones (Avison & Fitzgerald, 2006; Mihailescu & Mihailescu, 2010).
Objective	This can be development of a computerized information system; analysis and design of the problem area or improvement to business processes.
Domain	Domain refers to the scope and the boundaries of the problem being solved.
Target	This refers to the application of the methodology.

2. Model: This is the representation of the world surrounding the information system, i.e. verbal vs. mathematical.
3. Technique and tools: The manner in which things are done during the development process. According to Huisman and Iivari (2006) the correctness of the application of a technique determines the achievement of set outcomes. Flow diagrams, development languages and applications are some of the tools used during system development.
4. Scope: This involves identifying the boundaries of a particular methodology.
5. Outputs: These are the deliverables from the deployment of the methodologies.
6. Practice: This includes, among others, the background of the methodology: how long it has been used and in what kind of environment is it applicable.
7. Product: This is about what people receive at the end of the process; whether it be documentation, software, or after-sales service.

Using the framework developed by Avison and Fitzgerald (2006), Table 4.5, below, maps methodology groups against the elements mentioned above. A combination of the elements for the categorization of system development methodologies assists in the selection of a correct methodology, given the environment surrounding the methodology, as illustrated.

Table 4-5: Methodology Categorization based on discussions from Avison and Fitzgerald (2006)

ELEMENT/ **METHODOLOGY**	**PROCESS-ORIENTED**	**BLENDED**	**OBJECT-ORIENTED**	**RAPID DEVELOPMENT**	**PEOPLE-ORIENTED**	**ORGANISATIONAL-ORIENTED**
Philosophy	▪ Engineering/ Scientific ▪ Develop computerised systems	▪ Engineering/ Scientific ▪ Develop computerised systems	▪ Engineering/ Scientific ▪ Develop computerised systems	▪ Engineering/ Scientific ▪ Problem-solving	▪ Social and technical systems ▪ Personal relationships	▪ System based ▪ Improvement of business processes
Model	▪ Process-oriented	▪ Process-oriented	▪ Object oriented	▪ Process-oriented	▪ Socio-technical	▪ Process-oriented
Technique and tools	▪ Essential	▪ Not essential	▪ Essential	▪ Essential	▪ Essential	▪ Not essential
Scope	▪ Process based	▪ Data based	▪ Object and Process based	▪ Results based	▪ People based	▪ Process based
Outputs	▪ Computerised system	▪ Computerised system	▪ Computerised system	▪ Prototypes	▪ Human relations	▪ System analysis
Practice	▪ Commercial ▪ IS professionals	▪ Commercial ▪ IS professionals	▪ Commercial ▪ IS professionals	▪ Commercial ▪ IS professionals	▪ Academic ▪ Facilitator and Users	▪ Academic ▪ IS professionals
Product.	▪ Computerised system ▪ Manuals ▪ Books	▪ Computerised system ▪ Manuals ▪ Books	▪ Computerised system ▪ Manuals ▪ Books	▪ Computerised system ▪ Manuals ▪ Books	▪ Computerised system ▪ Manuals ▪ Books	▪ Computerised system ▪ Manuals ▪ Books
Examples	▪ YSM	▪ SSADM	▪ OOA/ RUP	▪ DSDM	▪ ETHICS	▪ SSM

4.3 SDM APPROACHES

There are hundreds of methodologies in use in the market (Harris *et al*., 2000). Studies have shown that pragmatic devotion to a particular methodology is a difficult task in the development environment. Organisations and development teams should undertake rigorous activities to ensure that an appropriate methodology is used during system development (Singh & Kotze, 2003). This is, however, not an easy task as there are myriad issues that need to be taken into consideration.

4.3.1 The early 'Build-and-fix it model'

Jayaswal and Patton (2006) classify this methodology as one of the development models used during the pre-methodology era in which testing was not part of system development. This is an instance where no particular methodology was followed. There is little adherence to any rules or standards when this model is followed. One character of build-and-fix is the absence of requirement and design specifications (Schach, 2010). This creates problems as there is no quality measurement of the software product. As may be observed in Figure 4.2 below, after development, a product is taken to the customer for use and "testing"; it is then that proper evaluation is conducted.

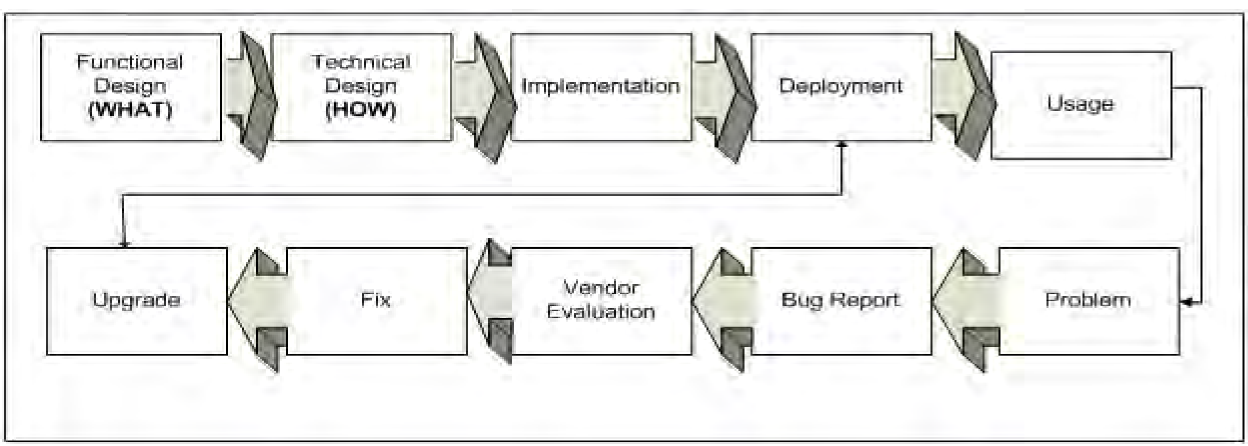


Figure 4-2 Build and Fix model (Jayaswal & Patton, 2006)

This methodology would not work on large or risky systems as failure to operate could lead to loss of life, for instance, in medical systems. It would definitely not work in today's competitive environment where customer satisfaction has become the main factor in software development.

According to Jayaswal and Patton (2006), this approach to development would probably work only in a monopolistic environment where customers are limited to the product of a single organisation.

4.3.2 Process-oriented methodologies

These methodologies are based on the traditional SDLC and mostly deal with pre-defined problems. Of utmost importance in these methodologies are the processes followed and the functionality of the system. In their classification of methodologies, Avison and Taylor (1997) identified Class 1 methodologies as those methodologies with a well defined and well structured problem situation and clear objectives. Process based methodologies would be included in this class. Examples of process based methodologies are Waterfall, Structured Analysis and Design of Information Systems (STRADIS) and Yourdon Systems Method (YSM) with emphasis on data structures (Yaghini, Bourouni, & Amiri, 2009). The main disadvantage of these methodologies is that there is limited user interaction (Avison & Taylor, 1997; Yaghini, Bourouni, & Amiri, 2009).

4.3.3 Object-Oriented Methodologies

These are methodologies that stress the understanding and the modelling of the system based on real world objects. Object-Oriented Analysis (OOA) applies object orientation to the analysis, design and implementation stages of system development (Pressman, 2010). According to Yaghini, *et al., (*2009), the emphasis of OO methodologies is the "what" rather than the "how" of the system, ensuring that objects are defined based on boundaries existing in the real world of the system. A typical OO based methodology, based on original principles by Jacobson, Booch and Rumbaugh, is RUP (Rational Unified Process) which emphasizes the use of guidelines and templates during the process of system development. Unified modelling language (UML) is a tool utilized for analysing the user requirements when employing object orientation.

4.3.4 Rapid Application Methodologies

When quick or iterative based solutions are needed, Rapid Application Development (RAD) methodologies are employed. The RAD methodologies accelerate development of the system through a constructive iteration approach where a prototype evolves into a working system with approval from the users (Whitten & Bentley, 2008). According to Pressman (2010), RAD is a "high speed" adaptation of the waterfall model with a fully operational system developed in a short period. An example of this is the Dynamics System Development Method (DSDM). These applications are more applicable to small systems and when the involvement of users is possible.

4.3.5 People-Oriented Methodologies

People-centred concerns are becoming important during the development of information systems as developers realise the significance of user involvement in the success of the system. The high rate of failure of information systems projects and the extensive use of computer systems by people of different social backgrounds, led to a shift in attitude of system developers and analysts. The user is no longer regarded as only an interviewee in the process, but plays a more participative role throughout the development of the system (Avison & Fitzgerald, 2006). This change in attitude is instrumental in enabling success for the development of systems for non-business use, for example, education systems.

Participation during system development is an important principle behind people-oriented methodologies. Participation implies that there will be greater awareness of not only the technical aspects, but also the human aspects of development. Recognition of socio-technical issues helps in enhancing understanding of the system from perspectives of people at different levels in the organization and in this case in the community (Walters, Broady & Hartley, 1994).

Effective Technical and Human Implementation of Computer-based Systems (ETHICS) methodology is popular for implementing a people-oriented participative approach to information systems development (Avison and Fitzgerald, 2006). ETHICS advocates the identification of roles and responsibilities in designing an approach that focuses on the technology and the organizational context in which the technology is placed.

4.3.6 Organisational-Oriented Methodologies

These are decision-making based approaches whose focus is on the organizational change and improvement of organizational processes. Soft System Methodology (SSM) helps with solving structured problems. SSM is used most often during the analysis stage of system development.

4.3.7 Blended Methodologies

These methodologies are said to capitalize on the best attributes from selected methodologies and emphasize data (Avison and Fitzgerald, 2006); SSADM is an example of these methodologies.

4.4 CONTEXT, AS IT APPLIES TO INFORMATION SYSTEMS DEVELOPMENT

The importance of context in developing information systems has been a key issue since the much publicised Standish Report on the high rate of failures of information systems. Context is a broad topic that applies a SDM based on the current development conditions (Roque, Almeida & Figueiredo, 2002). As pointed out earlier in the chapter, for an extended period of time traditional methodologies were default methodologies used in developing information systems. With the growth in the information systems development industry and the recognition of the volatile nature of user requirements, more flexible methodologies, commonly known as agile methodologies, are becoming popular.

4.4.1 Environment and system development

The environment in which system development takes place is important and should be considered in choosing a system development methodology (Boahene, 1999; Avison & Fitzgerald, 2006). Adopting a systemic approach emphasises a holistic consideration of the system development environment, which is probably what is missing in most failed system development projects. The table below presents the elements and the characteristics of the environmental factors as identified by Boahene (1999), which are then discussed.

Table 4-6: The System Development Environment (Boahene, 1999)

ELEMENTS	CHARACTERISTICS
Staff	Skills, background knowledge, experience
Stakeholders	Problems, interests, expectations
Power/ Authority	Organisational structure, influence
Procedure/ Process	Sequence of steps, tasks, deliverables
Technoogy	Computer language, hardware platforms, tools
Requirements	Stated, implied, anticipated and non- stated needs

Table 4.6 shows some aspects that need to be considered when making decisions about a methodology to be used. Faridani (2011) uses a similar approach to Boahene and indentifies key characteristics for consideration when making decisions about a SDM to use for a particular project.

4.4.2 Perspectives to SDMs

Harris, *et al.,* (2000) identify the Social Systems approach and Technical Systems approach as two main perspectives to SDM. These perspectives have also been applied by other researchers (as per the discussions below). A social system approach recognizes that systems are developed for people, whereas the premise of a technical systems approach is that technology is developed to solve problems. The latter approach is, however, losing momentum as more and more industries realise the importance of considering end-users when developing systems.

According to Harris *et al.,* (2000), a social approach emphasizes the context within which the system will be embedded, how the context interacts with the system and their interaction. Culture and human characteristics are some of the factors that a social based development context takes into account. According to Patnayakuni and Ruppel (2008), the social approach is made up of system developers, system users, the environment, the context and the social attributes of the system being developed. Concurring with this, Harrison and Zappen (2005) argue that the involvement of a significant number of a regular mass of community users is crucial to the design and development process. Users have a clear knowledge and understanding of community needs, environment, norms and boundaries.

On the other hand, the engineering or the technical approach operates on the premise that if the tools of analysis are adequate, every detail of the system may be easily defined towards finding a more suitable solution (Harris, *et al.*, 2000).The technical approach is more concerned with tools, techniques, devices, artefacts, methods, configurations, procedures and knowledge used by participants to acquire inputs, and with transforming them into a working system (Rambaugh, 1995).

Acknowledgement and nurturing of these approaches is important in improving performance during the system development process and as part of a holistic systems approach to system development to ensure user satisfaction. There is a growing trend by organizations to deploy a mixture of approaches or what is regarded as the contingency approach, discussed below.

4.4.3 Contingency approaches to system development

The basic notion of contingency theory is that there is no ideal or universal SDM that can be used in developing all systems (Fitzgerald, Russo, & O'Kane, 2000)**.** Contingency approaches literally take an "ad hoc" approach – there is no single best methodology, so the selection of a methodology must depend on the characteristics of the project. The argument here is that a specific tool is designed to solve a specific type of problem and that an attempt to find a "one-size fits all" solution will inevitably prove sub-optimal.

Adapting to the theory by Reid and Smith (2006) on Contingency Theory, a contingent approach to system development means that:

1. There is no universal or one best way to develop a system;

2. A system development methodology and its processes must “fit’ with the current development environment;
3. Effective system development methodology not only has a proper “fit’ with the current development environment, but also between other life cycles that are part of the system, e.g. project management.

There are various differing arguments on how the contingency approach could be applied in SDMs. The argument for the application of the contingent approach, however, is most applicable to the organizational environment, where a particular organization has explored a number of methodologies or there are sufficient resources to explore a number of methodologies (Fitzgerald *et al*., 2000). This approach is also applicable in organizations developing a number of information systems applications or where the characteristics of the system being developed are such that no one methodology could be effectively followed.

4.5 SDM PRACTICE

There is growing interest amongst system development researchers on the extent of usage of SDM (Avison, Shah, Powell, & Uppal, 1992; Iivari & Huisman, 2007; Shih & Huang, 2010). This interest could be associated with a need to improve the success of information systems development projects. Huisman and Iivari (2006) and de Vries (2004) associate this interest with the continued failure of the information systems projects, recognition of the need for a situation tailored methodology and the need to follow the trend. Over the years research has looked at the question of whether or not SDMs are used in practice.

Instead of asking whether SDMs are used or not, Russo, Wynekoop and Walz (1995) suggest that the question should consider the extent of use of methodologies. This question was later addressed by various studies (Fitzgerald, 1997; Huisman & Iivari, 2006; Rowlands, 2006; Iivari & Iivari, 2011) that used diverse perspectives in finding out how SDMs are used in organizations. The general conclusion from these studies is that SDMs are not being used as intended in their general form. From the conclusions, the following questions emerge as important, when looking at the use of SDM in organizations:

1. *Are organisations using a single SDM in all projects or should methodology selection be based on the project at hand*? This question looks at method tailoring and is related to whether organizations stick to one methodology in all projects or whether there is flexibility in choice of methodology, depending on the projects at hand. In recent years there has been a significant move by established information technology organizations to introduce their own SDM: IBM's Rational Unified Process and SAP's ASAP (Avison & Fitzgerald, 2006) are examples of this. In order to achieve the objectives from development, organisations see a need to customise SDMs to be suitable to a company's requirements. Chavart (2005) argues that single methodology use is unrealistic; many project managers have found that, in practice, one cannot simply use a methodology exactly as it stands.

1. *Are sections from different methodologies used instead of a single methodology*? Huisman (1999) refers to this as a vertical use of technology where components or parts of a particular SDM are used, instead of the SDM as a whole. Methodologies like SSADM, by their very nature, address only a particular aspect of system development and thus cannot be used in isolation. Further aspects on this question are addressed in discussions on contingency approaches to system development, as previously referred to in Section 4.4.3.

The challenge is still for developers to find ways to improve the success rate of ISDs in line with the changing software engineering trends.

4.6 ASSESSING SDMS

A software system, as a product of the system development process, emanates from a desire to bring a working solution to a complex set of organizational or human problems. These problems call for an intensive process of searching for a suitable solution within organizational and environmental boundaries.

4.6.1 Support provided by SDMs to the development process

The developers of information systems face the dilemma of creating a system that responds to organizational needs, making use of appropriate technology while still being suitable for operation by users (Schach, 2010). As indicated earlier, information systems were, over a period of time, faced with various challenges which resulted in failure. Use of a SDM is not a guarantee of the success of a system development process. There are various models and frameworks that have been suggested for evaluating the success of an SDM. The Software Engineering Book of Knowledge (SWEBOK) and the ISO 12207, provide a standard for system development; one of the measures used is the software Capability Maturity Model which employs various levels of maturity to evaluate the contribution of an SDM to improvement of development processes.

An important issue is the impact that an SDM has during the development process. Huisman and Iivari (2006) suggest a focus on the impact on the quality of the system being developed and also on the quality and productivity of the system development process. The aim of a development is to produce a working system that will add value to the users. There are various processes and people involved during the development and a methodology that does not assist with optimization of resources towards a quality system is useless. This means that elements such as the development team, tools and other resources that are used with the methodology, should ensure productivity during development. Iivari and Iivari (2011) regard speed and efficiency of production and the quality of the developed system as some of the positive support features that might play a role in the use of a particular SDM model, i.e. agile technology.

To necessitate the use of an SDM, these factors should be able to differentiate a system devised using a well-developed SDM from a system without, or using random, SDM selection.

4.7 DEVELOPMENT OF CISS

ICT is a social science. According to Giddens's structuration theory, the interplay between technology and people is ongoing, as technology shapes not only the people who use it, but also those who develop it (Giddens, 1984).

Roode (2003) applied the Burrell and Morgan Sociological paradigm framework to explain the role that a system developer or analyst plays in information systems development:

1. In the functionalist paradigm, the information system consists mainly of interactions which function independently of outside manipulation. The systems analyst might be seen as a technical expert; the ideals are objectivity, rigour and formality. There is a technical process view and one where information systems development is seen as a technical rather than social process.

2. The interpretative paradigm assumes that the analyst is subjective and interprets the problem situation. The analyst hopes to understand the intentions of the actors in the situation. Participation and involvement will be the best way to obtain detailed information about the problem situation, and later to be able to predict and control it.

3. In the radical structuralist paradigm, the situation will appear to have a formal existence but require radical change due to, for example, contradictory and conflicting elements. The systems analyst is assumed to be an agent for change and social progress, emancipating people from their socio-economic structures. The systems analyst might be seen as an agent for social progress; the ideals lean towards change of the socio-economic class structures.

4. In the radical humanist paradigm, the situation is seen as external and complex. There is an emphasis on participation to enable a rapport between the actors, leading to emancipation at all levels, including that of the socio-economic and psychological. The systems analyst might be seen as a change agent; the ideals lean towards change of the socio-economic structures and psychological barriers.

A developer should adopt a systems thinking approach when building systems, particularly when there are many social issues to take account of. The social nature of communities calls for a SDM that takes into consideration that the system users have multiple perceptions on how their lives are socially constructed (Walsham, 2001). This means that the form and structure of ICT development should be such that people are able to make full potential use of its capabilities without feeling constrained by the developers' design limits.

In concurring with the above position, Harris *et al.,* (2000) state that the social context, which influences the development and use of technology and empirical data from the community, is crucial to the design and development process. They developed a framework for methodologies to be used in developing community based systems which is based on the premise that for it to be successful, a SDM for developing community information systems should:

1. Arise from processes of social analysis.
2. Begin with an understanding of the context of the installation.
3. Target and measure community liberation.
4. Be embedded in the needs of the community, as they may emerge before or after the technology is installed.
5. Adapt to changing circumstances.
6. Require genuine participatory engagement between the analyst/liberator and the community.

Synthesizing the information from the above parameters and the categorization of system development methodologies in Table 4.5, Table 4.7 shows methodologies that may be used for developing community information systems.

Table 4-7: Selecting development methodologies for community information systems

SOCIAL PARAMETERS/ **METHODOLOGY**	**PROCESS-ORIENTED**	**BLENDED**	**OBJECT-ORIENTED**	**RAPID DEVELOPMENT**	**PEOPLE-ORIENTED**	**ORGANISATIONAL-ORIENTED**
Social analysis.	-	-	-	-	✓	✓
Understanding of installation context	✓	✓	✓	✓	✓	✓
Target and measure community emancipation.	-	-	-	-	✓	-
Needs of the community	-	-	-	-	✓	-
Adapt to change	-	-	✓	✓	✓	✓
Participatory engagement.	-	-	-	-	✓	✓

From Table 4.7, it is evident that people-oriented methodologies may be used to develop systems for communities, while organizational-based methodologies are able to be used to a certain extent. Other methodologies that are more technologically and scientifically inclined are not suitable for community systems. Using the data from the above table still does not answer the question about the necessity of the SDM for community based systems, but it gives an idea of the types of methodologies available for the community centres.

4.8 CHAPTER SUMMARY

This chapter explored SDMs. From the literature it was evident that there are numerous definitions of an SDM. The definition adopted for this study was that an SDM is a *combination of a system development approach, a system development method, a system development process model and a system development technique* while a method, for the purposes of this study, was defined as *a systematic way of conducting at least one complete phase of system development* (Huisman & Iivari, 2006). Adopting these definitions, the nature of SDMs was explored through a comparison of various approaches, models and techniques used during system development.

To further understand SDMs and assist during selection of the most appropriate SDM, an account of the evolution of SDMs, as adapted from Avison & Fitzgerald (2006) was presented. During the early years of development when no SDMs were in use, a system for a particular client would be developed and implemented. Defects would only be identified when the user returned with a complaint, as no testing was done before delivery. The current era of SDMs affords institutions and developers the freedom of establishing their own customised methodology. This era is chacterized by proliferation of object orientation and an agile approach to system development.

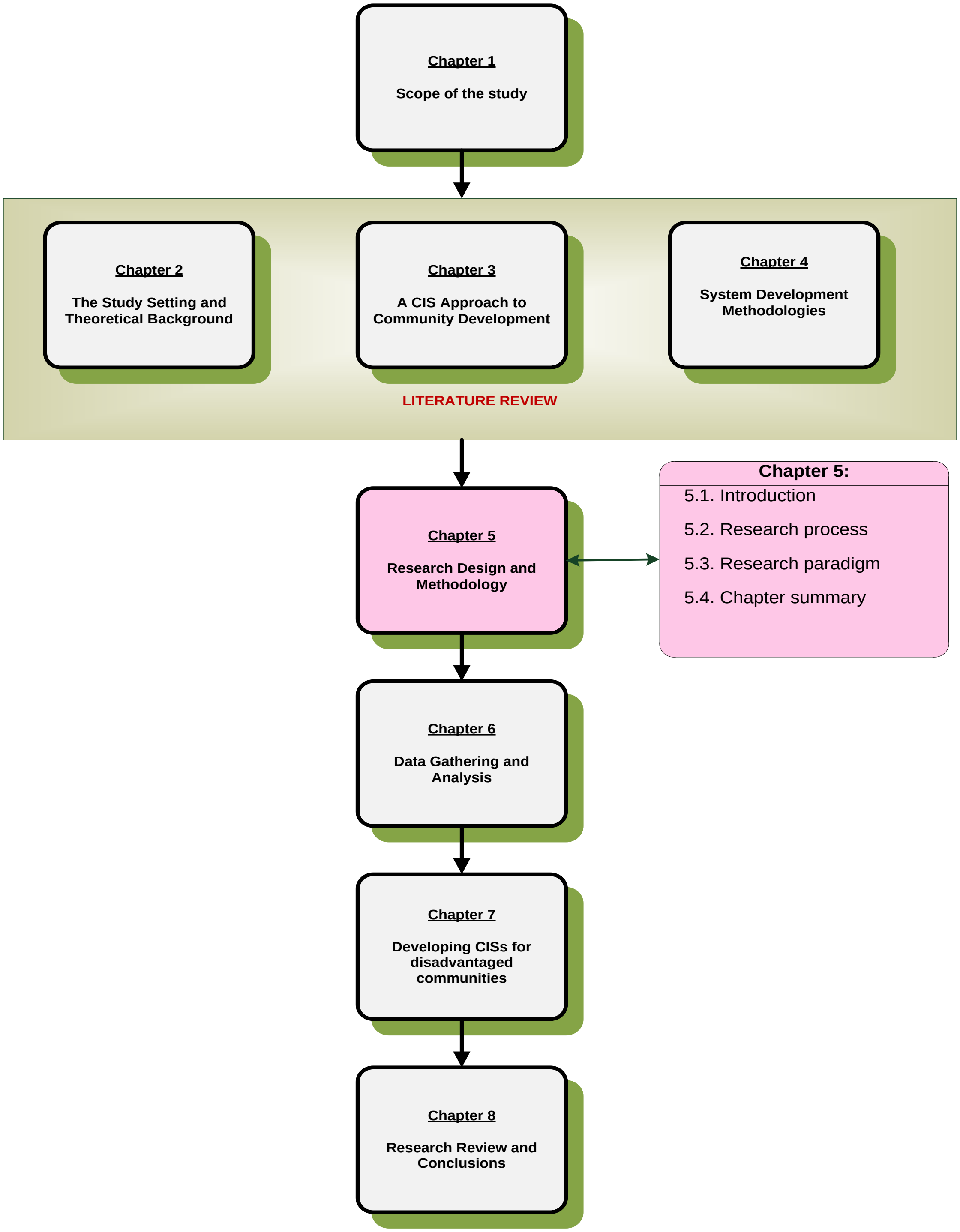
Use of SDMs during system development assists the development team in ensuring that there is proper management and accountability throughout the development process, whilst ensuring that the resulting system meets the needs of the users. Table 3.1 details objectives of SDMs, highlighting that there are differences in deployment of SDMs with some organisations adopting a particular SDM to be followed during development of all their systems. In contrast, for some organizations a decision to select a particular SDM depends on the system at hand, taking into account the environmental factors surrounding that particular system. A contingent approach to system development was also outlined, with emphasis placed on the importance of context, when making decisions about SDM use.

A number of theories have been suggested by researchers on how SDM selection should be done and various SDM approaches were discussed, taking into account the technical and social issues surrounding development. Blended methodology is an approach to development that brings harmony to the conflict over the best methodology to use by suggesting construction of an SDM through taking the preeminent aspects of various methodologies. Blended methodologies put into effect the importance of context during system development. The system development environment framework by Boahene (1999) was used as a point of reference on the importance of considering the system development environment during development.

The final discussion of the chapter examined the development of CISs using Burrell and Morgan's sociological paradigm framework (Roode, 2003) on the role that a system developer or analyst plays in information systems development. Social issues, community needs and participatory engagement were some of the factors considered important when selecting a methodology to use when developing CISs.

The next chapter offers a roadmap of how this study will be conducted.

CHAPTER 5. RESEACH DESIGN AND METHODOLOGY



5.1 INTRODUCTION

This chapter presents an account of the process followed in conducting this research. The main objective of this study was to develop a framework for evaluating the use and effectiveness of SDM when developing community systems aimed at the socio-economic development of disadvantaged communities. An SDM framework to be used when developing these systems will be recommended. In South Africa, Living Labs are at the forefront of the development of these CISs. Chapter two, up to chapter four, presented the contextual and theoretical background to the study.

Research objectives: the subjective and social nature of the study influenced the chosen research methodology. This chapter clarifies the process followed when addressing the stated problem to achieve the research objectives.

The chosen paradigm for this study is interpretive; qualitative multiple case studies were employed, utilising the data analysis tool, Atlas.ti™ The research process illustrated in Figure 5.1 is discussed in detail to show the relationship between the various aspects. The research paradigm is identified, paving the way for the rest of the process to unfold until the stage was reached where the data was analysed and presented.

5.2 RESEARCH PROCESS

This section presents the process used in addressing the problem identified in this research. It is important to define the process as it outlines the overall approach to answering the research question (Oates, 2006). Saunders, Lewis and Thornhill (2007) agree that a defined process also frames and focuses the study, and assists in developing boundaries for it.

The process followed in this research was adapted from a research onion developed by Saunders, Lewis, and Thornhill (2007). The process included the identification of a research paradigm, research approach, research method, data collection and data analysis technique.

The nature of the problem influences the choice of a research paradigm which influences the selection of a particular methodology. It must be noted that choosing a paradigm does not mean that the remainder of the questions on the problem are answered: for example, selecting an interpretive paradigm does not automatically imply that qualitative studies are to be used. Once the methodology is selected, an approach for the research is selected based on approaches pertinent to that particular methodology. A research technique then needs to be selected on how the chosen approach will be used to obtain information and answers about the problem at hand.

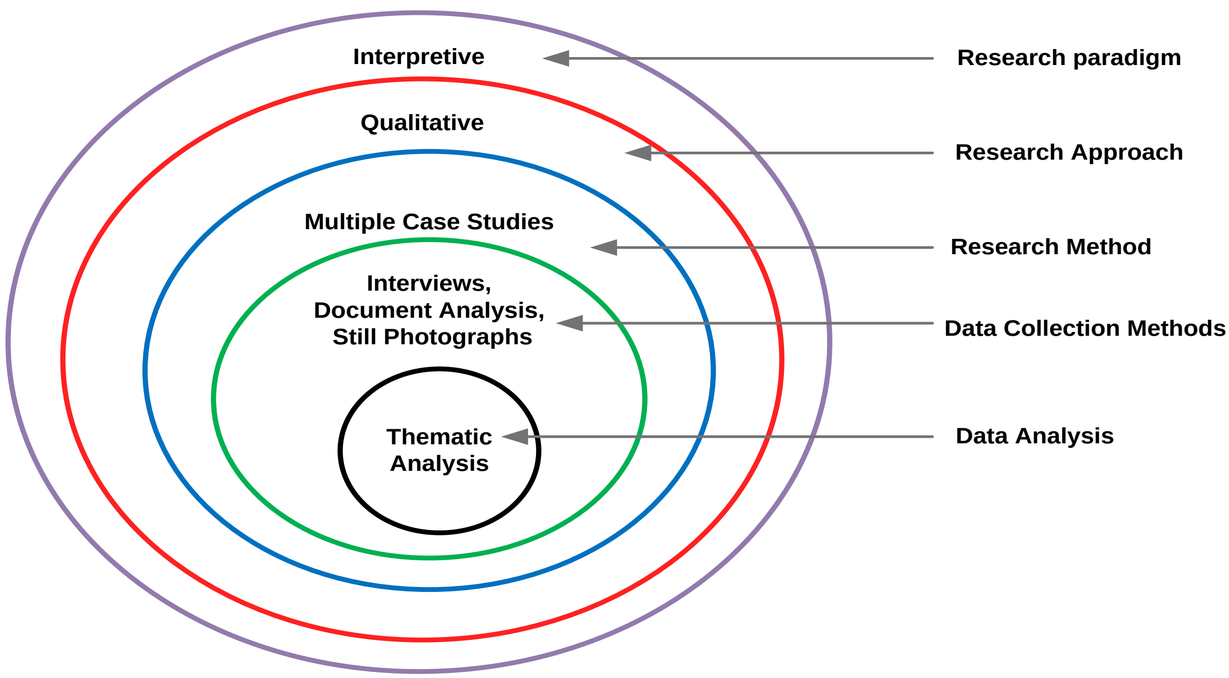


Figure 5-1: The Research Process Onion, adapted from Saunders, Lewis, and Thornhill (2007)

5.3 RESEARCH PARADIGM

According to Myers (1997), a research paradigm is built on underlying assumptions about knowledge and how that knowledge may be obtained. Knowledge relates to the nature of the problem at hand and the assumptions made are used to set the direction of the research. The Four Paradigms model introduced in Chapter 2 was used as a basis of understanding the direction of the study, taking into account the nature of the field and current enquiry. For easy reference, the diagram is presented below, incorporating placement of the interpretive and positivistic studies within the framework.

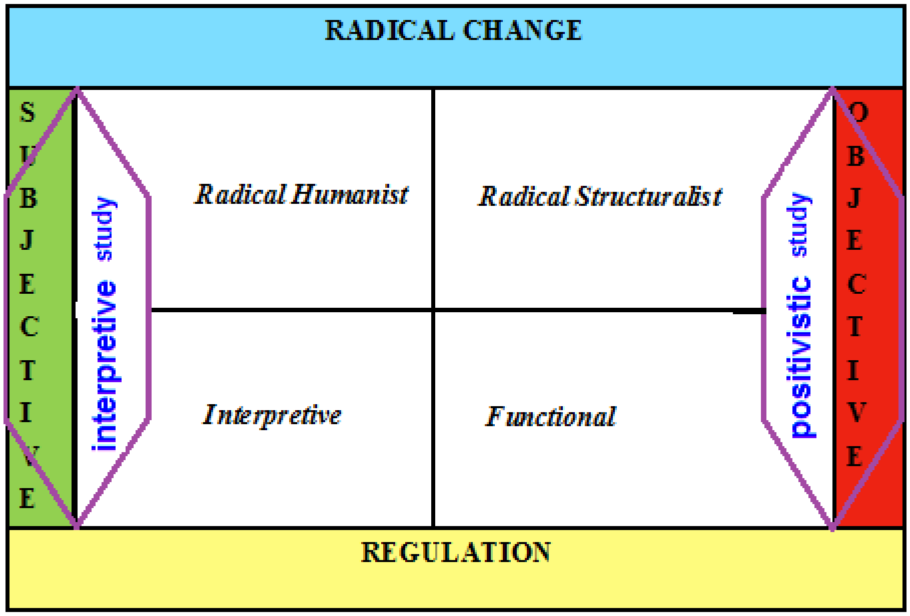


Figure 5-2: Four Paradigms framework for Social Analysis, adapted from Burrell and Morgan (1979)

Informatics is a social science and the SDMs are technical in nature. Consequently, this research needs to take the social and technical nature of the information systems field into account; therefore, interpretive paradigms were used to carry out this research.

In an effort to explain the rationale for the chosen paradigm, a distinction is made between the interpretive and positivistic research paradigms.

Two philosophical world views, those of the mechanical and romantic, are first explained to give a better understanding of the two paradigms. The mechanical view refers to a scientific philosophy based on quantitative analysis and that supports mathematical analysis (Mavetera, 2011). Reality and measurable phenomena characterise mechanistic thinkers. The romantic view on the other hand supports imagination, feelings and perceptions and has respect for norms, values and culture (Yin, 2009).

People following the romantic view believe that they need to view the world subjectively and also that their presence in the world needs to be felt. Mechanistic thinkers are associated with the positivistic research paradigm as they view the world and its surroundings as objective and realistic whilst the romantic thinkers are associated with the interpretive paradigm. The positivists are objective researchers in that they aim at eliciting a real presentation of occurrences from data and then use statistical techniques to make decisions. Positivists generally assume that reality is objectively given and may be described by measurable properties, which are independent of the observer (researcher) and his or her instruments. Positivist studies generally attempt to test theory, in an attempt to increase the predictive understanding of phenomena (Mingers, 2003).

Using an interpretive paradigm for this research flows from a belief about the social nature of ICTs and also, as Myers (1997) puts it, researchers need to understand people, their culture and also the social context within which they live. According to Cordella and Shaikh (2003), interpretive research adopts the stance that knowledge is a social construct and that reality is constructed by interpretations which emerge from analyses based on an alternative and non-univocal interpretive point of view. This type of research presents an understanding of the social world from the viewpoint of the actors within it, and oriented towards the actor's cognitive and symbolic actions and meaning associated with observable behaviours. Interpretive studies are vital for research into information systems as they produce a rich understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context (Walsham, 1993).

The subjectivity of the researcher is at the core of an interpretive study in that a researcher filters the participant's responses through the lens of his/her own "subjectivity" and then produces a story about what events have occurred and some possible reasons for them (Walsham, 2001). The researcher generates theory through inductive processes.

5.3.1 Research approach

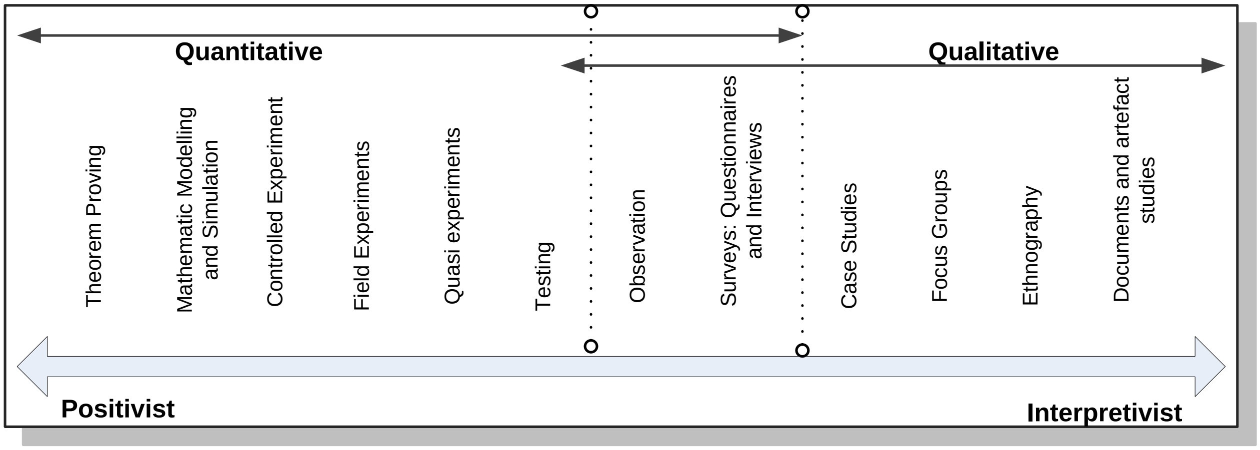


Figure 5-3: Research Approach, adapted from Van Gruenen (2009)

In research, an approach stipulates the mode of enquiry and how the analysis is carried out on the research findings. A research approach may be either qualitative or quantitative. These two approaches are both widely used in research; the choice of which research approach to use is not necessarily about which of the two is the best approach, but rather under which circumstances a particular approach is more suitable. Two researchers could be conducting research on one subject but be looking at different aspects in order to reach a conclusion.

Many researchers (McMillan & Schumacher, 2006; Olivier, 2004; Oates, 2006) agree that for some years research was based on exact measurement because positivism was a dominant world view. Olivier (2004) states that this view changed after the realisation that quantitative research could not be used to answer some pressing social problems; besides, it is not always as objective as the world was led to believe. Qualitative research thus emerged with its focus being on giving the users or research participant the freedom to express their world as they see it.

Frankel and Devers (2000) earlier identified three key areas of difference between qualitative and quantitative research:

1. Inductive versus deductive research;

2. Flexibility versus rigidity in research design;
3. The sequence of the process of conducting research.

Another factor that is useful in understanding differences between these two approaches is whether words or numbers dominate the design and analysis of research. A discussion on qualitative and quantitative studies is provided below and the factors identified by the above authors afford insight into each of these two approaches. It should, however, be noted, that although these approaches are usually used individually, there are studies that necessitate the use of both. Although these approaches appear to be at extreme ends, as per Figure 3.3, Collis and Hussey (2009) believe that using a combination of the elements allows one to take a broader and often complementary view of the research problem or issue. The mixed methods research introduced by Creswell and Clark (2011) is characterised by using a mixture of methods, depending upon the nature of the research at hand.

5.3.1.1 Quantitative Studies

Quantitative research methodology uses numerical descriptions and emphasises quantification in the collection of data (Bryman, 2012); this approach is thus used by researchers operating in the functional paradigm (Mavetera, 2011) as per Figure 5.3, above. This research approach is not concerned about behaviour and explanations thereof, but is more concerned about the statistical or mathematical values, based on the instruments used. This is also the case when using instruments such as observations where the results are presented in quantities.

The quantitative researcher generally applies a deductive approach to research. This means that the researcher first establishes the theory or examines existing theory and uses the enquiry to test if it holds true or to prove cause or effect. Researchers using deductive research work from the more general to the more specific argument, and usually base research on laws, rules and accepted principles (Aqil-Burney, 1998). When conducting a deductive approach, researchers start by generating a hypothesis from existing knowledge, after which the hypothesis is subjected to rigorous empirical verification (Mavetera, 2011).

Another attribute of a quantitative study is that quantitative researchers are more likely to follow a more linear or sequential pattern eliminating any change from a set pattern that might affect the study.

Oates (2006) uses the following principles to characterise quantitative research:

1. *The world exists independently of humans*: There is a physical and social world that exists “out there”: not just in our minds, to be studied, captured and measured.
2. *Measurement and modelling:* The researcher discovers this world by making observations and measurements and produces models of how it works.
3. *Objectivity:* The researcher is neutral and objective, an impartial observer and thus the researcher is personally detached from the research environment.
4. *Hypothesis testing*: Research is based on the empirical testing of existing theories and thus uses a hypothesis to prove or disprove a theory.
5. *Quantitative data analysis:* There is often a strong preference for mathematical modelling and statistical analysis.
6. *Universal laws:* Researchers look for generalisations.

5.3.1.2 Qualitative Studies

Creswell (2007) defines a qualitative study as an inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting the detailed views of informants, and conducted in a natural setting. Researchers need to understand people, their culture and also the social context within which they live. The main criticism of qualitative studies, according to Myers (2000), is thus their lack of objectivity and generalisability. This criticism is largely due to the small sample size being subjected to the research undertaken, compared to that of quantitative research. Myers (2000) and Neil (2007) suggest, however, that the generalisability of quantitative studies cannot be linked to validity, as it is possible to obtain a more credible representation from a small sample depending on the process, technique and depth used. Also it should be noted that differences in societies warrant applicability of studies to a particular situation and specific phenomena, coupled with a connection to the real world, as ease of description of a social context adds value to qualitative research.

Qualitative research is needed when the questions asked deal with difficult or issues impossible to be addressed using conventional research approaches (Frankel & Devers, 2000). Difficulties occur when undertaking qualitative studies as the researcher deals with variables that are not easily identifiable and explores the topic through inductive inferences to explain the behaviour of the participants. The premise behind inductive inference is that the researcher conducts research in order to develop a particular theory, whereas in a deductive approach, research is conducted in order to test or prove a particular theory or hypothesis.

A qualitative researcher uses life experiences and behaviours of the research subjects to formulate a story based on his or her subjective conclusions. Qualitative research places an emphasis on understanding through observation of words, actions and records (Myers, 1997). Hence, the qualitative researcher tends to become subjectively immersed in the subject matter, such that she or he becomes an important research instrument (Olivier, 2004; Neill, 2007).

One other difference between the qualitative and quantitative approaches is that in qualitative research the subjects of the research are afforded an opportunity to express themselves so that there is a variety of information gleaned, from which the researcher may make deductions. Unlike quantitative researchers, the qualitative researcher usually sets out a process, which is usually not easily adaptable as adaptation may affect the outcome of a study (Frankel & Devers, 2000). The dynamism in qualitative research affords the researcher an opportunity to change the original research question, in rare cases where the question was not salient to the context being studied (Frankel & Devers, 2000; Yin, 2003). This means that subsequent processes followed are altered to accommodate the new changes.

5.3.2 Qualitative Research as the approach of choice

A qualitative research approach was used to conduct this study because it provides a holistic overview of the context being investigated. The researcher used this approach as she needs to understand people, their culture and also the social context in which they live (Myers, 2000). This approach also enabled the researcher to be able to answer the following questions as suggested by Bryman (2012):

1. Why people live the way they do?
2. How opinions and attitudes are formed?
3. How people are affected by events that go on around them?
4. How and why cultures have developed?
5. What are the differences between social groups?

In justifying the use of the qualitative approach, Olivier (2004) uses an example of a study which determines which digital library interface users prefer. In this scenario quantitative research would be the preferred method for determining which interface users favour, providing a rating according to pre-defined reasons. This would be difficult for a qualitative user, who would be interested in understanding the specific reasons why users prefer certain interfaces. Olivier (2004) goes on to add that by using a qualitative approach the researcher may be able to identify reasons behind users' actions which could be more emotional rather than rational. A quantitative researcher on the other hand would have difficulty with that because the purpose of qualitative studies is to discover meaning and understanding, rather than to verify truth or predict outcomes (Bryman, 2012).

To summarise the discussions in the preceding sections (5.2.2.1 and 5.2.2.2), the following table presents the differences between qualitative and quantitative research approaches:

Table 5-1: Summary comparison between Qualitative and Quantitative Research

	Qualitative	Quantitative
Objective/ Purpose	To understand the richness, depth and complexity of phenomena in study. Social interaction in natural setting.	To collect numerical data in order to explain, predict and or control phenomena of interest.
Data Collection	Usually unstructured or semi-structured techniques like interviews, focus groups, photographs, etc.	Structured questionnaire, surveys.
Inductive versus deductive research.	Inductive research; moves from the specific to general.	Deductive research; moves from general to more specific theory.
Flexibility versus rigidity in research design.	Flexible: the researcher is open to adapting enquiry and can pursue new paths of discovery as they emerge. The researcher can conduct data analysis whilst still collecting data.	Rigid process followed. A predefined linear process is followed when undertaking research. Changes to the process are unusual and often considered undesirable.
Research sample	The sample size can range from n = 1 to n = 40.	A more representative sample is required.
Data Analysis	Narrative description.	Numerical estimation; statistical inference.

Although presented differently, most points on qualitative studies in Table 5.1 above could be associated with one or more of the following characteristics of qualitative research, as discussed by various researchers (Ragin, 1987; Patton, 2002; Creswell, 2003; Bryman, 2012):

1. *Natural setting as the source of data:* attempt to study everyday life of individuals, groups, communities or institutions in their natural environment.

2. *Researcher as key instrument of data collection*: researcher's experience in collecting, interpreting and presenting data is crucial.
3. *Data collected as words or pictures*: using multiple evidence to present a rich report.
4. *Analysis of data inductively:* immersion in the details and specifics of the data to discover important patterns, themes, and interrelationships.
5. *Focus on participants' perspectives, their meaning*
6. *Use of expressive language:* present the report in the manner that best captures the interest of the reader,
7. *Emergent design:* openness to adapt to changes as understanding and situation changes.
8. *Theoretical lens:* sensitivity to developing and emerging theory in the field.
9. *Interpretive inquiry*: conducts research that yield detailed, thick descriptions of people's personal perspectives.
10. *Holistic account*: focus on complex interdependencies and system dynamics that cannot meaningfully be reduced to a few discrete variables.

The challenge to the researcher concerns the pressure to present an interesting and persuasive description of the findings of his or her study, such that the reader experiences a sense of involvement during the process. The researcher should also be willing to engage in time-consuming data analysis, as qualitative research does not subscribe to strict guidelines and procedures.

5.3.3 Research method

Myers (1997) defines a research method as a strategy of inquiry which moves from the underlying philosophical assumption to a research design and data collection. Research techniques and data collection are thus influenced by a method chosen for research. There are various methods that could be used to gather evidence when conducting qualitative studies.

A brief outline of the commonly used qualitative research methods is provided, followed by a detailed discussion on a case study, a method selected for this study.

5.3.3.1 Ethnography

Derived from anthropology, this is a form of study in which the researcher becomes part of people's lives for a certain period of time. It is based on the philosophical assumption that when one is studying culture, one needs to immerse oneself in the society whose culture is the subject of the study (Mavetera, 2011). This means that there is active interaction between the researcher and the people involved in the study as observation is core to the method of ethnography. Hence, according to Olivier (2004), ethnography is also known as participant observation. Ethnography can be time consuming as the researcher might need to conduct the study over a period of time (McMillan & Schumacher, 2006; Creswell, 2003).

5.3.3.2 Action Research

Action research involves an iterative process when researchers determine the current situation and then make an intervention. An action researcher becomes both the subject and object of the study. The purpose is usually to develop a solution for a practical problem and document the process contributing to the theory.

5.3.3.3 Phenomenology

Phenomenology looks at subjective experiences and interpretations of people involved in research (Mavetera, 2011). Creswell (2007) regards phenomenology as a philosophy as well as a method because it seeks to understand lived experiences by studying a small number of subjects through extensive and prolonged engagement in order to develop patterns and relationships of meaning. The researcher uses the experiences of people to construct some form of reality, thus suppressing their own preconception about the subject in study.

5.3.3.4 Grounded Theory

The purpose of grounded theory is to build theory. Using inductive approaches, grounded theory researchers use various tools and techniques to give meaning to large volumes of raw data. Unlike other research methods, which begin with a theory and then prove that theory, grounded methods begin by observing a field of interest, after which theory emerges from what is observed (Olivier, 2004). Creswell (2003) identifies two primary characteristics of grounded theory: constant comparison of data with emerging categories and theoretical sampling of different groups to maximise the similarities. The essence of grounded theory is that there has to be a systemic process which continuously compares developed theory with analysis of further participants until the researcher is convinced that new participants will not add to the developed knowledge.

5.3.4 Case study as a research method

The case study is a widely accepted research method in information systems (Myers, 2000; Patton, 2002; Walsham, 2006). In a case study, the research subjects are investigated in order to reach a particular conclusion about the enquiry. Yin (2003) defines a case study as an empirical enquiry investigating a contemporary phenomenon within a real life context when the boundaries between the phenomenon and the real life context are not clearly evident. The benefit of a case study is the ability to examine data within a context specified by the researcher. The main purpose is not to generate general laws, but to understand phenomena in their context (Mavetera, 2011).

A case study may be used with both quantitative and qualitative research, the difference being the deductive or inductive nature of enquiry used and analysis of the results. Some researchers use a combination of qualitative and quantitative case study methods when conducting their research: this is part of triangulation or mixed methods research (Creswell & Clark, 2011). Most studies make use of some triangulation; it depends on each case and at what level, the researcher or investigator chooses to triangulate. *Triangulation* is the use of multiple measures and approaches to enhance the validity, reliability, equity and utility of the data as well as decisions about the phenomena (McMillan & Schumacher, 2006). *Mixed methods research* is the use of at least one qualitative method and one quantitative method in one study (Creswell & Clark, 2011). The purpose in both instances is to ensure credibility of the research findings.

This study makes use of a qualitative approach and uses case study as a research method. Various techniques were used to collect the data, such as semi-structured interviews, documents, pictures and descriptive logic, rather than a numeric presentation, and are utilised to report the findings of the study.

5.3.4.1 Case study designs

Yin (2003) suggests basic types of case designs: he distinguishes between *single case studies* and *multiple case studies* and also makes a further distinction based on the type of enquiry being conducted, on whether they are holistic or embedded.

5.3.4.1.1 Single Case Study:

This is used to investigate a unique circumstance. According to Yin (2003), use of a single case study represents a critical test of a significant theory. Undertaking a single case study requires significant amounts of work from the researcher as more depth is needed in order to produce convincing findings. Yin (2003) and Oates (2006) caution researchers to conduct careful investigation in order to minimise chances of misrepresentation and to maximise access to the case study evidence.

5.3.4.1.2 Multiple Case Studies:

These studies investigate several cases in order to obtain more representative evidence. In the instance of multiple case studies, data are gathered from diverse sources using multiple techniques. A multiple case study design allows the researcher to explore the phenomena to be scrutinised through the use of a replication strategy (Patton, 2002; Yin, 2009). Using multiple case studies also prevents the research findings from bias towards one-sided views.

To address the frequent question of the number of case studies to be used, Yin (2009) states that a typical sampling criterion is not relevant for qualitative studies, but a decision must be based on the number of case replications a researcher would like to have on their study. The number of case studies to be conducted depends on the phenomenon under investigation, as a representative sample could be used. The same also applies to the specifications of the sample size for the research; researcher expertise becomes important as poor planning could jeopardise satisfactory results.

5.3.4.1.3 Types of enquiry

Yin (2003) distinguishes between holistic and embedded enquiry which can both be applied to single and multiple case studies. Holistic enquiry studies the case/s in their entirety, whilst embedded enquiry studies various identified units within the case/s. As indicated in Figure 5.4 (below), this study adopted a holistic, multiple case design.

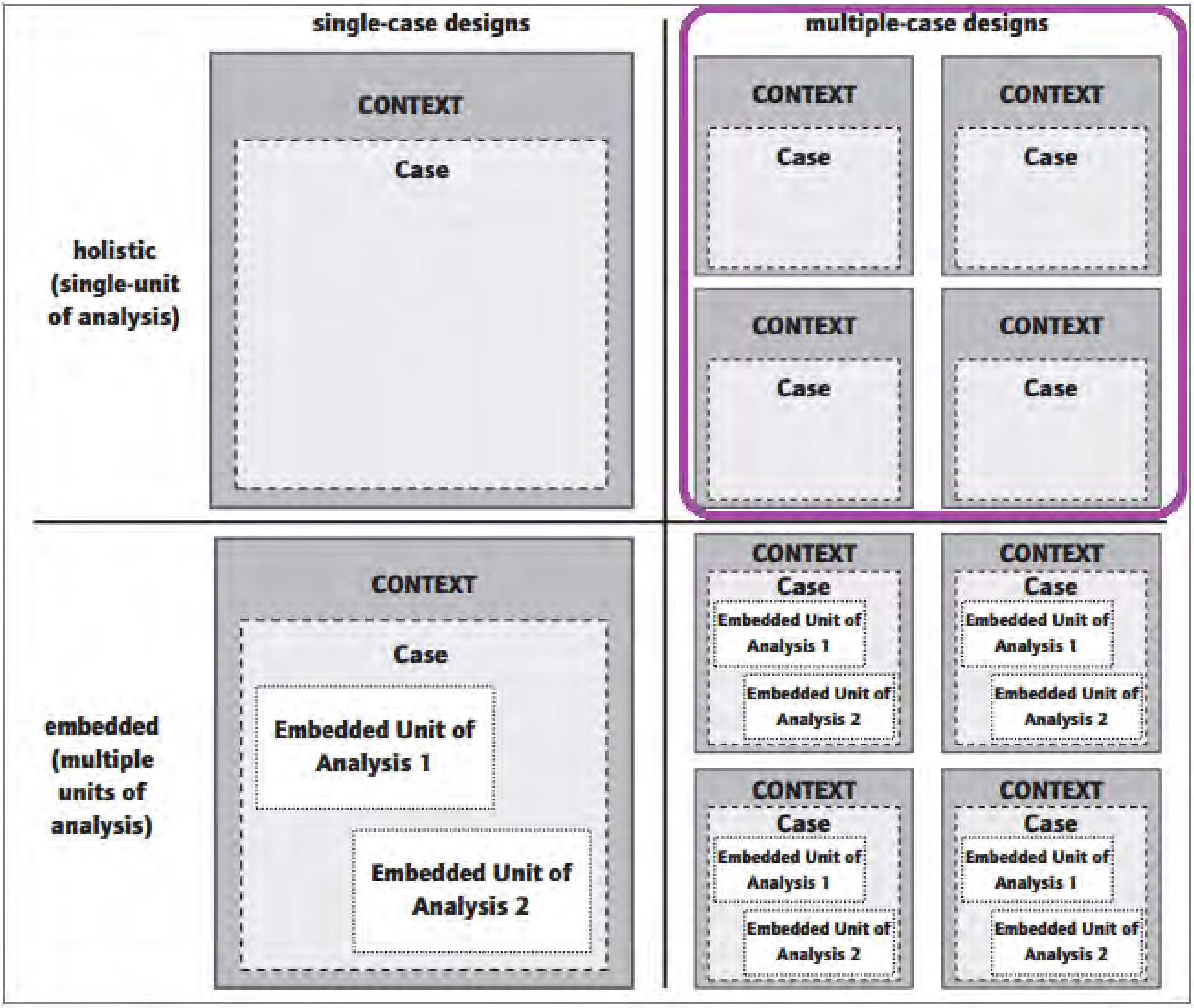


Figure 5-4: Basic types of case study design (Yin, 2003)

Three Living Labs (Siyakhula, Limpopo and Reconstructed) from various provinces in South Africa were selected for a qualitative study. The main criterion for the choice of a case study was that a Living Lab needs to have been involved in the development of a particular system to be used for community development. The community in question needed to be either a community earmarked for development or a community of users within the Living Lab.

5.3.4.2 Characteristics of a good case study

Benbasat, Goldstein and Mead (1987) suggest three reasons to justify the appropriateness of case study research:

1. The researcher can study information systems in a natural setting and generate theories from practise.
2. The case method allows the researcher to answer "how" and "why" questions; that is, to understand the nature and complexity of the processes taking place.
3. A case study approach is an appropriate way to research an area in which few previous studies have been carried out.

The following are some factors that contribute to an exemplary case study, which have a lasting contribution (Yin, 2003):

1. *The case study must be significant*: the case study is unusual and of general interest and the issues addressed should be of national interest.
2. *The case study must be complete*: completeness in terms of giving explicit attention to the boundaries of the study, exhausting all possibilities in gathering evidence and the absence of certain conditions.
3. *The case study must consider alternative perspectives*: investigator bias should be limited by addressing different views instead of supporting a single point of view.
4. *The case study must display sufficient evidence*: the evidence presented should convince the reader that the investigator has been in the field and covered all options; that all cases are treated fairly and that evidence is validated.
5. *The case study must be composed in an engineering manner*: presentation of the report should be presented in a persuasive, engaging manner that entices the reader to continue reading.

5.3.4.3 Conducting Case Study Research

Various process steps that have been used by diverse researchers to conduct case study research. Although presented differently, content coverage from these processes is similar. Three of such processes were covered: the *six steps process* (Stake, 1995; Dooley, 2002; Creswell, 2003); the *four phase process* (Cooper & Schindler, 2006) and the *case study process model* (Yin K. R., 2009).

The six steps (Stake, 1995; Dooley, 2002; Creswell, 2003) for conducting case study research are:

1. *Determine and define the research question:* Regardless of the approach or method used in a study, determining and defining the research question is the first and crucial step (Cooper & Schindler, 2006). A well-defined research question facilitates subsequent decisions in the research process.
2. *Select the case and determine data gathering and analysis techniques*: After the problem has been identified and questions have been carefully defined, the next step in the process is deciding on the cases for research. Whether using a single case or multiple cases, the researcher must determine the techniques for collecting data.
3. *Prepare to collect the data*: Case study research generates a large amount of data from multiple sources and therefore systematic organisation of the data is very important, and keeps the researcher focussed on the original research purpose and question (Creswell & Clark, 2011). Preparing for data collection involves being clear about participants, acquiring permission to conduct the study and organising questions to suit various groups of individuals used in the research.
4. *Collect data in the field*: The researcher must collect and store multiple sources of evidence comprehensively and systematically in formats that can be referenced and sorted so that converging lines of inquiry and patterns may be uncovered (Creswell & Clark, 2011). The researcher should carefully observe the object of the case study and identify causal factors associated with observed phenomenon. Using triangulation assists in strengthening the research findings and conclusions.
5. *Evaluate and analyse the data:* The raw data is examined using many interpretations in order to find linkages between the research object and the outcomes with reference to the original research question.

6. *Prepare report:* The researcher reports the various case studies in a way that transforms a complex issue into one that may be understood, allowing readers to question and examine the study and reach an understanding independent of the researcher.

Yin (2003) also uses similar phases presented in the model (Figure 5.5) which starts with formulation of theory, inclusive of literature problem identification; the literature review and defining applicable theoretical underpinnings. The model, in a distinct manner, illustrates the process for conducting multiple case studies.

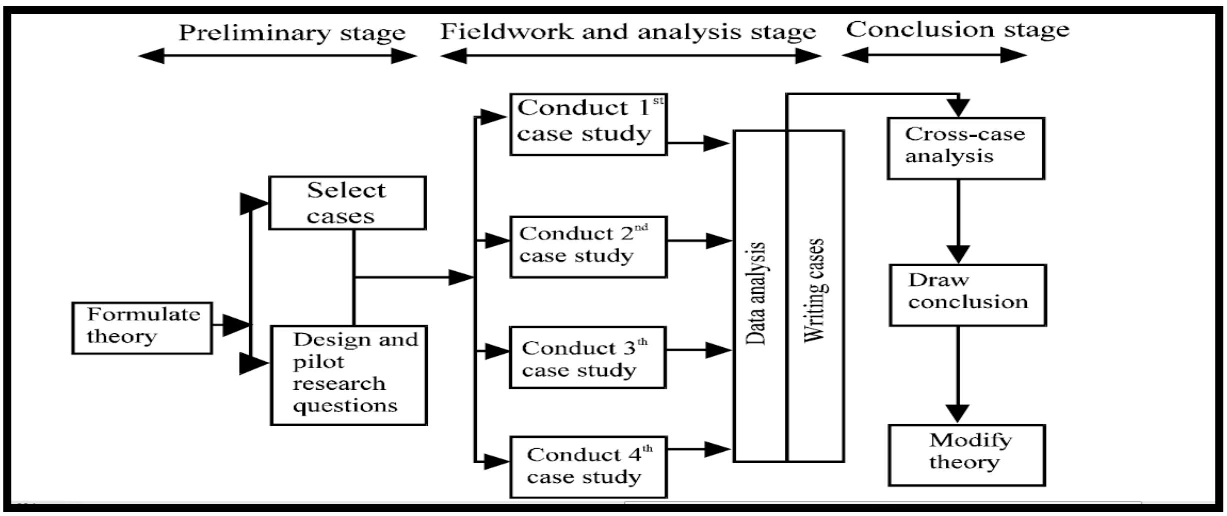


Figure 5-5: Case study research process (Cooper and Schindler, 2006)

Cooper and Schindler (2006) present the case study process, which is used to show an amalgamated view on how these three processes cross-reference each other. Cooper and Schindler (2006) identify four phases: Planning, Data Collection, Data Analysis and Closing. The integrated Case Study Process is presented in Table 5.2 below. The first column presents the phases as per the Cooper and Schindler model, while the second and the third columns show the relationship between the three processes by cross-referencing the two models to Cooper and Schindler (2006). The last column presents activities performed at various stages, making reference to the activities which were planned for this study.

Table 5-2: Integrated Case study Process (Stake, 1995; Dooley, 2002; Creswell, 2003; Cooper & Schindler, 2006; Yin, 2009)

Phase	(Stake, 1995; Dooley, 2002; Creswell, 2003)	**Yin (2009)**	**Research Activities**
1. Planning	1. **Determine and define the research question** 2. **Select the case and determine data gathering and analysis techniques** 3. **Prepare to collect the data**	1. **Preliminary Stage** ▪ Formulate Theory ▪ Select cases ▪ Design and pilot research questions	◘ Drawing up the research questions-aligned to the problem identified. ◘ Semi-structured open-ended ◘ Three Living Labs have been identified as case studies and permission to conduct research received.
2. Data collection	4. **Collect data in the field**	2. **Fieldwork and Analysis Stage** ▪ Conduct Case Studies	◘ In conjunction with the semi-structured interview, document, research reports, still photos and field notes will be used to collect data. ◘ Interview data will be recorded and transcribed. ◘ The interview will be conducted mainly in English.
3. Data analysis	5. **Evaluate and analyse the data**	2. **Fieldwork and Analysis Stage** ▪ Data Analysis ▪ Writing Cases	The data analysis and interpretation of the qualitative interview will be conducted according to the steps identified in Creswell (2003): i. Organise the data for analysis: transcribe the interview and type the field notes. ii. Read through all the data in order to obtain general ideas. Make use of keywords in the margins and highlight the relevant information. iii. Perform a detailed analysis of paragraphs by using a coding process, and by labelling categories with *Atlas.ti*™. iv. Decide on the way the categories must be presented in the qualitative narrative.
4. Data interpretation*	6. **Prepare report**	3. **Conclusion Stage** ▪ Cross- Case Analysis ▪ Draw- Conclusion	◘ Cross- case analysis will be done and final findings will be reported.

5.3.5 Data collection

Unstructured interviews will be used as a technique for carrying out the case study and collecting data. The researcher sat together with the research participant and asked questions that provided an insight into the research questions and in this way helped the researcher to reach conclusions. After the data had been collected, findings were compiled and documented, based on the researcher's subjective judgement.

5.3.5.1 Sampling Design

The collection and analysis of qualitative data is always regarded as labour intensive (Marshall & Rossman, 2010). It is, therefore, important that care be taken in deciding the sampling strategy to be employed as sample selection affects the credibility and completeness of the findings. This section dwells on the sampling design and also presents how participants are identified.

As already indicated above, multiple-case studies were used for this research. The case studies were located in various provinces around South Africa. There are currently about eight operational Living Labs in the country (Cunningham, Herselman, & Cunningham, 2011; Llisa, 2013).

The sample for research included managers or coordinators of the Living Labs, system developers and workers (when applicable). The initial sample included users of the CISs from the Living Labs but they were removed because initial interaction with some proved unsuccessful as they claimed not to have any knowledge of types of systems being used. Another issue that arose was that except for the case of one Living Lab (where the main users were interviewed), the systems were still undergoing testing. Purposeful sampling was used to select participants in this study. A purposive sample is a sample selected in a premeditated and non-random fashion to achieve a certain goal (Patton, 2002; Creswell & Clark, 2011). A researcher uses his or her judgement to decide on the most representative sample that can contribute to the study dependent on their knowledge. Different categories of participants were chosen: owners/managers, developers and users to ensure that different views on the phenomenon were explored to elicit a better picture of the phenomenon. Creswell and Clark (2011) refer to this method as maximal variation sampling; they also mention extreme case sampling and homogenous sampling. The former concerns the use of unusual, troublesome cases, whilst the latter relates to the use of people with distinctive characteristics.

The number of individuals interviewed was different for each case, depending on the circumstances, such as the size of the Living Lab and the number of people working on site.

5.3.5.2 The case of Living Labs

The Living Labs approach to socio-economic development has been widely adopted by various ICT projects aimed at ensuring socio-economic development. Although there are a number of such initiatives in South Africa, there is still a scarcity of ICT systems developed to meet the specific needs of communities. When this study began, initial studies were planned to be done on projects based in the North West province. Pilot studies were conducted in various telecentres within the North West province. From this pilot study it was discovered that there were currently no specific ICT systems aimed at communities, as the focus in these telecentres was still on access to technology. The scope of the study was changed to look at projects from around the whole of South Africa. The literature revealed that there were some Living Labs developing systems for the disadvantaged communities (Herselman, Marais, & Roux, 2009; Cunningham, Herselman, & Cunningham, 2011); hence Living Labs were selected as the subjects of the study.

5.3.5.3 Data Collection Instruments

Various researchers (Stake, 1995; Patton, 2002; Yin, 2009) agree that the techniques listed in Table 5.2 are some of the more popular techniques used for data collection in case study research. Some of these techniques are compatible for use with both qualitative and quantitative studies, such as interviews, for example. The difference is to be found in the question content, question design and the actual approach to conducting the interview.

Table 5-3: Techniques for collecting evidence, with identification of techniques to be used for this study

	Technique	Specific to this Study
1.	Documents (letters, agendas, progress reports)	Research papers, information from websites and various reports
2.	Archival records (Service records, organisational charts, budgets etc.)	None
3.	Interviews (typically open-ended, but also focused, structured and surveys are possible)	Open-ended face-to-face interviews, open- ended telephone interviews
4.	Direct observations (formal or casual; useful to have multiple observers)	None
5.	Participant observation (assuming a role in the situation and getting an inside view of the events)	None
6.	Physical artefacts	None
7.	Still photos	Photos taken on site and photos from other sources

Interviews, focus groups, documentation, and archival records are some of the most common instruments used when undertaking qualitative studies (Cooper & Schindler, 2006; Yin, 2009). As per Table 5.3, the shaded areas show a combination of interviews, document analysis and photographs used to collect data from the Living Labs.

1. Interviews

Interviews are essential sources of data for qualitative case study methods. Interviews use oral or verbal conversation between the researcher and the participants and offer an advantage over surveys by enabling the researcher to ask follow-up questions (Yin, 2009). This also gives the interviewee an opportunity to ask questions and to easily pose their concerns or complaints about the process. Walsham (2006) cautions that it is important for the researcher to inform the interviewee about the purpose of the interview and also to reassure him or her about confidentiality of information. Due to the distance between the cases used, both face-to-face and telephonic interviews were required for this research. In additon, with permission from the respondents audio recording was used in all interviews.

2. Documentation Analysis

When conducting a qualitative study, data on the background and historical context are gathered for a better description of the particular setting (Marshall & Rossman, 2010). Document collection makes use of existing information about the case study and the unit of enquiry. The document may be in any format, i.e. electronic or paper, internal or external, but the information must be within the current research interest. Documentation was used as part of the evidence for the case studies conducted. Research articles, annual reports and photos were used in conjunction with interviews.

3. Still photos

Still photos assisted the researcher to capture data that would otherwise not be recorded or overlooked from the interview. Marvasti (2004) argues that they can be used to support certain findings to provide visual evidence in support of certain claims. Photos were captured by the researcher during site visits and photos from other sources were additionally used.

5.3.6 Data Analysis and interpretation

In order to derive the research findings, the data had to be analysed. Data analysis is a stage during which the collected research data is organised and studied in order to present a case towards fulfilling research objectives. Yin (2009) states that data analysis consists of examining, categorising, tabulating and testing evidence to address the initial propositions of a study. Creswell and Clark (2011) state that during data analysis the researcher codes the data by dividing the text into small units, assigning labels to each unit and then grouping them into themes. Various authors (Taylor-Powell & Renner, 2003; Olivier, 2004; Ryan, 2006) agree that qualitative data analysis is not without some difficulty. Yin (2009) suggests that unlike the case of quantitative analysis, there are few fixed strategies; instead much depends upon the researcher's thinking and novice researchers are the most challenged.

Thematic coding and Computer-Aided Qualitative Data Analysis Software (CAQDAS) have become increasingly useful (Ryan, 2003; Oates, 2006; Jones & Diment, 2010) as it helps in coding and categorising large amounts of textual data. According to Creswell and Clark (2011), CAQDAS can store source data and notes on the source, enable data coding, visually show linkages and relationships amongst codes, and also enables searching of text that contains multiple codes. The mistake that most researchers make is thinking that all they need to do is capture data and then CAQDAS will magically do data analysis. Yin (2009) cautions that the software does not do the work for the researcher, but it may serve as an able assistant and reliable tool. This view is also shared by Creswell and Clark (2011) who emphasise that a researcher's mind is the best tool for analysing data and that the tools should provide a supporting function.

There are various CAQDAS applications available in the market like NVivo, Nudist, Atlas.ti™ , Maxdata, HyperRESEARC. (Jones & Diment, 2010). Atlas.ti™ (www.atlasti.com) was used as a tool to code and analyse the data for this study. The decision to make use of Atlas.ti™ was based on the fact that this tool assists in coding qualitative data and also that it is freely available at North West University, where this study is done.

5.3.6.1 Data Analysis Process

Qualitative data analysis also calls for a well thought-out approach that ensures the study does not lose its focus on its original objectives or propositions. There are some general strategies used to assist in data analysis. Creswell (2007) suggests some common steps involved in the analysis and interpretation of qualitative research data. These steps are summarised in Table 5.4 and briefly discussed from section 5.3.6.1.1 up to section 5.3.6.1.6.

Table 5-4: Common Steps used in Data Analysis (Creswell J. , 2007)

	ANALYSIS STEP	DESCRIPTION
1	*Organise and prepare the data for analysis*	Transcribe audio interviews to text. To ensure accuracy and completeness of data, the researcher needs to edit the transcriptions.
2	*Read through all the data*	In order to have a much better understanding of the data presented.
3	*Use the coding process to generate a description of the setting or people, as well as categories or themes for analysis*	This involves detailed background information about people, places or events in a setting.
4	*Use the coding to generate a small number of themes or categories*	Identify themes from data
5	*Advance an example of how the description and theme should be represented in the qualitative narrative*	Narrate the findings
6	*Interpretation*	Explain the meaning of data

5.3.6.1.1 Organise and prepare the data for analysis

For ease of use, data from the interviews should be properly prepared (Taylor-Powell & Renner, 2003). Prior organised interview questions aid this process as it becomes easy to organise well-grouped questions. This process seems straightforward if one is doing it for the first time, but it is one of the tedious tasks at this stage of research. Once the data is transcribed, it needs to be edited for completeness, accuracy and for further quality purposes (Creswell & Clark, 2011; Mavetera, 2011). This means that the researcher needs to replay each audio recording, compare the audio output with the transcription and recheck the notes to eliminate any mistakes.

5.3.6.1.2 Read through all the data

According to Taylor-Powell and Renner (2003), a good analysis depends on understanding the data, through reading and re-reading the text and replaying the audio recordings several times.

Researcher participation during data collection is crucial to attaining better understanding of the reseach setting as well as unrecorded acts during data collection. Writing memos and reviewing various forms of data like field notes, pictures and transcripts from the interviews is important (Creswell & Clark, 2011). Ryan (2006) advises that this step should not be left until a later stage in the research, because in the meantime the researcher could start to establish possible codes to be used for analysis.

5.3.6.1.3 Use the coding process to generate a description of the setting or people, as well as categories or themes for analysis

Coding is the process of examining and categorising raw research data by assigning codes or labels. It reduces data into small manageable chunks of groups that lead to easier interpretation (Ryan, 2006). Strauss and Corbin (1990) identify three types of coding: Open-coding, Axial coding and Selective coding which are often associated with the Grounded Theory Method (GTM). Open-coding is defined as the practice of coding or labelling words or phrases found in text whereas axial coding creates themes, categories or families by grouping codes from open coding, while during selective coding the researcher chooses data that support the intended theory (Strauss & Corbin, 1990). Axial coding is also referred to as relational coding (Gibson, 2006); to avoid association with GTM, relational coding is the term adopted for this study. Only open and relational coding are used in this relational study; open-coding is applicable to this step whilst the next stage deals with relational coding.

During open-coding, the researcher intends gaining an understanding of the inquiry, the respondent's experience and views on the phenomenon under study as well as the nature or types of relationships involved. Some codes can be pre-set during the early stages of research, literature review or research questions and some may emerge as the researcher works through the data (Taylor-Powell & Renner, 2003). The coding labels emanate from the exact words of the participants, known as *in vivo* coding, or the labels may emerge from phrases composed by the researcher or general concepts used in the field of study (Creswell & Clark, 2011). A code is identified once and can be aligned to various statements or phrases in the data.

With Atlas.ti™, the researcher is able to append memos and comments to the data, which can be used for analysis. The second step, *reading through the data*, also assists with better understanding and labelling of data.

5.3.6.1.4 Use the coding to generate a small number of themes or categories

As explained above, this step is also referred to as axial coding. During this step the researcher looks for themes, patterns and relationships emerging from the data (Taylor-Powell & Renner, 2003). Themes may be defined as concepts that explain how ideas or categories are connected (O'Connor & Gibson, 2003). Themes are outcomes of coding identified through classifying and grouping data by looking for a logical connection between the categories established during open-coding. Codes are grouped together because they share some similar characteristic or address the same concept. This makes it easy to establish relationships from data.

Identifying relationships from themes helps to interpret data. One way to identify relationships is to look for themes that often occur together in the data (Taylor-Powell & Renner, 2003; Ryan, 2003). One of the features of Atlas.ti™ is that it enables categorisation and grouping of documents according to the criteria specified by the qualitative researcher under themes or "families" (Friese, 2012). Families can be a collection of related primary documents (*PD families)*, codes (*Code families)* or memos (*Memo families)*.

Coding is an iterative process, and success first time around is rare. Sometimes working with more than one researcher during this step assists in eliminating any errors and identifying new, possible connections that might not have been apparent to the principal researcher.

5.3.6.1.5 Advance an example of how the description and theme should be represented in the qualitative narrative

This is the step where documentation is produced to bring meaning to the codes identified.

5.3.6.1.6 Interpretation

Using information from code families (or themes), relationship and possible network structures from data, the researcher will bring more meaning to the findings of the research, taking into account the literature and theories used in research.

5.3.6.2 Atlas.ti™ for Data Analysis

Atlas.ti™ is a computer based qualitative analysis tool that is particularly useful for large sections of text, visual and audio data (Smit, 2003). Atlas.ti™ enabled the researcher to efficiently store, organise and manage data for straightforward analytical use. The tool uses codes, quotations, memos and comments to give meaning to data through features like families, networks, etc. All these are contained in a component known as the Hermeneutic Unit (HU). Instead of manually grouping chunks of text, Atlas.ti™ was used to categorise data into codes or themes relevant to the study. This enabled the researcher to identify factors that are common amongst all the Living Labs which had an influence on the decision to use or not to use SDM during development.

Another advantage of Atlas.ti™ is that the data is able to be stored in various formats such as text, pictures, audio and video. Documents might include interview transcripts, articles used in the study, or any document that forms part of the analysis, and are regarded as primary documents (PD). Using Atlas.ti™, the researcher was able to output the coded data into various formats such as a list of all codes, memos, quotations and was able to indicate the frequency of use of all of these. Through the use of networks and families, the researcher was readily able to detect patterns and relationships in data for easy theory building.

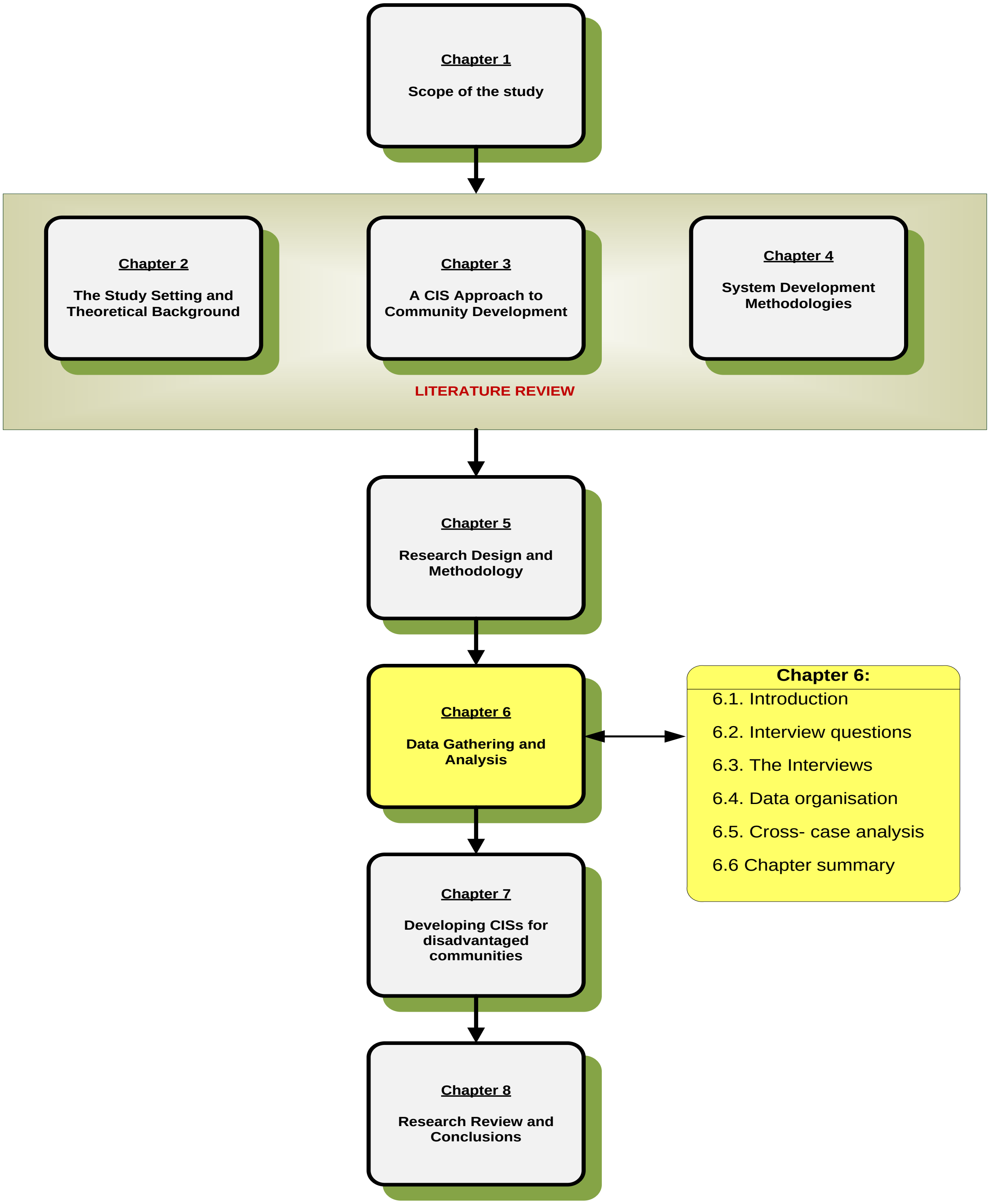
5.4 CHAPTER SUMMARY

This chapter presented an overview of the research design and methodology adopted for this study. Making a reference to the research onion developed by Saunders, Lewis, and Thornhill (2007), details of the key research paradigms, approaches, methods, data collection and data analysis methods used in information systems research were outlined.

The study follows an interpretive paradigm and a multiple qualitative case study was used as the method of enquiry. Living Labs were chosen to represent community initiatives aimed at using ICT to improve the livelihood of people in disadvantaged communities. The interviews were both face-to-face and telephonic. Documents, reports and still photos were used for data collection. Data were analysed through thematic analysis, using Atlas.ti™ ,and cross case analysis was conducted to present a holistic picture from the multiple case studies.

Chapter 6 details the process that was followed in conducting this study and Atlas.ti™ is used to assist in coding and analysing research data. Research outcomes are recorded in chapter 7.

CHAPTER 6. DATA GATHERING AND ANALYSIS



6.1 Introduction

The previous chapter mapped the process of this research. This chapter presents a description and analysis of data obtained. Categories identified from Atlas.ti™ are used in the reporting and interpretation of data from the case studies.

As discussed in Chapter 5, analysis of data is based on the steps as proposed by Creswell and Clark (2011) and presented in Table 5.4. The first two steps: *Organise data for analysis* and *Read through data,* are covered in section 6.2 of this chapter. An outline of the process followed in gathering and coding data is provided. The rest of the chapter covers steps three (3) through to six (6) for analysis of the individual case studies and later applied during cross-case analysis. For individual case analysis (sections 6.5.1, 6.5.2, 6.5.3), each case will be presented based on various themes as identified in section 6.4.1, while reporting and presentation of the individual case studies (section 6.5) will be split into two sub-sections. The first sub-section offers a descriptive view of the case study, of which literature studies are the main source of information. The second sub-section uses categories / groupings identified from Atlas.ti™ to provide and analyse each case study.

At the end of each case presentation, propositions are formulated based on the findings of the interviews and themes. To ensure coherence across the case studies, the propositions are reviewed after the cross-case analysis in section 6.6.

6.2 Interview Questions

This section presents a discussion on questions used during the interviews. Thirty-seven core questions were developed and further categorised into six related sections for easy reference and manageability. A different list of questions was developed for the users, addressing their understanding of the system and whether they played any role during development.

6.2.1 General Information about the Living Lab

Questions from this section are aimed at obtaining information about the living lab; its establishment, the objective and the stakeholders. The questions are also aimed at establishing the presence of any CIS and whether or not there was any type of system development. The ultimate intention of these questions was to eliminate any living lab that does not have systems in place and/or which has not done any form of development to the systems, from the study.

6.2.2 Information about the CISs

This section is aimed at understanding the system/s developed by the living labs, each of which has a number of small systems, usually developed by various people. There are two categories of systems used within the living labs: the first concerns systems that are developed for use by the users from the community while the second consists of systems used by employees to enable them to deliver ICT based services to communities. The focus of this study concerns the first category.

6.2.3 Use of information systems development methodology during development

This question is aimed at establishing whether there was any conscious decision to use an SDM. It also looks at the SDM used in the organisation as well as investigating whether any standard process was being followed. To better understand the perceptions of different user groups, questions regarding the composition of the development team were also asked.

6.2.4 Extent of User Participation (consultation) during development

In that users are an important part of system development, these questions were aimed at establishing who the users of the system are as well as the extent of their participation during development of the system.

6.2.5 Effectiveness of SDM

The second research objective was to find out whether or not SDMs are effective in assisting with the success of the system development process. Questions under this section were posed to establish whether the methodology used contributed to the success of the system development process. Respondents were also asked to comment about challenges with the system.

6.2.6 Information about the Participants

As part of the interview, the participants were either given (in case of face-to-face interviews) the consent form or the contents were read out (in case of the telephonic interview) detailing the ethical principles and the confidentiality of the information. The purpose of collecting personal information was for follow-up, if necessary, and thus does not form part of data analysis.

6.3 THE INTERVIEWS

Purposeful sampling was used as a technique to select research sites and individuals who could contribute to the study due to their experience of the subject under study (Creswell & Clark, 2011). In selecting the case studies, two conditions were to be met. The first condition was that to be part of the study, the initiative should be focused on a Living lab. There are several ICT-based community initiatives concerned with using ICT4D towards improving the living standards of people from disadvantaged communities. These initiatives vary from providing/distributing technology to facilitating the use of technology or developing it (Bergvall-Karebom, Holst, & Stahlbrost, 2009). This consequently meant that for this study, specification of the second condition was necessary which was that the living lab chosen should be or should have been involved in development of an ICT4D CIS. Development in this case does not only apply to developing from scratch, but includes changing some aspects of the system so that it satisfies the identified purpose.

To establish the first condition, contact was made with representatives from the living labs through a Living Lab workshop held in Grahamstown, in June 2011. From that workshop, participants from six Living Labs showed interest and agreed in principle to participate in this study. A follow-up email asking further questions was sent to establish the second condition. The participants from the Living Lab ware asked if they were involved in any form of system development, with "development" being explained to accommodate the context of this study. From the responses to the emails, the researcher then approached five of the Living Labs who met the conditions and they agreed to participate in the study. The sixth was unsuitable for this purpose as the staff indicated that they only work with researchers from within their own stakeholders. During the site visits, two of the Living Labs did not meet the second condition, as the system was still in the planning stage of development.

Initial literature and document research on each of the case studies that met the conditions revealed that the Living Labs are different from each other in several aspects. Specific details of these differences will be discussed during the description of each case study, but in general, the size and the number or type of people working for the Living Lab were different. Location and maturity of the practices of the Living Labs also varied. This meant that the sample from each case study would be different, but should include someone from the development team, owner/management team and/ or users where necessary.

A visit was then planned to all the sites for data collection, as elaborated in the next section.

6.3.1 Preparing for interviews

A number of researchers (Kvale, 1996; Cooper & Schindler, 2006; Yin, 2009) agree that interviews in a qualitative study are aimed at understanding the context of study from the point of view of the research subjects to obtain their meaning, based on their personal experiences. To eliminate anomalies in the data collection process, the interviews were planned well in advance. Planning included preparing research questions, identifying participants and contacting each Living Lab for interview dates. Open-ended interview questions were prepared in order to obtain as much information from the participants as possible. Due to the dynamics of the Living Labs, it was ultimately impossible to interview all the respondents during the site visit and it was decided that recorded telephone interviews would also be used. The distances of the various research sites from the interviewer also presented a problem as multiple visits were not always feasible. The estimated distances of the research site from the researcher (East London) were: Dwesa approximately 180 kilometres), Polokwane about 1 275 kilometres and Cape Town approximately 1 045 kilometres

A consent form was also worked out to be used for each participant, the purpose of which was to give a brief background to the study, to outline the interview procedure and duration, give an overall view of the potential benefits of the study to the research participants as well as for the country. More importantly, the consent form assured the participants of the confidential treatment of their personal information ensuring anonymity; the participants were further given the choice to withdraw from the interview at any point during the study.

One of the weaknesses of interviews as a data collection technique is that there may be inaccuracies created by poor recall of discussions as the interviewer may not be able to engage in fruitful discussions whilst taking thorough notes (Yin, 2009). As noted by Marshall and Rossman (2010), audio recording is one of the solutions to this problem. With prior permission from the respondents, all interviews were audio recorded to ensure that all data was captured and to limit misrepresentation. The decision to record the interviews was very useful during telephone interviews. One of the advantages of face-to-face interviews is that the interviewer can recollect, for instance, a facial expression which assists with the capturing of notes. This is not the case with telephonic interviews, hence the importance of recordings.

6.3.2 Interview setting

The interview environment was different for each living lab due to differences in dynamics as indicated above. Unlike organisations, Living Labs have fewer staff members. Four respondents were interviewed from Siyakhula and Limpopo Living Labs and five respondents from RLabs. As may be observed in Table 6.1 below, some respondents played multiple roles, not only as managers but as members of the development team.

Table 6-1: Interview participants

Case	Management Team	Management Team/ Developer	Developer	User	Total
Siyakhula LL	1	-	3	0	4
Limpopo	1	2	1	0	4
RLabs	1	1	1	2	5

Arranging interviews with members from the Living Labs was challenging because of the research nature of the Living Labs, where people spend most of their time outside their work stations. Some people working for the Living Labs have other equally demanding jobs, making availability for interviews difficult.

At Siyakhula Living Lab (SLL), research and system development is mostly conducted by students. What differentiates Siyakhula Living Lab from others used in the study is that the Living Lab has no permanent physical presence (in terms of office or personnel) within the community, but this is offset by almost bi-weekly visits from the students and other stakeholders to the site. The coordinator is stationed in Grahamstown, more than 300kms away from the site. This meant that the best way to obtain a representative sample was to make use of opportunities during those visits. Communication was through the coordinator who advised on the dates of the visit. On arrival on site, interviews were conducted with relevant members of the group.

The scenario above was different from that of Limpopo Living Labs and RLabs, as these two Living Labs have offices on site. Limpopo Living lab has two locations: one office in Polokwane and another permanent, office in Mokopane. Members from Mokopane were attending a conference during the time of interview visits and thus interviews were held with members at the Polokwane office.

Telephonic interviews were scheduled and conducted for all other members from these three Living Labs who were unavailable during the site visits. Telephone interviews were also audio-recorded.

6.4 DATA ORGANISATION

In this study the major part of organising data involved transcribing the audio recordings to text. The exercise included converting the text into a proper, written format by identifying passages that did not make sense, without distorting the meaning as well as correcting grammar, spelling, and punctuation as necessary. Recordings were replayed several times to ensure that transcription was accurate. This exercise was also necessary due to differences between the spoken and written word in terms of correct grammar use (Marshall & Rossman, 2010). There is more flexibility in correct grammar usage in the spoken word, such as an absence of punctuation or use of words such as "its" instead of "it is", as accepted in written language. Responses were organised according to the order of the questions. Through utilising this approach, the researcher was careful not to distort the original meaning of the text. Codes were assigned to each case study and to the respective respondent for easy identification. As Atlas.ti™ is used for data analysis, the data was then converted into a Rich Text format to be added (assigned) to the HU, ready for manipulation. Although it appears a trivial task, when starting to work with a CAQDAS the researcher needs to decide where project files will be saved and how they will be organised. Saving project files under one folder location is a crucial step when using Atlas.ti™ for data analysis as any movement or editing of the file in an Atlas.ti™ project (or most of CAQDAS) renders the HU dysfunctional.

6.4.1 Thematic analysis

One of the advantages of making use of Atlas.ti™ for data analysis is that it makes it easy to group research questions and data into a set of related themes. The third and fourth steps from Creswell (2003), as discussed in Chapter Five, address the coding process, naming and labelling of data and combining related codes under the same category, known as a family in Atlas.ti™ . These two are presented below.

6.4.1.1 Assigning codes to text

After all interviews were transcribed and the text organised, all interview scripts were saved in one location for easy organisation. The interview documents, known as Primary Documents (PD) were added into the project HU.

Assigning codes for use during analysis started well before the analysis process. Some codes and themes emerged during the literature study and some after compiling the research questions. These codes were used as basis for the analysis. The text from each PD was read line by line and codes were assigned to words or phrases which captured the essence of what the study was about. As an iterative feature of qualitative analysis, some codes from the original list were later discarded and new codes were added as they emerged during open coding (Taylor-Powell & Renner, 2003; Ryan, 2006). With each emerging code, whilst working through PDs, it was necessary to re-assign code to texts that aligned with the new code. Table 6.2 lists some of the codes used in this study.

Table 6-2: Examples of codes used, extracted from Atlas.ti™

Code	Number of Quotations
Addressing social challenges	8
Agile	4
Awareness of user circumstances important	6
Basic needs not met	2
Community members	8
Computer illiteracy	6
Conflicting statement on the development team	12
Continuous requirement specification	3
Effectiveness of technology for community development	8
Flexible SDM to meet the environment	6
Language challenges	2
No computer ownership	4
No formal approach	5
Open source	7
Pilot system before user input	9
Private company to manage System development	7
Several systems	9
Student developer	5
System replication	3
Train users on computer usage	9
User do not know how helpful technology is	2
User feedback	9
User involvement important	7
User requirements specification	8
With no SDM you gamble	3

Initially more than 150 codes were used for labelling text, with more than 500 quotations. Through further data refinement and grouping of similar codes, the number of codes was reduced. Analysis and interpretation of data is normally a dreary process, but it has been made easy by categorisation and establishment of relations in data, as covered under relational coding. Memos assist in storing any additional thoughts or ideas, thus reinforcing meaning to a particular text or code.

6.4.1.2 Establishing relationships between codes

This is part of relational coding, commonly referred to as axial coding. According to Mavetera (2011), relational coding makes it easy for the researcher to analyse data and assists in formulating research propositions. To identify themes, the research objectives and subsequently, the categories of questions asked during the interviews were considered and code families were identified. Related families became the basis for themes in this study. Families are very useful when querying data for a more focused analysis as they enable filtering of data for a specified output from only a particular, selected subset of data (Muhr & Friese, 2004; SUNet, 2008; Friese, 2012), i.e. achieving a combination of codes and quotations from one or more case studies. The identified themes and associated families are presented in Table 6.3 below, followed by Table 6.4 which maps the code families to the interview questions. As is evident from both tables, some items overlap amongst two or more families or themes.

Table 6-3: Identified Themes and families

Themes (Relational Coding)	Family (Focused Coding)
Development team	**Developers**
Individual Role	
Community Challenges	**Living Lab**
LL Establishment	
LL Financial Support	
LL Focus	
LL Location	
LL Stakeholders	
Development Length	**SDM**
Documentation	
SDM Approach	
SDM Challenges	
SDM Effectiveness	
SDM Features	
SDM Process	
SDM Selection factors	
SDM Tools	
SDM Use	
System development platform	
System Development Team	
User Participation	
Main System	**System**
Student individual systems	
System Challenges	
System commercialisation	
System Maintenance	
System Name	
System Status	
System success factors	
System Testing	
System Users	**Users**
User feedback	
User Introduction	
User Training	

Table 6-4: Mapping Code families to research objectives and interview question category

Families	Research Objective	Interview question category
Living lab	▪ Establishing existence of information systems aimed at addressing socio-economic development issues for disadvantaged communities around South Africa.**	▪ General Information about the living lab
Developers	▪ Identifying whether SDMs are followed when developing the CISs in South African disadvantaged areas.**	▪ Information about the participant ▪ General information about the living lab ▪ Use of information systems Development methodology during development
System	▪ Establishing existence of information systems aimed at addressing socio-economic development issues for disadvantaged communities around South Africa.	▪ Information about the CISs
SDM	▪ Identifying whether SDMs are followed when developing the CISs in South African disadvantaged areas. ▪ Establishing from the Living Labs the factors influencing the use and effectiveness of SDMs when developing the CISs for South African disadvantaged communities. ▪ Establishing how Living Labs should develop CISs for disadvantaged communities.	▪ Use of information systems Development methodology during development ▪ Effectiveness of SDM ▪ Use of information systems Development
Users	▪ Establishing from the Living Labs the factors influencing the use and effectiveness of SDMs when developing the CISs for South African disadvantaged communities.**	▪ Extent of user participation (consultation) during development

** Shows indirect connection to the research objective/s.

6.4.1.2.1 Living Lab

This theme family seeks to gain a general understanding of the Living Lab environment as a community. To recapitulate on the adapted definition of a community from Chapter 3, a community is a group of people facing similar socio-economic challenges, with on-going interactions and common interests. It is important to understand a Living Lab community because, according to the respondents, it also has an impact on system development practices, particularly when it pertains to users of the system.

Codes that emerged from open-coding included general information about the Living Lab establishers or initiators, the focus or the purpose of the Living Lab and the stakeholders too. Stakeholders are defined as institutions and people who are involved or are affected by the Living Lab.

Although this information does not seem related to the main objectives of the research, an understanding of the Living Lab environment plays a role in the choice of a SDM.

6.4.1.2.2 Developers

This family seeks to understand the nature of those involved in the development of the systems, from the developers to the development organisations. It will become evident from individual case studies that there are various types of developers involved in the development of systems for Living Labs. The developers include students, and other organisations with a growing trend being the establishment of a private company as a system development arm of the living lab. Questions were aimed at establishing the role of developers in making decisions about use of SDMs.

6.4.1.2.3 System

The system theme deals with diverse issues contiguous to the system: the objective; architecture; extent of use and support issues, such as maintenance, user training and language issues. Emergent from data gathered, an issue that arose is that there is a possibility of system replication and commercialisation exists. System challenges and success factors are also covered.

Discussions on this theme are divided under the following sub-themes:

1. System Objective
2. System Use
3. System Challenges

6.4.1.2.4 System Development Methodologies

The need to follow a methodology when developing information systems was realised as far back as the 1960s. This theme focuses on the use of SDMs by Living Labs when developing systems for disadvantaged communities and also on the effectiveness of these SDMs in assisting teams to deliver systems that will be used successfully by these communities. Issues addressed in this theme include whether or not a conscious decision has been made by the Living Lab to follow a particular system development methodology.

To cover the issues under this theme in more depth, discussions are organised under the following sub-themes:

1. SDM Selection
2. Development Process
3. Development Issues
4. Necessity of SDM

6.4.1.2.5 Users

As systems are developed for use by people, it is important that users engage during system development. User issues pertain to various levels of involvement by users during system development and user training.

6.5 DATA PRESENTATION: INDIVIDUAL CASE STUDIES

The focus of this study is on a community as people sharing the same impoverished or challenging socio-economic conditions, which are being addressed through the use of appropriate information and communication technologies.

The literature forms the basis of discussion for the first four topics under each of the case studies, i.e. *Background, Establishment, Users and Activities of the Lab*, as they are general. Data from the interviews was found to be consistent with the literature. Discussions on the rest of the topics, *System development team, System issues and System development methodologies* (*thematic presentation of data)*, are solely based on data gathered during the interviews.

For easy reference and to ensure confidentiality of identities of respondents, the following codes are used for case studies and respondents:

Table 6-5: Reference table for Research Participants.

Case	Case Reference	Respondent Group	Respondent Reference
Siyakhula Living Lab	C1	Management team	C1M1
		Developer	C1D1
		Developer	C1D2
		Developer	C1D3
Limpopo Living Lab	C2	Management team	C2M1
		Developer/ Management team	C2DM1
		Developer/ Management team	C2DM2
		Developer	C2D1
RLabs	C3	Management team	C3M1
		Developer/ Management team	C3DM1
		User	C3U1
		User	C3U2
		Developer	C3D1

The numbers attached to the references have no particular significance other than for labelling purposes.

6.5.1 Case 1: Siyakhula Living Lab

Formerly known as Dwesa ICT Project, the aim of the Siyakhula (Xhosa word for "we are growing") Living Lab was to address the socio-economic conditions of a former Transkei community through promotion of access to ICT and also to provide ICT skills to the community. Siyakhula Living Lab is located in the Wild Coast Region of the Eastern Cape, in the Dwesa-Cwebe community.

6.5.1.1 Background to the Community

Figure 6-1: Map showing location of the Siyakhula Living Lab in the Wild Coast, the Eastern Cape (Cunningham, Herselman, & Cunningham, 2011)

The Siyakhula Living Lab is located in the Dwesa community, under Mbashe Local Municipality which is part of the Amathole District Municipality. Bordered by the Indian Ocean, the Wild Coast is a well-known area in South Africa due to its attractive, unspoilt natural reserves. The villages in the Living Lab vicinity are surrounded by two nature reserves: the Dwesa and Cwebe Nature Reserves which are located on either side of the Mbashe River estuary approximately 250 km north-east of East London.

The nature reserves, the hotel and the guest houses are the main employment providers in the area with handcrafts (sold to tourists), subsistence agriculture and government welfare grants. Education is a challenge in the area as there is no secondary school in the neighbouring villages (Pade-Khene, Palmer, & Kavhai, 2010).

The majority of the population living in these villages is Xhosa and forms part of the 82% of the population in Mbhashe Municipality that live in poverty (Phiri, 2009). The area is one of the most poverty stricken communities in the country, evident from the poor infrastructure, no electricity, bad roads and poor access to telecommunication. To access the villages, one has to travel about 50 kilometres on a gravel road in very poor condition, suitable only for 4 X 4 vehicles, particularly during the rainy season.

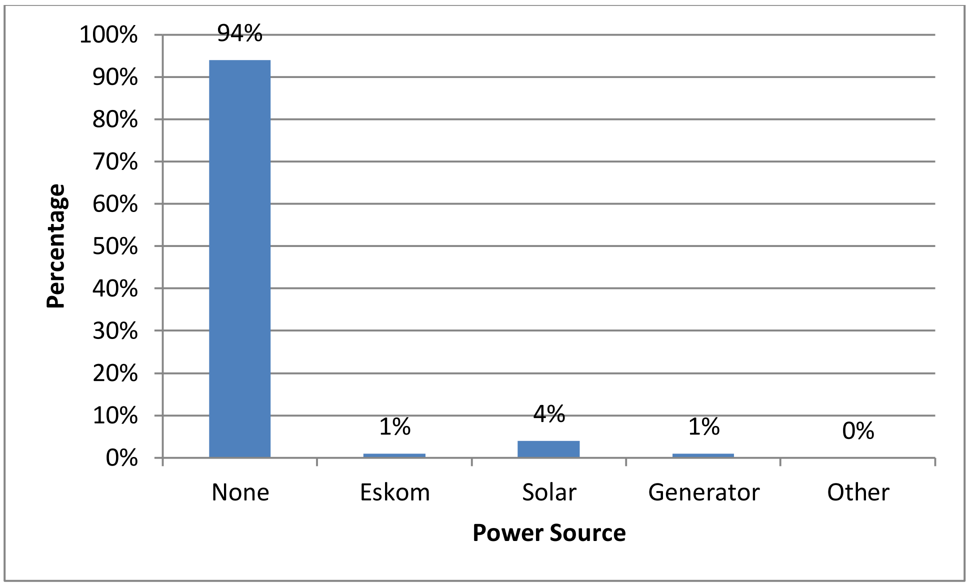


Figure 6-2: Power availability in Mpume (one of the villages in Dwesa- Cwebe area) (Pade-Khene, Palmer, & Kavhai, 2010)

Figure 6.2 illustrates that 94% percent of the households have no access to electricity. Although not an obligatory element, electricity facilitates easier connection and use of ICT. Without electricity, people do not make as much use of their mobile phone applications as it is not easy to charge batteries and often exposes them to theft when charging in small battery-operated mobile phone-charging businesses.

6.5.1.2 Establishment and history of the Living Lab

The Living Lab was established in 2005 as an indirect result of a relationship that grew between Dwesa community and the Rhodes University Anthropology Department (Isabirye, 2009).

The Living Lab was established through the partnership between two universities (Rhodes University and University of Fort Hare), industry partners (Telkom, Saab Grintek), and the government via the Department of Trade and Industry and COFISA (The Cooperation Framework on Innovation Systems between Finland and South Africa). The Living Lab has also enjoyed support from SAFIPA (South Africa-Finland Partnership on ICT), the Meraka Institute and is part of LLiSA (Living Labs in Southern Africa).

The two universities drive the projects through student research and development of telecommunication platforms and this is made possible by funding from the Telkom centre of Excellence (CoE).

Siyakhula Living Lab was established to develop applications relevant to rural communities to improve the socio-economic development and to impart technology skills to the people in these communities. The aim was to develop these technologies through co-creation, with active involvement of the communities and to address the socio-economic needs of the people in communities.

6.5.1.3 Users of the System

Currently, the activities of the Siyakhula Living Lab are meant for the members of the broader community around Dwesa. A challenge facing the Living Lab is a high level of computer illiteracy. According to C1M1, the systems are being established to be used by people who are using a computer for the very first time, "*…that's why maintenance is not something that is a priority*". This challenge leads to a change in focus to first providing basic computer skills training before the system could be used.

6.5.1.4 Activities and Systems Available in the Living Lab

As mentioned above, research students from Rhodes University and the University of Fort Hare are currently responsible for developing the network platforms, developing applications and facilitating training. The computers, servers, network and internet are located in schools for easy access and security. Initially focused on three schools, the project has been expanded to include other schools, bringing the number to five in total: Mpume Junior Secondary School, Ngwane Senior Secondary School, Mtokwane Junior Secondary School, Nondobo Junior Secondary School and Nqabara Secondary School. These schools are connected to the WIMAX wireless network.

6.5.1.5 System development team

The living lab is jointly used by the Rhodes University Departments of Computer Science and Information Systems and the Department of Computer Science at the University of Fort Hare, who are part of the Telkom Centre of Excellence. Although there is no permanent presence in the village communities, there are people in the Living Lab who have various responsibilities. Personnel for the Living Lab are:

1. The project leader from each university, i.e. the University of Fort Hare and Rhodes University.
2. Co-ordinator of the Rhodes/Fort Hare TOC, currently based at Rhodes University.
3. Postgraduate (Masters and PhD) research students from these academic institutions become part of the Living Lab whilst still doing their studies. It is not easy to ascertain the number of students as they are in constant flux, depending on their studies.
4. Academics from the two institutions that supervise and guide the students are also part of the Living Lab.

All respondents this Living Lab from confirmed that systems for the Living Lab are largely developed by the students. A new company, Reed House Systems, has been established to drive development and test the applications for the Living Lab as well as to ultimately commercialise some of the applications, which will assist in the sustainability of the Living Lab.

6.5.1.6 System issues

6.5.1.6.1 System Objective

In response to the question of the primary objective of the system, all four participants offered different responses. C1M1 listed support for education, local business and community development as objectives of the system. C1D3 cited support for education as the system objective. C1D1 cited revenue management as the primary objective of the system. CIR3 had a different perspective on the objective of the system, stating that the system is aimed at integrating several small applications onto one platform.

Although these responses differ, they represent the unique perspective of each respondent. It transpired that indeed there were various systems as per views from C1M1, C1D1 and C1D3 within the Living Lab and that these systems are indeed going to be integrated into the main system, *Teleweaver*. This is evident from a statement by C1M1 who added that "….*students are doing their own individual thing; I don't even know how many they are."* C1D2 also made a reference to the integrated system, "*The major projects will be all combined in one thing so that problems with the system can be solved by one person*."

6.5.1.6.2 System Use

For this question, which was posed to establish whether or not the system was used immediately after its release, only C1D1 provided a direct response to this question and stated, "*Yes because it was tested, we took it down here and tested it with the users*." Statements from other respondents were not as convincing, as recorded below:

- "*Ummmmmh yes yes actually it was*", C1D3.
- "*Jajaja, it was available*", C1D2
- "*I can't really answer much on that one because that was the first trial version*", C1M1

Three respondents (developers) state that the system was used immediately after release. C1M1, however, also presented a conflicting statement when he stated that *"the developer did a proof of concept at first. It had its bug because that's what happens when you ask students to do stuff. It is now being redone for Teleweaver."* Although the statements seemed to imply that the system was not really in use, all the respondents made reference to the testing phase that various systems were going through. Answers could be because the system (referring to individual systems, not Teleweaver) was not wholly used in its entirety but trial versions were being tested. C1M1 qualifies this uncertainty, stating that they had done a trial version but that the final system had not been released yet (at that time).

Another question relating to this theme was posed to gain insight into how the system was introduced to the users. All respondents agreed that training was conducted to introduce the system to the users. However, the challenge highlighted by both C1M1 and C1D1 was that the user manual is in English whereas people in the community speak Xhosa, and both respondents stated that there were plans to translate the manual into Xhosa.

6.5.1.6.3 System Challenges

The following challenges were identified as affecting success of the systems:

1. *Incomplete system functionality.*

This challenge refers mostly to the e-commerce system. This is one of the initial applications developed by students from Siyakhula Living Lab, which provided online trading of handicraft products from the community, thus increasing their exposure. The major challenge cited with this system was that it could not be linked to the banking systems, making the online trading platform a futile feature.

2. Poor system maintenance

As with the challenge in (i) above, respondents stated that most challenges arise as result of the transitory nature of the students who often leave the institution once they complete their research studies. System maintenance becomes a problem for the users who have just been introduced to computers. This challenge is fuelled by the absence of a maintenance plan for the system; if a student leaves a system with bugs it becomes difficult for new students to fix the problem. According to C1M1 in some instances students struggle to even fix their own systems.

6.5.1.7 System Development Methodologies

6.5.1.7.1 SDM Selection

A standard question, that all participants in the study were asked, concerned whether any formal decision is made regarding use of a particular SDM. All the respondents stated that no formal decision is taken on the use of a particular SDM. A statement from one respondent: *"It is not* *specified. There's none, you don't have an instruction that says you have to use a particular methodology."(C1D2)*

6.5.1.7.2 SDM Use

On the issue of using a particular methodology: as expected, there were differences in responses. Two respondents (C1M1 and C1D1) mentioned prototyping whilst C1D2 mentioned that development is done based on the waterfall methodology. One respondent (C1D3) stated, "*We actually, the thing is that Ummmmh ... developing methodology ... ummhhhh ... our developing methodology was in fact, basically we did not have one*", but later mentioned following an agile methodology when developing systems. The choice of prototyping as a SDM is evident in that the system is first tested by users before any further development takes place. Based on the users' input, the system is fixed. C1M1 said, *"The fact that you're doing this for the first time, you realise you need to consult with the community members in order, until you get the system running."*

There is, however, agreement from the respondents that the use of SDMs is important for ensuring that there is a standard way to develop a system. C1M1 argued that without the use of a SDM, the team (in this case the students) would not know what they are doing. To emphasise the importance of following an SDM, C1D2 states "*…if we don't use some methodology, how are we going to complete a project? That means someone can do a project for five years of which its going to be a waste of time, its time consuming. That's why the researcher will only work with the system for the period of two years and afterwards you have to be done with the project*".

6.5.1.7.3 System Development Process

There are also variations in the processes that are followed to develop a system. The open source platform has been adopted as the platform of choice in developing all applications. "*We use open source software because it is cheap and anyone can use it"* (C1D1). Developing the system takes about eighteen months to two years. CIRI remarked, "*Two years. Most students have to do their projects in two years*". Making a reference to Table 4.2, in Chapter 4, the process followed could be summarised as indicated in Table 6.6.

Table 6-6: SDM process followed in C1

PHASE	**RESPONSES FROM USERS ON APPLICATION OF THE SDLC**
Feasibility Study	As the developers are most concerned about a project for their studies, feasibility is looked at in terms of the potential of the project to make a contribution to the studies.
System Investigation	This is the stage that is most referred to by the respondents. This is the stage where students conduct research on the community towards the system idea.
System Analysis	There is no standard process followed on conducting analysis.
System Design	There is no reference to this stage.
Implementation	Students do their own development, using any tools that they are comfortable with. Open source is used as a base platform. Some systems are implemented, but others with bugs are not fully implemented. C1D1 makes reference to training that has been conducted to ensure use of the system, but the challenge is that the users do not know how to use computers and the instructions are in English, which is not a local language.
Review and Maintenance	Maintenance is one of the neglected activities during the system, due to students leaving the living lab after completing their studies.

A further comment on the prototyping process was made by C1D1 who stated that *"We developed a working prototype, we deployed it, tested it and then from there on we used the feedback from the users to develop some other aspects of the system."* User training has been seen as the best way to obtain any kind of response or feedback. C1M1 also mentioned documentation as part of the process, as they are expected to document the procedure as part of the research.

6.5.1.7.4 Necessity of SDM

To understand the effectiveness of an SDM, the respondents were asked if they believed that the use of an SDM assisted them in achieving their system objective. Two of the respondents (C1D1 and C1D2) agree that using a SDM assists in improving the chances of success of the system. Regarding the effectiveness of prototyping, CIR2 stated, "*It seems very effective on the context like this because you work on the problem that you have to test different versions before completing*." C1D3 believes that the choice and the effectiveness of an SDM depend on the system at hand. For example, according to C1D3 small systems do not need an SDM whilst the SDM is crucial for larger systems with increased technology.

6.5.1.8 Propositions

The following propositions were formulated based on the interview data from C1. For easy reference, the case study code (C1, in this case) is used together with a P number to represent the proposition number, i.e. C1P1 is the first proposition from case one and C1P2, a second proposition.

Table 6-7: Research propositions from C1

REFERENCE	PROPOSITION DETAIL
C1P1	*CISs from the living labs are developed in-house.*
C1P2	*The living lab develops a varying number of CISs for use by the communities towards socio-economic development.*
C1P3	*There is no prescribed formal SDM approach followed when developing CIS by the living lab.*
C1P4	*There is no formal decision on the use of a SDM when developing CISs by the living lab. Use of SDM is completely voluntary.*
C1P5	*The CIS development process starts with the research to establish the needs of the community.*
C1P6	*A prototype is first developed and shown to the users and then the feedback received is compiled into user requirements.*
C1P7	*CIS developed in the living lab are not yet fully in use.*
C1P8	*Computer illiteracy is a challenge as computer skills must first be transferred to the users before the CIS can be introduced to them.*
C1P9	*Users do not form part of the CIS development team.* User involvement is limited to the early stages of the CIS development process and during the system testing stages of the project.
C1P10	*Involvement of the private entity from the living lab will ensure that SDM is formalised and there is better system maintenance*: The Living Lab is currently in the early stages of establishing a private company whose mandate includes management of system development projects and also the commercialisation of the Living Lab systems.
C1P11	*Students are responsible for the development of CISs in living labs.*
C1P12	*Developers believe that SDMs are necessary to ensure that CIS development is a success.* This is based on the perception of the respondents as there is no evidence of the role contributed by use of SDM to CIS development success.
C1P13	*Size and complexity of the CIS play a part in the decision on use of SDM.*

6.5.2 Case 2: Limpopo Living Lab

To address the socio-economic conditions in the province, the Limpopo provincial government established the Limpopo Living Lab as part of a bigger initiative by the provincial government to enhance development in the province being driven by Limpopo Development Enterprise (LimDev). As part of LimDev, the Living Lab's focus areas are business incubation, skills development, development of innovative solutions and community development; there are therefore various stakeholders who are working with the Living Lab. Although primarily located in Polokwane, the Living Lab has various other sites in communities around the province.

6.5.2.1 Background to the community

Figure 6-3: Map showing location of the Limpopo Living Lab (Cunningham, Herselman, & Cunningham, 2011)

Limpopo Province is South Africa's northernmost province, sharing external borders with Mozambique, Zimbabwe and Botswana as well as internal, provincial borders with Gauteng, North West and Mpumalanga. Formerly Northern Province, the Limpopo province was named after the great Limpopo River that demarcates its northern border. The province boasts unsurpassed natural beauty and biological diversity, together with rich mineral resources.

Limpopo inherited Venda, one of the former homelands in South Africa, so that most people live in rural communities. In 1994 the province was declared the second poorest province in the country, after the Eastern Cape (Limpopo, 2005). About 97% of the population is African (StatsSA, 2009). Although rich in natural resources, corruption and poor service delivery has robbed the province of its potential growth. According to the 2011 census report, Limpopo is the poorest province in South Africa (Lehohla, 2012).

6.5.2.2 Establishment and History of the Living Lab

The Living Lab has gone from initially operating under the auspices of the premier, to being part of Limpopo Economic Development, Environment and Tourism (LEDET) to currently operating under LimDev, within the INSPIRE (the Provincial Information Society Strategy Program-Limpopo) division of LimDev. LimDev is a provincial parastatal focussed on helping the province to achieve its *Employment, Growth and Development Plan* by uplifting communities through various socio-economic development projects.

The Living Lab was established in 2007 after a feasibility study, conducted through the Premier's office and LEDET. In 2010, the Limpopo Living Lab was integrated into the LimDev and became a member of LLiSA.

The Living Lab has a long list of stakeholders, due largely to the number of activities in which they are involved. These include:

1. the Limpopo Premier's office
2. LEDET
3. The Limpopo Department of Sports, Arts and Culture,
4. National Department of Science and Technology,

5. SMMEs (Small, Medium and Micro Enterprises),
6. Limpopo, Municipalities,
7. the University of Limpopo
8. the broader Limpopo community

6.5.2.3 Users of the System

Due to the nature of this Living Lab and the various communities served, there are various types of users of the systems in this Living Lab. Some of the users are:

1. Broader citizens in Limpopo villages,
2. Municipal departments,
3. Workers at the LimDev,
4. SMMEs in the province,
5. Other stakeholders that use the services of the Living Lab

One of the challenges facing an iCommunity is poor computer illiteracy. Contributing to this state of affairs are the high levels of poverty within rural communities. This is exacerbated by inadequate computer literacy amongst teachers who are supposed to be assisting learners with computer training and system use. "*And it's unbelievable to see that pre-test their level of knowledge is very poor yet they've been on training skills and the big thing is they have nothing to practise on, they consolidate the information they have learnt but they have no infrastructure to do it on"(C2DM2).*

6.5.2.4 Activities and Systems Available in the Living Lab

Activities within the Living Lab are based on the following business model (see Figure 6.4):

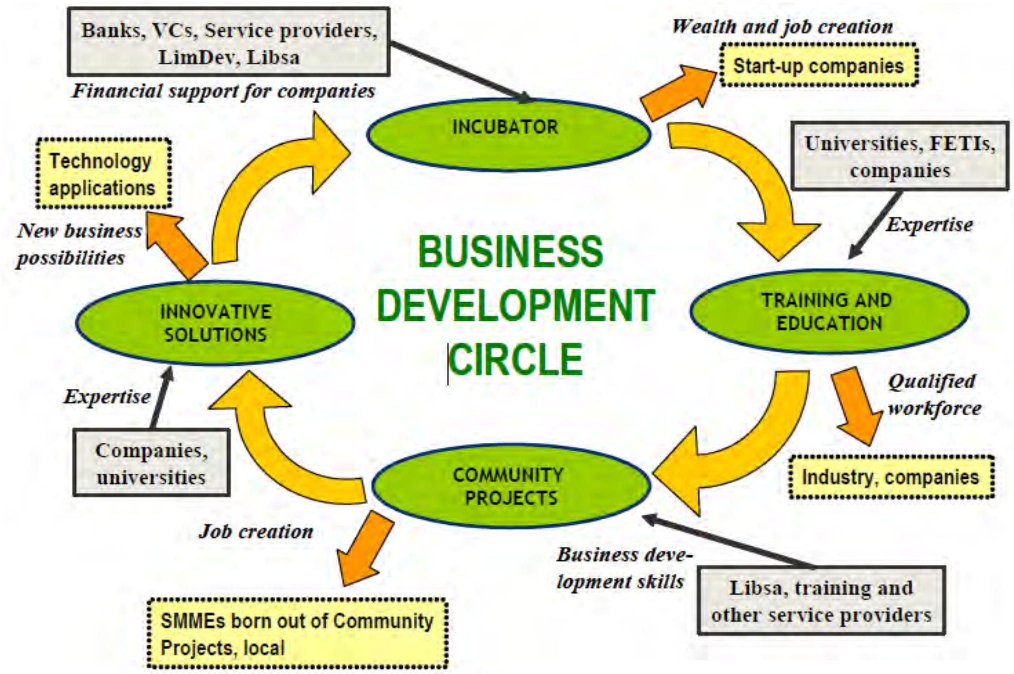


Figure 6-4: The Limpopo Living Process Model (LimDev, 2011)

1. *Incubator:* The incubator is concerned with facilitating new business development to youth, schools learners, women, the physically disadvantaged and SMMEs.
2. *Training and Education*: ICT based training communities. Currently basic ICT skills and business skills training is held in the Living Lab centres around the province.
3. *Community Projects*: These are various ICT-based initiatives aimed at improvement of living conditions in rural communities. Associated with the Incubator activities, the Moveecom is a mobile small business solution. This provides services similar to those of a typical internet cafe such as faxing, copying, typing, internet and calls.

Figure 6-5: Moveecom, a mobile business initiative (LimDev, 2011)

4. *Innovative Solutions*: Making use of Open Source solutions, the Living Lab develops solutions for the provincial government and other stakeholders. There are various systems that have already been devised.

The Living Lab is involved in various activities and has several ongoing projects. Similar to that of the Siyakhula Living Lab, System Developments are done using the Open Source Platform.

6.5.2.5 System development team

The Limpopo Living Lab has two sites, one in Polokwane within the LimDev offices and another one in Mokopane, a rural community 10 kms away from Polokwane. The Mokopane site, known as iCommunity, mostly deals with rural community projects whereas the Polokwane site is responsible for projects for local and provincial government. As already mentioned, the Living Lab is administered by LimDev. For easy reference, the Mokopane site will be referred to as C2A and the Polokwane site as C2B.

The following are the people currently involved with the living lab:

1. The LimDev Programme Manager

2. The programme manager from INSPIRE
3. Polokwane site; a project leader and an assistant
4. Mogalakwena site: a project lead and a developer
5. Trainers used in various communities.

There is a developer on each of the Living Lab's sites. Honours students from the local university have also been used in developing systems, but this arrangement seems to be less stable or formal than in the case of Siyakhula Living Lab.

6.5.2.6 System issues

6.5.2.6.1 System Objective

There are various systems that the Living Lab is dealing with as there are various community groups.

1. Mokopane site (C2A)

The Mokopane site aims at using technology to better the lives of people in the rural community. Currently iCommunity is busy with systems which are aimed at using technology to improve matric results for matriculates from the villages. The first one is DVD-based software with a compilation of educational resources, i.e. question papers and a downloaded Wikipedia to assist students with their school project. According to C2DM2 *"the Wikipedia has interactive information for their school project".* The second system was developed to mirror students' work from the school computer on 30 Gigabyte (gig) memory stick mirrors:

"we developed on a 30Gig memory stick a complete open source operating software with all the associated files, so that instead of somebody going around to find R5000.00 for a computer, they will be able to use this USB will boot up, it doesn't matter which software you are using like Microsoft, all the got to do is to redirect, there's a booting sequence in the USB and then it will display all the software with all files." (C2DM2).

2. Polokwane site (C2B)

Some of the systems being developed by this site include a Limpopo e-Heritage system, a SMME system and a project management system. Referring to the e-Heritage system, C2M1 stated that "*the ultimate goal is to have the heritage of the province being digitized, but that will be for the public consumption*." These systems are developed on request from different stakeholders in the province, towards ensuring use of ICT to improve living conditions. The SMME system profiles SMMEs in the province for easy identification and matching of business opportunities, whereas the project management system is aimed at optimising and standardising management and tracking.

6.5.2.6.2 System Use

Most systems from the living lab are still undergoing testing. The DVD system is used by a school in Skrikfontein; a pilot version of the project management system is being used while other systems are still not used at the Polokwane site.

According to the respondents, there is no standard approach to introducing the system to the users. For the project management system, an initial demonstration was done, and various iterations of a prototype were given to the users after which the system was then developed, based on their comments and suggestions and training was thereafter conducted for a completed system. C2DM1 states that for the e-Heritage system, awareness workshops and meetings will be used to introduce the users to the system. When the iCommunity system was taken to the school, it transpired that the teacher in charge of computer training had limited computer competency; she was then given training on basic computing and subsequently on how to use the system.

6.5.2.6.3 System Challenges

1. Poor system maintenance

Considering both these sites, one of the challenges is that the systems were developed by the students. Both C2M1 and C2DM1 are in agreement that delays on the e-Heritage system could be attributed to students who come and go, depending on the duration of their studies. Coupled to this, students do not follow any structured protocol when developing the systems and there is frequently no documentation available. Various parts of the system are developed by different groups of students at different times. "*Remember students, different people and organisations worked on it. Now that you're going to put your company organisation's brand on it, you want to do certain changes to ensure its functions*" (C2M1).

The same challenge was highlighted at the iCommunity where a student who assisted them in developing the memory stick application, was still busy with undergraduate studies, which contributed to delays in completing the system.

2. Open Source Compatibility

The DVD WIKI based system has been developed on an open source platform; users have experienced compatibility issues, particularly when working on the new versions of Microsoft.

6.5.2.7 SDMs

6.5.2.7.1 SDM Selection

From the discussions it became clear that there is no prescribed SDM used in the living lab and the same applies to the sites; each developer builds the system according to their own understanding and experience.

6.5.2.7.2 SDM Use

Respondents from the iCommunity both agreed that no methodology is followed when developing systems at their site. According to C2D1, semi-formal discussions were held concerning the concept and what the system should look like at the end. C2DM2 believes that the systems developed so far do not need a methodology; the methodology will be needed "*if we have complex process where a big database will be used*" (C2DM2).

C2DM1 seemed not to fully understand what an SDM was and thus the researcher had to further clarify the concept. Instead of mentioning a particular methodology, the researcher explained the process followed. This is outlined below, in Section 6.5.2.7.3. C2DM1 on the other hand stated that he uses a combination of prototyping and waterfall SDMs when developing systems, but stresses that the main methodology used is prototyping. His choice of prototyping stems from the belief that most of the time users do not understand what they are looking for and thus a demonstration of a potential system gives the users ideas of possible uses for the system. The demonstration usually makes use of an adapted, open source system that addresses the high level needs of the users.

6.5.2.7.3 Development Process

As pointed out in the discussions above, the Limpopo Living Lab does not follow a uniform process when developing their systems. There are two sites and each site is responsible for developing its own system. There is, however, some uniformity on the development platform as open source is used by the Living Lab for developing systems, which also mitigates costs. Using an open source platform further means that the developer does not have to does not have to start development from scratch but uses the already available basic application library (C2DM1and C2DM2).

The length of system development time varies based on the product at hand, as well as the commitment from the client, as in the case of the Polokwane office. One system was developed over four months (C2DM2 and C2D1) while another system has taken over a year (C2DM1). Table 6.8 summarises the process followed in C2 when developing systems.

Table 6-8: SDM process followed in C2

PHASE	RESPONSES FROM USERS ON APPLICATION OF THE SDLC
Feasibility Study	According to both C2DM2 and C2D1, there is no conscious decision taken to conduct a thorough feasibility study, but there is a focus on the problem at hand and what appropriate system can be used as a solution. Referring to the e-Heritage system, C2DM1 explained that a feasibility study was conducted through a review of a system from Finland and how it could be applied to the Limpopo situation, but the responsibility for development of the system was handed over to the students. C2DM1 does not believe in doing feasibility studies as he explicitly stated, "*I don't do the feasibility study, especially not on the open source system and so on*". Generally, a form of feasibility study seems to be considered for reporting compliance where external funding will be needed.
System Investigation	This is another stage that is not given proper consideration at iCommunity due to the belief that users do not know what they want from the system. C2D1 states that "*if you go to the rural community and ask them, they would have great difficulty in perceiving what the need is. Many people can't think in the abstract*". C2DM1, however, does collect user requirements after having demonstrated the first iteration of the system. The reasons given are that "*in most cases people are not always aware of what technology can do for them. So when they see the demonstration, it opens their eyes to possibilities. After that demonstration, I can then do the user requirements*" (C2DM1).
System Analysis	Respondents from both sites agree that system design is conducted. This is evident from the statements from C2DM1: "*the first thing I did was to analyse the entire system, all the tables and relationships from the database*"; and C2D1: "*The concept was discussed and also the layout of the files and I start to work on all the functions so that I can figure out what needs to be done.*"
System Design	Performed in conjunction with system analysis.
Implementation	Open source is used as a platform for development. Each developer uses their own experience to develop the system. "*But when they were developing, the concept was in their heads*" (C2D1). The systems undergo testing before the final handover to the users.
Review and Maintenance	Most systems are in the testing stage and thus a review has not yet been conducted. Maintenance is done to fix errors within the system.

6.5.2.7.4 Necessity of SDM

On the question on the importance of methodology, the following responses were received:

- "*I think it really depends on the complexity of the task*" (C2DM2)

- "*I did the testing for them and that was my biggest critique that they should have followed a development methodology"* (C2DM2)

6.5.2.8 Propositions for C2

The following propositions were formulated from interview responses.

Table 6-9: Research propositions from C2

REFERENCE	PROPOSITION DETAIL
C2P1	*Development of CISs from the living lab is done both in-house and also through outsourcing.* Outsourcing is made possible through the Living Lab's association with LimDev, as some projects are done as a directive from the provincial government.
C2P2	*The living lab develops a various number of CISs for use by the communities towards socio-economic development.*
C2P3	*There is no prescribed formal SDM approach followed when developing CIS by the living lab.*
C2P4	*There is no formal decision on the use of a system development methodology when developing CISs by the living lab.*
C2P5	*In many cases, research to establish community needs is conducted either by LimDev or other partners associated with the Living Lab .*
C2P6	*A prototype is first developed and shown to the users and then the feedback received is compiled into user requirements.*
C2P7	*CIS developed in the living lab are undergoing testing.*
C2P8	*Computer illiteracy is a challenge as computer skills must first be transferred to the users before the CIS can be introduced to them.* C2B faces this challenge to the greatest extent due to being located in a rural community where most systems are aimed at rural users with limited or no computer literacy.
C2P9	*Users do not form part of the CIS development team.*
C2P10	*Association with the private entity ensures that the Living Lab has formalised processes and there is better system maintenance.*
C2P11	*Students and full time developers are responsible for the development of CISs in living labs.*
C2P12	*Developers believe that SDMs are necessary to ensure that CIS development is a success.*
C2P13	*Size and complexity of the CIS plays a part in the decision on use of SDM.*
C2P14	*SDM selection should be flexible, taking into account the community environment.*

6.5.3 Case 3: Reconstructed Living Lab

RLabs is situated in Athlone, in Cape Town. The purpose of the Living Lab is to use innovative technology to address various challenges affecting the people from poor communities. Although initially intended to serve people around Cape Town, the project has grown so much that there are various similar initiatives established all over the globe.

6.5.3.1 Background to the Community

Figure 6-6: Map showing location of the Reconstructed Living Lab

Athlone is located east of Cape Town. Although the city of Cape Town is one of the top two cities in terms of economic growth in South Africa, there are economic disparities between people living in affluent communities and those in townships (Margaux, 2009; Parker & Wills, 2009; Walsh, Wesselink, & Janisch, 2011). There are a large number of African and Coloured people living below the poverty line due to high levels of unemployment and massive migration of people to the urban areas.

The Cape Flats area was known as the apartheid dumping ground during forced removals of what the apartheid government regarded as the non-White population. Originally occupied mainly by the coloured community, other population groups have increased in great numbers in the Cape Flats since 1994 (Margaux, 2009). With the low standard of living and high unemployment rates, communities in the Cape Flats are plagued by violence and have major substance abuse issues, with reports stating that South Africa has the highest rate of heroin smuggling in Africa (UNODC, 2011). There are a number of drug support centres in the affected areas of Cape Town (Wanis, 2005), but the severity of the problem calls for many more centres or tools that could be used in fighting this scourge. Unfortunately, Cape Town is no longer only famous because of use but also because most dangerously addictive drug substances are being manufactured there. Methamphetamine *("meth" "tik", "tuk", "Speed", "crystal"),* is one of the most deadly drugs manufactured in Cape Town (CTDCC, 2007). Besides the devastating effect on the user's health, substance abuse is in many instances a contributory factor in violent crimes, HIV/AIDS, poverty, family breakups. The following is an example of how serious the problem is:

"Look at my own street. Every second house is affected with drugs," says Nicolette Sass. "Number 50: two sons using heroin. Number 52: tic. That man over there, down in the gutter: once a drinker nowadays he is a 'ticker'. That woman has a son on tic, he's now in jail for violent robbery. Over there they have got a grandson in the house who sells everything, from clothes from the washing line, meat from the freezer, to buy drugs. Look what's hanging around in our street. Young children, stray dogs, gangsters and merchants. Can you imagine how a place like this is at night?", according to a quote from a former user (Kools, 2011)

6.5.3.2 Establishment and History of the Living Lab

The Living Lab was established in 2008 with the intent of using mobile technology as a solution to the complex social issues facing the people of the Cape Flats. As discussed in Chapter 2 of this study, mobile technologies are appropriate technologies when addressing these kinds of challenges in disadvantaged communities. The crux of RLabs was the use of available social networking based technology such as MXit and Facebook to offer online counselling, particularly for youth affected by drugs. The initiators saw an increasing need for other social services too, to address such issues as HIV, gangsterism, domestic abuse and viewed this as an opportunity to offer more comprehensive services. During its introduction, RLabs was the first of its kind to offer an intervention for social problems, and has grown to include sites in various African, Asian and European countries. JamiiX (Jamii is the Swahili for Social and x is for exchange) is a flagship system devised by RLabs that is able to integrate with any other social networking application.

Although established through the efforts of one individual, RLabs has established a partnership with various stakeholders. The Cape Peninsula University of Technology (CPUT), COFISA, SAFIPA, Vodacom, LLiSA, Local NGOs, Cell-life, the Cape Flats community and Movigo technologies, are some of the stakeholders that work with RLabs.

RLabs use the services of various volunteers to offer training to the users. The users, who have just finished training, are encouraged to offer training to other users; in this way everyone in the community participates in the Living Lab.

6.5.3.3 Users of the Living Lab

The living lab has two types of users: primary and secondary users. The primary users are the workers (counsellors) at the Living Lab and the client organisations who actually work on the system; the secondary users are users who request counselling services from RLabs. The secondary users do not use the system directly as they connect through any social media platform integrated with the system, such as MXit, Facebook, gtalk.

Figure 6-7: Some of the social challenges addressed by RLabs (Parker & Parker, 2009)

The picture above (Figure 6.7) illustrates the plight of the main users of the Reconstructed Living Services. These users mostly make contact with the services online; however, they may use either the online platform or visit the centre for various services.

6.5.3.4 Activities and Systems Available in the Living Lab

Figure 6.8 shows some activities, including products and services offered at RLabs:

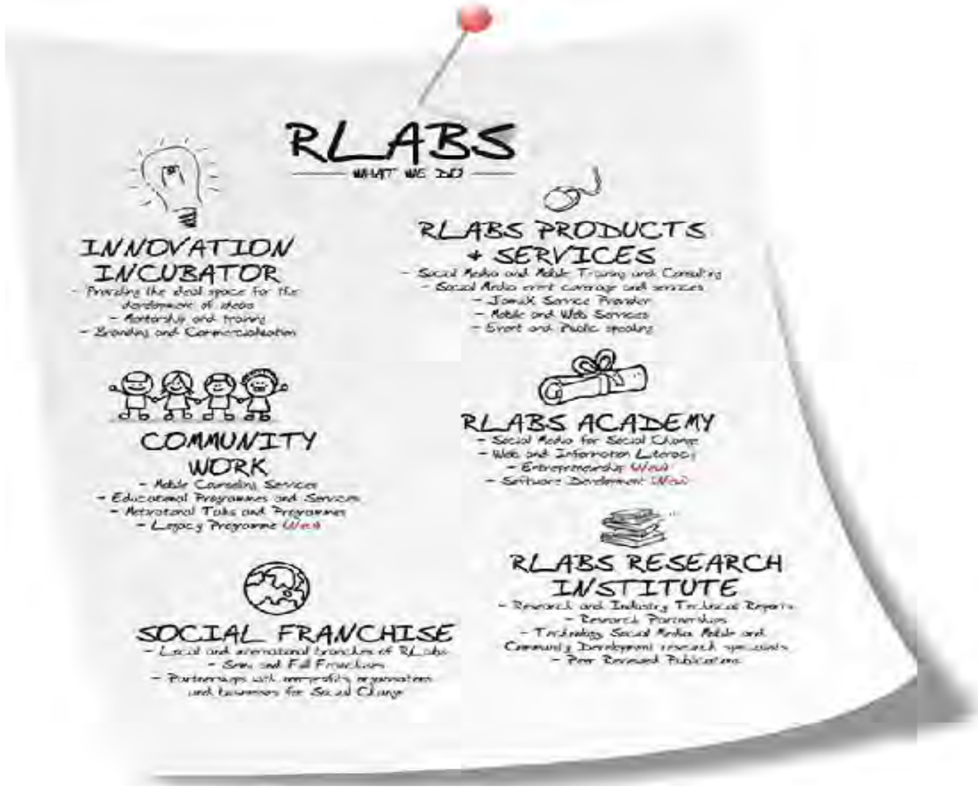


Figure 6-8 RLabs activities (Rlabs, 2011)

The initial purpose behind the establishment of RLabs was that of global mobile counselling. The social franchise ensures that various other communities adopt the social counselling approach using the RLabs brand to address similar social challenges across the globe. Research is another activity that is gaining momentum in RLabs. Through partnership with CPUT and other research institutions, RLabs has published work on various platforms. This not only raises awareness about the Living Lab, but it also affords the initiators opportunities to network and share how technology could assist development with other Living Labs.

Depending on the user's preferences, the counselling conversation could remain electronic or the user could choose to come to the centre for a face-to-face meeting with a trained counsellor. The success of this system has led to institutions like the World Health Organization (WHO) adopting JamiiX as an information sharing platform for various social issues. The system also generates some income for the sustainability of RLabs through its licensing. Income generation is a new model for the Living Labs to ensure that initiatives and systems continue serving communities.

As with other Living Labs, training is a vital part of the activities at RLabs. The initiators do assume that everyone who has access to a mobile phone understands social networking. There are various courses offered through the RLabs academy, such as social media for social change, entrepreneurship.

6.5.3.5 System development team

The Living Lab employs 18 full-time employees who assist in various activities. The manager is one of these employees and is also the founding member of Movigo Technologies. The workers at Movigo Technologies are involved in the development and enhancement of the capabilities of JamiiX.

6.5.3.6 System issues

6.5.3.6.1 System Objective

To ensure sustainability of the RLabs activities, the Living Lab is associated with Movigo Technologies who are the developers of JamiiX. As indicated earlier, JamiiX is the main system used by RLabs for the management of social networking and networking communication. Initially based on the MXit platform, the system enables people to communicate by sending text conversations from a particular social network platform, and this information is delivered to the RLabs counsellor in real-time.

6.5.3.6.2 System Use

Of the three case studies, this is probably the most mature and developed Living Lab in terms of systems and practice. This is probaly because, unlike the other living labs, RLabs have enjoyed a permanent presence, with an office located in the community and personnel working on a full-time basis. All the respondents from this living lab are in agreement that the system came into use after its completion. C3M1 however emphasises that although the system was working, it did have some problems at the beginning.

6.5.3.6.3 System Challenges

During the early stages when the Living Labs had just started, the system was based on the MXit platform. It was later integrated with gTalk but it crashed due to an inability to handle the rapid growth in users. The company then decided to start developing its own systems.

Online availability is another current challenge as the team is not always online and thus sometimes, when they go online, there are more people than the available counsellors are able to handle at one time. This is more an operational issue than a system challenge.

6.5.3.7 System Development Methodologies

6.5.3.7.1 SDM Selection

C3DM1, C3U2 and C3D1 are in agreement that the RLabs have adopted an agile approach to development. In his statement, C3DM1 says, "*We've made a choice of agile type of the development*." This statement is supported by C3D1 who also states, "*it was basically agile. The key was getting people's feedback."* Agile development was chosen because the lab works with real issues and people who often voluntarily give feedback; the methodology is also referred to as on-demand development. This means that the system is evolving, based on the response of the users.

6.5.3.7.2 Development Process

RLabs has adopted an agile approach to developing applications. Unlike other living labs where there is some trace of a linear process, the product is the focus during application development. This is done through an iterative product-based development process called the Milestone Development Life Cycle. According to C3DM1, the process focuses on building the system as rapidly as possible; taking it "out there" as fast as possible; getting feedback as quickly as possible, and then reiterating the whole process. This is done over and over again. Some systems are built and released over just a weekend as needed by the users and this, following the traditional SDLC process, would not normally be possible.

Table 6-10: SDM process followed in C3

PHASE	RESPONSES FROM USERS ON APPLICATION OF THE SDLC
Needs identification	The need for a system could emanate from feedback from users or just an idea from anyone from the Lab. There is, however, limited user involvement at this stage.
System Investigation	When a list of needs for systems has been identified, the team hold a meeting to prioritise systems according to the needs and also according what the Living Lab stands for. Milestones are drawn from the priority. The team also decide on what basic modules will be needed, how the system will work and what feedback mechanism will be used for the system.
System Building and release	The system is built with the minimum functionality needed. The built system is released to customers; C3DM1 terms this "*Flying the plane whilst you're building it*."
User Feedback	This is a key aspect during the development of the Lab, such that during system investigation a decision is made on integrating the feedback mechanism into the system.
System testing and Maintenance	Testing is not a formal process; it is done as part of a working system during the iteration. When the feedback is received from the users, the process starts again from system investigation.

The process may be conceptualised as illustrated in Figure 6.9.

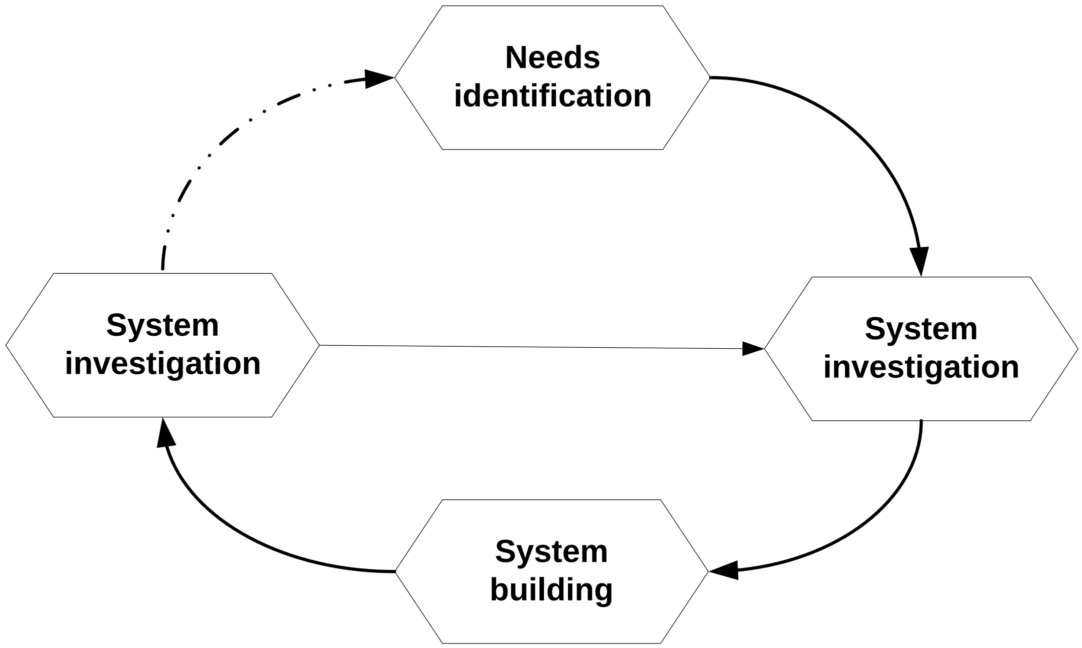


Figure 6-9: Basic conceptualisation of a system development process followed by C3.

6.5.3.7.3 Necessity of SDM

The respondents indicated that they believe there is a need for a SDM. There is, however, a general feeling that the SDM must be flexible according to the environment of the Living Lab, such that a Living Lab may identify more than one methodology and an appropriate technology chosen, depending on the need. C3U2 states that it is best to have a "mash-up" of methodologies to choose from, but the decision on methodology should follow a decision on what one intends to achieve as far as the product is concerned.

Commenting on whether the chosen approach is working for their development, C3DM1 states "*to us its effective. It has taken the product to a place where it is good enough to build a company over*." The methodologies followed have evolved and improved over years, but the approach has always remained agile.

6.5.3.8 Propositions for C3

Table 6-11: Research propositions from C3

C3P1	*Community information systems from the Living Labs are developed in-house.*
C3P2	*There are various numbers of CISs developed by the Living Lab for use by the communities towards socio-economic development.*
C3P3	*Agile is the chosen approach followed when developing CIS by the Living Lab.*
C3P4	*An in-house SDM is used as a base when developing CISs by the Living Lab.*
C3P5	*CIS development process starts the feedback and recommendations from the users.*
C3P6	*A prototype is first developed and exposed to the users and the feedback received is then compiled into user requirements*
C3P7	*CISs developed in the Living Lab are in full operation.*
C3P8	*Most users are familiar with the technology used; training is offered for specific systems.*
C3P9	*Users give frequent feedback during CIS development.*
C3P10	*Involvement of the private entity from the Living Lab ensures that SDM is formalised and there is improved system maintenance.*
C3P11	*Full-time developers are responsible for the development of CISs in Living Labs.*
C3P12	*Developers believe that SDMs are necessary to ensure that CIS development is a success.*
C3P13	*Urgency of CIS plays a part in the decision on the use of SDM.*
C3P14	*SDM selection should be flexible, taking the community environment into account.*

6.6 Cross-case analysis

This section presents the second level of analysis of the case studies in an attempt to develop a holistic view and make generalised conclusions, taking into account differences and similarities in approaches, environments and experiences from these case studies.

Taking a theoretical framework into account for easy comparisons and discussions, the themes introduced in Section 6.2.3 are further refined into three super-themes that look at the Living Lab environment, the system and then system development issues.

The propositions introduced during case study presentations are collated, revised and presented as propositions for this study.

6.6.1 Living lab environment

6.6.1.1 Establishment of the living labs

Certain academic institutions were involved during the establishment of the living labs in C1 and C3. C2 was established mainly through the initiative of the provincial government, but now has an informal partnership with a local institution. C1 and C3 have partnerships with the private sector. SAFIPA and LLiSA are some of the stakeholders common to these Living Labs.

6.6.1.2 Location of the living labs

The three Living Labs chosen for the study are located and operate in different community environments. C2 and C3 Living Labs have offices within the community whereas the officials from C1 are based at two academic institutions: Rhodes University and the University of Fort Hare. C1 is located in a rural community, which is 300 kilometres away from these institutions, and the community site has poor basic infrastructure: a lack of constant power supply, poorly maintained gravel road access and poor health services. C2 has two locations; C2B is in a town, thus located in an urban environment while the other one is situated in a rural community and C2A is in a rural community too. The rural communities serviced by C2A face similar social and economic conditions as those served by C1. C2A on the other hand is located in an urban area although servicing municipalities and general provincial sectors. The third Living Lab, C3, is located within the community it serves; a township community, also referred to as a peri-urban community. This community is plagued by gang activity and drug abuse and has very high levels of unemployment (Cunningham, Herselman, & Cunningham, 2011).

The differences in the case study environments are summarised in Table 6.10 as follows:

Table 6-12: Summarised view of case study environments

<table>
<tr><th rowspan="2">Case study / Issue</th><th rowspan="2">C1</th><th colspan="2">C2</th><th rowspan="2">C3</th></tr>
<tr><th>C2A</th><th>C2B</th></tr>
<tr><td>Office presence</td><td>Outside the community</td><td>Within one of the communities</td><td>Urban area</td><td>Within the community</td></tr>
<tr><td>Location</td><td>Rural community</td><td>Rural community</td><td>Urban</td><td>Township/ peri-urban community</td></tr>
<tr><td>Literacy level of users</td><td>Generally limited</td><td>Generally limited</td><td>Poor and literate</td><td>Semi-literate</td></tr>
<tr><td>Services offered</td><td>Computer training, Education, Small Businesses</td><td>Computer training, Develops systems mostly targeting education</td><td>All sectors, as per need but mostly SSMEs</td><td>Mostly social issues</td></tr>
</table>

6.6.1.3 Community challenges

There are various socio-economic challenges facing the communities where the case studies are located. Poverty is a plight common to all the communities currently served by the Living Labs together with limited or, in some instances, no access to basic needs. The challenges facing communities surrounding C3 include social issues such as drug-abuse, familial issues and HIV/AIDS; hence the C3 systems are focused on connecting people to counselling services using available technologies.

6.6.2 System issues

6.6.2.1 System role in socio-economic development

There are various systems developed in each of the chosen case studies which are aimed at improving the social and economic conditions in the communities; C3DM1 estimates that they are busy with about nine systems, of which Jamiix is the main one. Regarding a number of systems from C1, C1M1 remarks "*I don't even know how many they are. But the final project is the one called Teleweaver that integrates several little applications onto one platform*."

The systems used range from those intended to ensure access to basic telecommunications through to those aimed at facilitating trade between entrepreneurs and consumers (C1 and C2); a system that provides support for education (C1, C2 and C3); systems that assist the Living Labs to better manage their services (C2 and C3) as well as systems that facilitate electronic social interaction between the user and the service provider (C3). Heeks (2009) suggests that to contribute to the development the ICT4D, initiatives should be inclusive, enabling and focused. Most systems from these Living Labs are focused on the needs of the people from the community one way or another, and are intended to enable better lives for the communities. Inclusitivity may be regarded as relative to the target users for that particular system.

6.6.2.2 System Commercialisation

The early decades of the ICT4D evolution were hallmarked by failure arising from issues such as lack of technical and financial sustainability, poor continuity plans and services that did not match community needs (Phahlamohlaka, Braun, Romijn, & Roode, 2008; Heeks & Molla, 2009). From the interviews conducted, it became clear that the Living Labs are taking a more business-like approach to managing the Labs so as to ensure accountability to prevent wastage of the funds injected in order to achieve the developmental objective.

The systems from C2B and C3 are no longer only developed for the resident communities but have been sold to other partners, with C3 having captured the international market with the mobile based social networking capabilities from Jamiix. According to C1M1 and C1D2, there are plans to replicate and commercialise the Teleweaver system from C1 and respondents from C2A stated that there are plans to commercialise the applications which they are developing.

An emerging trend in the evolution of ICT4D initiatives, especially the Living Labs, is the establishment of a private company linked to a particular Living Labs. These companies facilitate commercialisation of Living Lab systems and ensure that a business approach is upheld in each Living Labs. Commenting on the establishment of a private company from C1, Cunningham, Herselman, and Cunningham (2011) stated that if successful, it will become a major source of funding for C1, thus ensuring high chances of sustainability.

6.6.3 System development issues

6.6.3.1 Profile of system development team

Students are currently the main developers of the systems for C1. C2 and C3 Living Labs have resident developers, although students from the partnership institutions have been used during development. The students at C1 and C2 develop the systems as part of their university curricula and thus often leave the university once their degree objectives are achieved. Although the students work under the supervision of experienced promoters, reliance on students for development has been cited as one of the causes of poor system maintenance (C1M1, C1D2 and C2DM1).

6.6.3.2 Extent of use of system development methodology

Regarding the use of an SDM, the questions posed in Section 4.5 are refined below:

i. *Do living labs use a single SDM in all projects?*

In all cases, there is no single methodology used in developing the systems. The only exception is at C3 where an agile approach has been adopted as a system development methodology approach for all projects, with no specific reference to a particular methodology.

ii. *Is methodology selection based on project at hand?*

Although this is not a formal declaration from any of the living labs, methodology use or selection seems to be based on the experience or preference of the developer and the perceived dynamics of the system at hand. C2DM1 and C3DM1 also mention consideration of the user, technological complexity and the estimated length of development.

iii. Are sections from different methodologies used instead of a single methodology?

As there is no particular methodology used during development, the use of sections from diverse methodologies is probably the approach used, although it has not been easy to establish. The developers seem to be conscious of the generic phases of system development. The development practice of C3 on the other hand, seems to be based on iterative development where the system is submitted to the users who provide feedback as input to further development or improvement of the system.

6.6.3.3 Role of users during CIS development

Users are generally involved during CIS development, predominantly during the early (eliciting of requirements) and the final (testing) stages of development. One of the remarks from C2DM2 was that unfulfilled basic needs have an impact on community participation during their development as people often mention a need for water or employment instead of mentioning needs related to information systems. Both C1D2 and C2DM2 agree that the greatest challenge facing people in disadvantaged communities is that they seem to be living in a different world, with limited understanding of how information and communication technologies could affect their world. Mobile phones are, however, the closest contact that the people under discussion have when it comes to technologies; hence C3 uses mobile technologies since their use is already established in the community.

According to C1M1 and C1D1, C1 research is conducted during the early stages when the developer establishes community needs. From this research the developer chooses a system to develop as part of his or her study, but the users are not involved until there is a system to be tested. It was, however, also interesting to note that although there were some resident users from C3, these users were only involved at a late stage of the development of the system. These users are mostly involved during the system testing when the first working system has already been developed.

In general, respondents from all the Living Labs acknowledge that user involvement is very important during development of a community system as the community members are more keenly aware of what is needed. In a closing statement on lessons learnt from system development, C2DM1 stated that "*The lesson is that if you don't involve users involved in the early stages you are going to have some problems. You might have a functional system that is not being used.*"

6.6.3.4 System Development Process followed

Although not based on any particular methodology, the process followed when developing the systems in C1 and C2 may be traced to the general stages of the SDLC, as introduced in Table 4.2. C3 follows a slightly different process as the system evolves through re-iteration.

6.6.3.5 Tools used during system development

In C1 and C2 open source is used as a standard platform for system development. The two main reasons cited by the recipients are affordability and the fact that there may be other systems already available on open source which could offer the required functionality. Each developer is at liberty regarding which development language to use. Due to the nature of their system, the MXit platform is used in C3.

6.6.3.6 Effectiveness of system development methodologies

Making reference to the discussions in Section 4.6.1, the two concepts suggested by Huisman and Iivari (2006) are explored in the context of the case studies:

6.6.3.6.1 Impact on the system being developed

The most important aspect to be considered is that the systems must be linked to the needs of the community and thus, on completion, it must add value to the intended users. The system from C3 seems to be making an impact on the users, whereas there is no evidence of concrete impact from other Living Labs.

Living labs face various challenges with the systems developed and a systemic approach should be applied looking at CIS for disadvantaged communities. Education, infrastructure, computer illiteracy are some of challenges that were identified in Chapter 3 (Turker, et al., 2007; Chigona, Beukes, Vally, & Tanner, 2009). The maturity of the Living Lab is another aspect to be considered. As mentioned earlier, C3 has had a permanent presence in the Living Lab, making it easy for them to learn from their development process whereas other Living Labs rely on students and currently do not have structures in place to ensure that there is learning and continuity in system development. Another issue is the type of the community being served as there are differences in dynamics between peri-urban and rural communities.

6.6.3.6.2 Impact on the quality and productivity of the system development process

According to Iivari and Iivari (2011) speed, efficiency of production and quality of a developed system are important considerations for the choice of a particular system development methodology. The students from C1 seem to be governed by the limitation of the duration of their study programmes and deliverables. Client-demands control the plans around systems developed by C2B, but according to the respondents, most systems have been completed much later than the scheduled time.

C3DM1 was happy with the chosen system development approach used in the Living Lab and further states that "*To us it's effective. It has taken the product to a place where it is good enough to build a company over ....*" Respondents from other case studies also agree that using an SDM is important for the development of a successful product. The following represent a record of some of their perceptions on the importance of using SDMs:

"*I think if you don't follow a methodology it's like you're taking a gamble. Sometimes you may hit the jackpot and sometimes you're going to fail" (C2DM1).*

"Yes. The methodology helps to ensure that the users participate in the process of developing the system" (C1D1).

However, it was not easy to establish the actual impact from these Living Labs as there is limited or no explicit use of any particular methodology. There was also not enough information obtained about the in-house SDM established in C3, leading to an assumption that it is still in a conceptual stage.

6.6.4 Revised propositions

6.6.4.1 Revised Proposition 1

CISs from the living labs are usually developed in-house (C1, C2, C3) and also outsourced, where there is support (C2).

This proposition is in agreement with the view of Harrison & Zappen (2005) who state that due to the nature and the unique needs and circumstances of communities, CISs would have to be developed. To accommodate the specific needs of the communities, the living labs develop CISs to be used to meet their developmental needs. In living labs where there is the presence of solid government support, consultants are also used for developing CISs. This is the case with C2, as they are part of the provincial government unit.

6.6.4.2 Revised Proposition 2

Living labs develop a various number of CISs for use by the communities to aid their socio-economic development (C1, C2, C3).

There are various small systems developed by the Living Labs. Each system addresses a specific need in the community.

6.6.4.3 Revised Proposition 3

There is flexibility in choosing an SDM when developing CIS (C1, C2). The more experienced the Living Lab is, the more formal its SDM approach is (C3).

There is currently no upfront decision made on a particular SDM to be used when developing CIS for C1 and C2. This is different in the case of C3, where an agile approach has been adopted as the model for developing systems. This may be attributed to C3's experience and the maturity of their system. According to C3M1, there were challenges in the early stages of the system but with time and experience, system development improved.

6.6.4.4 Revised Proposition 4

Diverse contingent factors play a part in the choice of a particular SDM to use when developing CIS (C1, C2, C3). Developers from C1 and C2 believe that the size and the technological complexity of the CIS at hand play a role in the decision on whether to use an SDM or not. C2M2 states, "….I think to do the job does not want a full methodology. If we develop a complex system where a big database is needed, you have to have a methodology". C3, on the other hand added that urgency also plays a part in the decision to use SDM, as systems are sometimes urgently required and thus the SDM selected must accommodate the issue of time pressure.

6.6.4.5 Revised Proposition 5

The start of the development process depends on the nature of the problem at hand or the users of the system. As part of their study processes, students are required to conduct feasibility studies from the communities, which is how the system development process usually starts (C1). Facility C2 on the other hand, has links to partners like LimDev and the provincial government and a need for a particular system would come as a directive from a partner; thus, an identified need would have been previously established. The C3 CIS was already operational with ongoing development on the system emerging from the feedback and recommendations by the users.

6.6.4.6 Revised Proposition 6

A prototype is first developed and shown to the users and then the feedback received is compiled into user requirements (C1, C2, C3). This process was being practised by all the Living Labs. C2DM1 qualifies it by stating that users do not always know what they want from information technology and thus a prototype gives an idea of what the system will look like. Users then have an opportunity to give feedback and contribute more towards CIS development.

6.6.4.7 Revised Proposition 7

CIS developed in Living Labs are at different stages of deployment. C1 has not enjoyed stability in its development efforts due to the student-oriented development, with poor continuity once a student leaves the university. Most of the systems in C1 are not in use as there are a number of software bugs that have not been solved. This situation is different from C2 which does not only rely on students but also has full time developers on site, so that student departure does not affect completion of the system. The CIS in C3 has gone through various stages of development and this is attributed to a stable environment offered by the full time developers from the private entity linked to the Living Lab.

6.6.4.8 Revised Proposition 8

For Living Lab in rural communities, computer illiteracy is a challenge as computer skills must first be transferred to the users before the CIS can be introduced to them (C1, C2). This has not been identified as a challenge for C3 as the CIS runs on a social networking technology, with which most users are familiar. In the case of C3 social networking, lessons are frequently offered for users not familiar with social networks.

6.6.4.9 Revised Proposition 9

There are differing levels of user involvement during CIS development in the Living Labs (C1, C2, C3). User involvement is limited to the early stages of the CIS development process and during the system testing stages of the project (C1, C2). Some users of the C3 CIS are located in the *Living Lab* and thus readily become part of the CIS development process.

6.6.4.10 Revised Proposition 10

Private entities are believed to be crucial towards better management of system development and commercialisation of CISs (C1, C2, C3).

6.6.4.11 Revised Proposition 11

The nature of developers used depends on the circumstances of the Living Lab and the system at hand. C3 and C3 already have an established private entity linked to the *Living Lab* and thus there are permanent employees. For C1 the private entity linkage is still in the formation stages and thus students are still a key part of system development.

6.6.4.12 Revised Proposition 12

Developers believe that SDMs are necessary to ensure that CIS development is a success (C1, C2, C3).

6.6.4.13 Revised Proposition 13

SDM selection should be flexible, taking into account the community environment (C1, C3). It is important that user circumstances are taken into account when selecting an SDM.

6.7 CHAPTER SUMMARY

This chapter presented the process that was followed during collection of data for this study and also how sense was made of the data through data analysis. A link was made between the research objective, the interview questions and later the themes for data analysis. The six steps commonly used in data analysis, as established by Creswell (2007), were used to explain the process followed for data analysis. Some of the steps include: data transcription, data organisation, thematic coding and interpretation. The examination of the interview process involved a discussion on the interview setting and how the collected data were prepared for analysis.

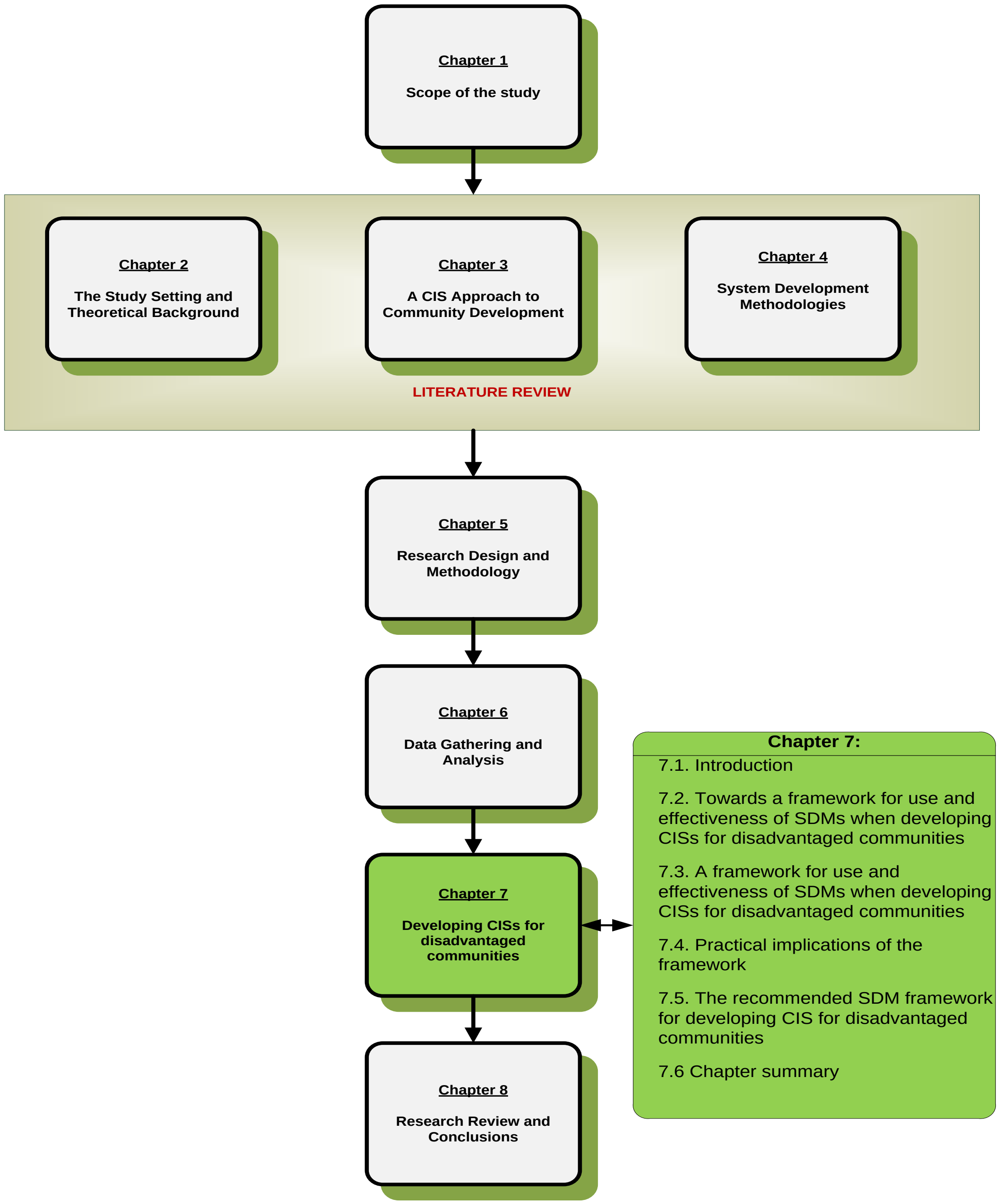
To present a picture and understanding of the case studies, a thorough description of each case study was presented.

Data was presented through individual case studies and secondary analysis through cross case analysis. This was performed using themes identified through an open coding process. There is a general consensus from the respondents that there has been no decision on a particular SDM to be used for developing CISs. The C3 facility have established their development methodology, although it is still not widely used nor documented. There is, however, awareness of the importance of utilising a methodological approach when developing a system. Importance of user input has also emerged as one aspect requiring consideration during system development.

A further, interesting finding from the study is the establishment of a link between private companies (entities) to a Living Lab whose purpose is to ensure that standards are adhered to during system development and to facilitate commercialisation of the systems that are developed for the Living Lab. Propositions were established from each of the case studies and these were further reviewed to be able to offer final propositions as a result of cross-case analysis.

The following chapter presents the outputs of this study; a recommended frameworks for evaluating the use and effectiveness of SDMs when developing CIS for disadvantaged communities and an SDM framework to be used when developing

CHAPTER 7. DEVELOPING CISs FOR DISADVANTAGED COMMUNITIES



7.1 INTRODUCTION

Chapter 6 detailed how data gathering was conducted and also provided the data analysis. Themes were used to present data from the interviews and findings of the study were discussed through a cross-case analysis.

This chapter considers the proposed framework for evaluating the use and effectiveness of SDM when developing CISs for disadvantaged communities. The framework elements may be used to assess the extent of the use and effectiveness of SDM. From the interviews, it became clear that there is no prescription regarding what SDM is to be used by the Living Labs when developing their CISs. There is, however, general consensus that the use of an SDM is important in ensuring successful system development efforts. Propositions established in Chapter 6 are used as a basis for the framework presented in this chapter. This proposed framework is applied to the case study to evaluate their use of SDMs and their effectiveness.

The second objective of this study is to recommend a SDM framework to be used when developing CISs for disadvantaged communities. This framework takes into account the literature and results from case studies, and makes links to some aspects addressed by the framework addressing objective one of this study. An onion model is used to present a process-based approach to selecting an SDM for CISs, comprising four components; SDM approach, SDM model, SDM process and SDM techniques, all which are areas identified as defining an SDM from the literature.

7.2 TOWARDS THE FRAMEWORK FOR EVALUATING THE USE AND EFFECTIVENESS OF SDMS WHEN DEVELOPING CISS FOR DISADVANTAGED COMMUNITIES

Boahene (1999) and Avison & Fitzgerald (2006) agree that consideration of the system development environment is important when making decisions about an SDM to be used. This became apparent during the interviews as there is constant reference to the Living Lab environment, the users, and the CIS being developed. The propositions established in Chapter 6 have been instrumental towards identification of factors that influence the decision to use SDMs, and thus the effectiveness of SDMs when developing CIS in Living Labs. The factors identified were:

- Location of the Living Lab
- Employment status of the developers
- Existence of the private entity linked to the Living Lab
- The CIS
- User participation
- SDM model
- CIS deployment

These factors were arranged into two component groups: the first one encompassed factors relating to the Living Lab environment and the second, factors relating to the CIS development environment. Each of the factors is further expanded by variables which enable assessment of their impact on one or more other factors. Understanding the interaction between the factors and their variables offers a better understanding of what leads to use or non-use of SDMs and thus their effectiveness. The two components are:

1. *Nature of the Living Lab as it applies to CIS development.* These are factors specific to the Living Lab which have an impact on the decisions about CIS development, such as the location of the Living Lab, the tenure of developers, presence of a private entity linked to the Living Lab and the extent of replication or commercialisation of the Living Lab.
2. *CIS development factors*. These factors relate to the development environment of the CIS, the extent of user participation, a decision on the formalisation of the SDM approach and the status of the CIS system. Living Labs' environmental factors have been found to have an impact on the CIS development factors, which further influence the use or effectiveness of SDMs.

These factors are discussed below.

7.2.1 Living lab CIS development context

This is based on the finding that there is a relationship between the context of the Living Lab and the extent of use and effectiveness of SDMs when developing CISs. The following common factors about the Living Lab emerged from the interviews:

Table 7-1 Living lab System Development environment

FACTORS	VARIABLES
Location	Within the community
	Outside the community
Developers	Full-time
	Students
	Consultants
Private Entity	Well established
	Early stages
	No private entity
The CIS	Full commercialisation
	CIS complexity

To elaborate further on the Living Lab environment, these factors are extended further, using related variables, as were identified during the study. Some factors cover aspects similar to those elements identified by Boahene (1999)'s system development framework as well as some of the key characteristics as identified by Faridani (2011), and which were discussed in Section 4.2.

7.2.1.1 Location of the Living Lab

The physical presence of the Living Lab has an impact on the extent of use or effectiveness of SDMs. In Living Labs, where there is no upfront decision on SDM use, developers sharing the same office space are most likely to adopt a uniform way to develop CIS, whereas those not interacting closely are more likely to make individual decisions. The presence or existence of a Living Lab may be described in one of two categories. The first is the existence of the Living Lab within the community, where its office space is physically located in a specific community. The second is that where the Living Labs are located outside the community, meaning that the Living Lab has no physical office space within the specific community.

7.2.1.2 Employment status of the developers

Boahene (2005) and Faridani (2011) describe the employment status of the developers as *staff*. This component is about the experience and the work arrangements of the project team. The tenure of the responsibilities of the developers with regard to the development of the system has an impact on the number of SDM areas, such as the process, methodology use, and user participation. Developers who become part of a living lab for an extended period of time are more likely to demonstrate experience and maturity in their system development practices through learning from related development efforts.

Developers in the Living Lab environment may be either be full-time staff, students or consultants. Full-time developers are those who are employees of the Living Lab. This also applies to developers who are part of the private entity linked to the Living Lab. Students from partnering higher education institutions may also be responsible for development of CIS in the living labs. In some instances consultants are hired through the Living Lab partners to assist with CIS development.

7.2.1.3 Existence of the private entity linked to the living lab

In an effort to improve sustainability, it has been found that Living Lab are now establishing private companies to provide a business approach to the processes and operations of the living lab and also provides means platform for commercialisation of CISs developed in Living Lab. The private entity at C3 is well established with existing company structures, whereas C2's private entity is in early stages of establishment, whilst C3 has not yet established its own private entity but it has linkages to a Limpopo provincial government structures and LimDev.

The presence of a private entity supporting CIS development in the living lab has an impact on decisions surrounding SDM. Akin to the discussions regarding the location and tenure of developers, development practices in a structured entity are more likely to improve as each new system is developed; an established entity means that more structure develops and more learning occurs from the system development processes. There are also more opportunities to learn from other partners, the industry and clients.

7.2.1.4 The CIS

One of the frequent responses from the participants concerns the impact of the size and complexity of the CIS which has an impact on the perceived need for use of an SDM.. The perception is that there is no need for use of SDM when developing small or less complicated CISs. Little (2005) and Faridani (2011) also mention dependency on other systems, size and urgency of the system as contributors to the choice of a SDM.

Variables in this regard are those of commercialisation and complexity. Living Labs are able to replicate the CIS and market it for use in other similar circumstances. A commercialised CIS is more likely to be developed using structured development practices due to industry requirements and a potentially competitive environment. Complexity refers to the size of the CISs in terms of complexity of the database structures.

7.2.2 CIS development factors

The factors involved in the Living Lab development environment have an impact on the CIS development component. A combination of variables from the Living Lab component affects the extent of user participation, the selection of SDM model to be used as well as the status of the developed CIS. Decisions about the choice of SDM model determine the use or non-use of SDM when developing these CISs in the Living Labs. The CIS development factors are presented below.

Table 7-2 The CIS development factors

FACTORS	VARIABLES
User Participation	Throughout CIS development
	Partial user participation
	No user participation
SDM model	Mandatory
	Voluntary
	None
CIS Status	Full operation
	Stages
	Not in use

7.2.2.1 User Participation

User participation has been identified as one of the key factors for the Living Labs. A number of factors in the Living Lab environment influence the extent of user participation during CIS development. The chances of success of the system are greatly increased if users are involved during development of a CIS aimed at addressing their needs.

It emerged that users are able to be involved throughout the CIS development process, giving feedback on the CIS or establishing new requirements. There are cases where users are only involved at a particular stage during the CIS development process. Elicitation of requirements and testing stages are the most common user-participation interactive stages. There are however, also cases where there is no user participation.

According to Stillman and Henry (2009) the diversity of users is one of the challenges encountered when developing systems for rural communities A mistake that initiators make is in assuming that users do not know what they want, and so tend to select systems themselves (Donner, et al., 2008). Thus, these initiators risk their systems not being used.

Some other issues that were identified by the respondents as pertaining to the users were:

1. *User champion*. Identification of such a champion is important, particularly in rural communities where there are high levels of illiteracy.
2. *Computer literacy*. One of the challenges facing Living Labs is that the intended users of the CIS are usually computer illiterate, which meant more time, was required for training them on how to use a computer before actually introducing a system. Living Labs using students as developers are most disadvantaged by this as the student would end up leaving university without having seen the CIS in full operation due to the extra time spent on training.
3. *The imperative for basic needs*. This is the case especially in the rural communities where the people tend to be more concerned about meeting basic needs, like water and employment, and are less concerned about information and communication technologies.

7.2.2.2 SDM model

Several factors in the Living Labs environment have an impact on decisions surrounding the use of an SDM model when developing CISs. Variables regarding the SDM model concern decisions on the use of a particular SDM. There are situations where it is mandatory that developers will follow a particular SDM. In other cases, the use and a choice of an SDM model is voluntary and totally dependent on the experience and preferences of the developer; such as in situations where no prior decisions had been taken on the use of a particular SDM.

A choice of an SDM model during CIS development is used to give an indication of the extent of SDM use when developing CISs for socio-economic development.

7.2.2.3 CIS Status

System development endeavours are aimed producing a system that is in good working condition and meeting the needs of the user (Avison & Fitzgerald, 2006). There are various challenges that affect the deployment status of the CISs. A CIS is in full operation if it is used for the purposes for which it was intended. A number of CISs in the Living Labs are still going through testing stages and there are CISs that have not been deployed as intended.

SDM use and the deployment status of the CIS have an impact on the conclusions about SDM effectiveness.

7.3 A FRAMEWORK FOR EVALUATING THE USE AND EFFECTIVENESS OF SDMS FOR DEVELOPING CISS FOR DISADVANTAGED COMMUNITIES

Based on the discussions in the previous section, the following framework is proposed for assessing use and effectiveness of SDMs during development of CISs aimed at socio-economic development. There is a relationship between factors from the Living Labs environment and the CIS development factors, which in turn have an effect on the use and effectiveness of the SDM for CIS in the Living Lab. The framework takes into account both social and technical aspects of the product and development.

The proposed framework is presented in Figure 7.1 below, followed by a discussion on all the affected areas, as demonstrated by the linking lines in the graphic.

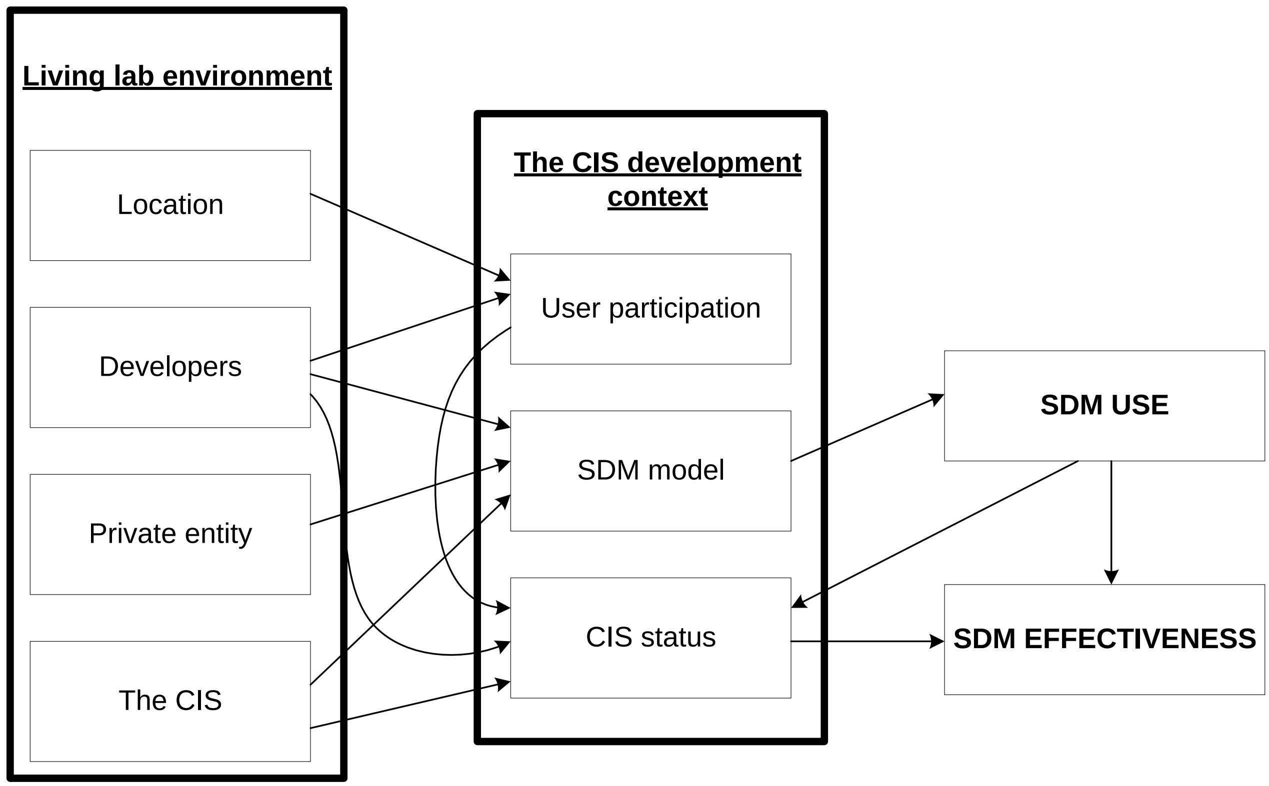


Figure 7-1: Proposed framework for evaluating the use and effectiveness of SDM for developing CIS for disadvantaged communities

7.3.1 User Participation

According to the findings, the extent of participation by users during development of CIS is influenced by two factors: the location of the Living Lab and the employment tenure of developers. The findings further indicated that a Living Lab that has a physical presence within the community has more chances of interacting with the users of the system and thus user participation is likely to occur throughout the stages of CIS development. The same may be said about developer employment status; there are more chances of multiple contacts with the users if a developer is available on a full-time basis in the Living Labs. A challenge which was identified was that of relying on students for system development as their focus tends to be on ensuring that requirements for their studies are met rather than a fully operational CIS. For CISs developed beyond the duration for the student degrees, different types of users might be involved during development of one system, with different expectations from the system. This might have negative effects on the final products and thus perceived effectiveness of the SDM used.

7.3.2 SDM Model

On a general level, the choice of a particular SDM model to be used is influenced by an organisational or institutionally based decision. An organisation may choose to follow a traditional model or an agile model in all projects (Pressman, 2010; Schach., 2010). Three Living Lab environment factors: developers, private entity and the CIS, have been found to influence the choice of a model used to develop the CIS. The employment tenure of developers and their development experience play a part in a choice of a particular SDM model to use; with their experience being based on system development or experimentation with a particular model. On the other hand developers with very limited time on the project are more likely to choose an SDM model that favours their short-term involvement. The presence of a private entity linked to the Living Lab is however, more likely to lead to the choice of a particular model for developing the CIS due to the opportunities for learning from the systems over a more extended period. A decision to use a particular SDM model is linked to the use of SDM in development of CISs.

7.3.3 CIS deployment status

A number of CISs from the three Living Labs were found to be in a “challenged state” (Schach, 2010), as they were either incomplete, not in full use or still undergoing testing. The factors identified as having had an effect on this status were: the complexity of the CIS, the developers and user participation. Respondents from C3 remarked that due to the complexity and the number of linkages to other systems, their CIS was initially challenged with many bugs which were identified through user feedbacks.

A significant factor that was echoed by respondents was the importance of user involvement during CIS development. The more involved the users are during the development of the CIS, the more the chances of are developing a CIS that will be usable (Avison & Fitzgerald, 2006; Faridani, 2011). Involving users only during certain stages of development resulted in more time being spent on testing the system.

The final factor influencing the status of the CIS is the use of SDM. As it transpired from the propositions, the current status in the Living Labs is that SDM is contingent on factors such as the size and type of the system being developed and the envisaged length of the development process.

7.3.4 SDM Effectiveness

As a decision to use particular SDMs was not formalised in the Living Labs, the assessment of SDM effectiveness was based largely on the perception of the respondents. Adherence to estimated schedule and budget, productivity in terms of delivered codes per men-hour, system user friendliness and adherence to user specifications are some of the outcomes that may be used to measure effectiveness of SDM (Boahene, 1999; Andres, 2002). Respondents from all of the participating Living Labs agreed that SDMs are effective towards ensuring that the CIS development efforts are achieved. SDM effectiveness thus depends on the use of an SDM and CIS. An SDM must have been used in order to assess its effectiveness and the CIS status will give an indication of whether the CIS has been completed according to initial specifications.

7.4 PRACTICAL IMPLICATIONS OF THE FRAMEWORK

In order to give greater context to the proposed framework, the following extended framework includes variables that are used at each level of assessment. These are based on the current situation from the Living Labs used in the study. Table 7.3 presents a summary of the variables, discussed earlier.

Table 7-3: Summary of variables used in the application of the proposed framework

	FACTORS	VARIABLES	DESCRIPTION
LIVING LAB ENVIRONMENT	**Location**	Within the community	This refers to the presence of the living lab office within the community.
		Outside the community	This is a case where the living lab does not have a presence in the community in terms of an office or a responsible person.
	Developers	Full-time	This refers to developers who are part of the living lab.
		Students	Development being done by students.
		Consultants	In some instances consultants are hired by the living lab partners to assist with CIS development.
	Private Entity	Well established	This refers to the private company attached to the living lab that is already in operation with existing company structures.
		Early stages	A case of a private entity in existence but still in the early formation stages, with no existing structures.
		No private entity	Absence of linkage to a private entity.
	The CIS	Full commercialisation	Replication of the CIS to other communities.
		CIS complexity	This refers to the size of the systems in terms of complexity of the database structures
CIS DEVELOPMENT ENVIRONMENT	**User Participation**	Throughout CIS development	Full user participation
		Partial User Participation	At some stages during development, commonly the user requirement and testing stages
		No User Participation	Users not involved
	SDM model	Mandatory	Developers expected to follow an SDM
		Voluntary	Experience and discretion of developers on use of an SDM
		None	SDM not considered.
	CIS Status	Full operation	CIS is in good working condition, as intended
		Stages	CIS is still incomplete or still undergoing development stages, i.e. testing.
		Not in use	CIS not completed or not in use

As it may be observed in the graphic of the extended framework depicted in Figure 7-2, variables from the identified factors are colour-coded to demonstrate strength of that particular variable towards a particular outcome.

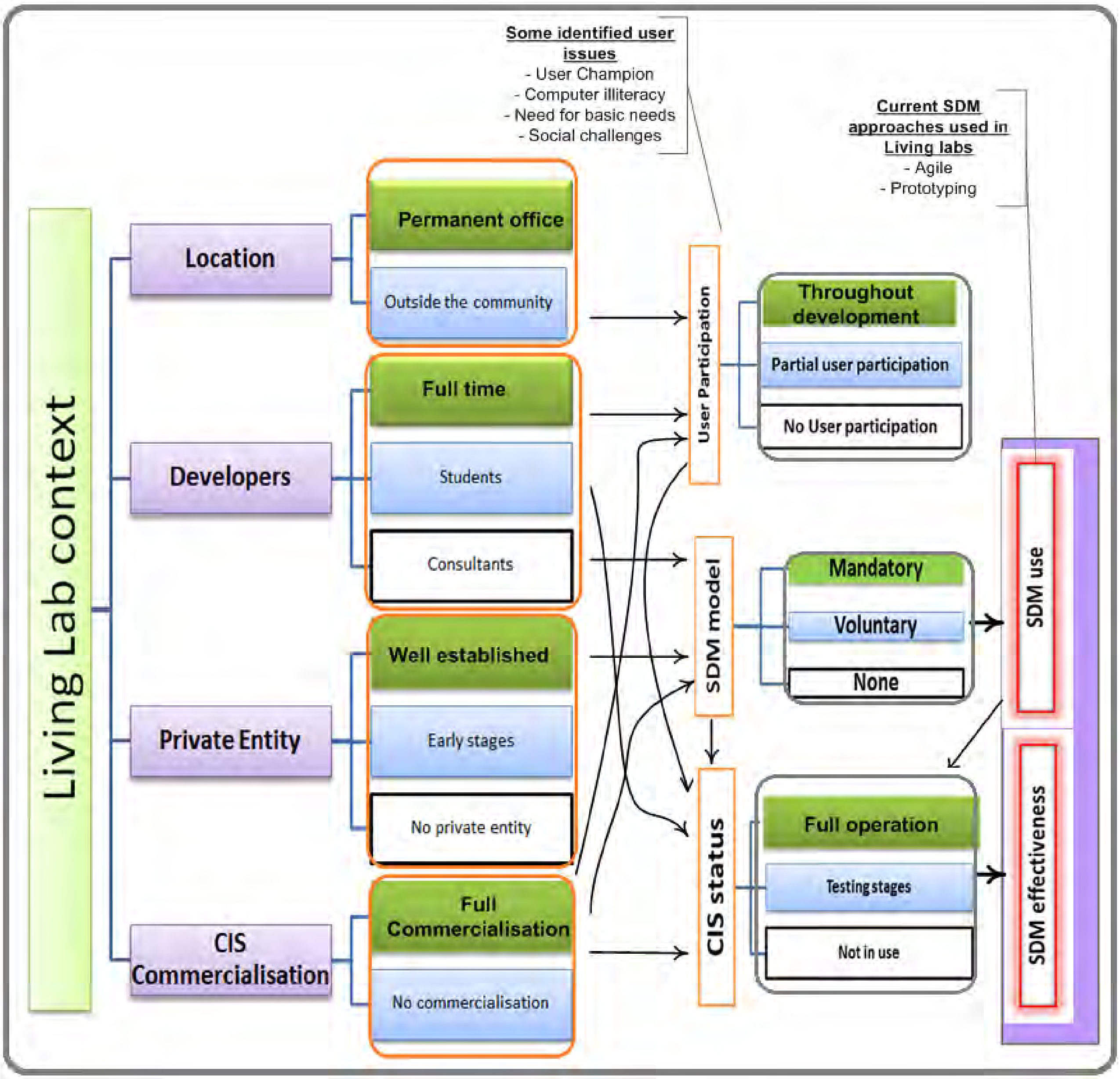


Figure 7-2: Extended framework for assessing use and effectiveness of SDMs when developing CISs

When being assessed it is not necessary that variables applicable to a particular Living Lab should be within a uniform colour; dominance of a particular colour moves an outcome towards results associated with that colour. The colours are used as follows:

- The green colour is associated with use of SDMs when developing CISs.
- The blue colour is associated with voluntary use of SDM
- The white colour is associated with no use of SDMs.

For an example a living lab satisfying all green coloured variables is most likely to be using an SDM when developing CISs and thus it should be possible to assess SDM effectiveness. The extended framework is applied to the case studies to check how the recommended framework can be applied in practise. This is done in Sections 7.4.1, 7.4.2 and 7.4.2, below, with a diagram demonstrating the implication for the living lab.

7.4.1 Application to C1

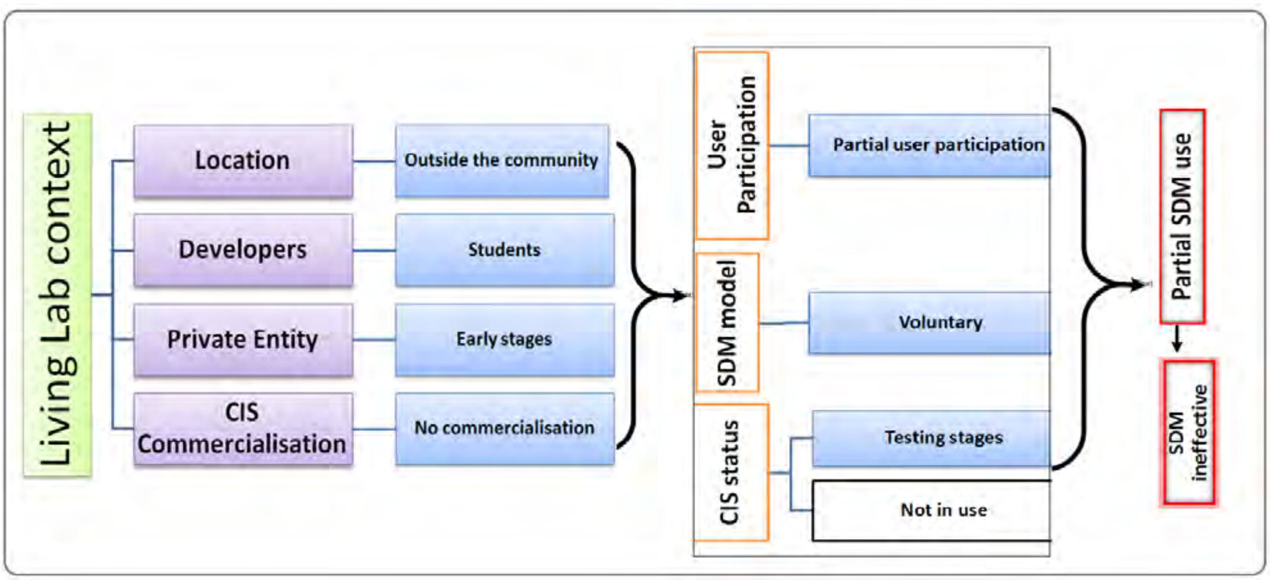


Figure 7-3: Framework for assessing use and effectiveness of SDMs when developing CISs: ***Application to C1***

According to the literature (Isabirye, 2009; SAFIPA, 2011), interview respondents and researcher observation, C3 does not have a physical presence within the community. Development is carried out by students and thus their presence in the community is limited to visits, mostly for data collection and for any other related services, i.e. network services. The office is located at Rhodes University, which is more than 300 kilometres from the Living Lab and students are drawn from two institutions which are themselves located more than 100 kilometres apart. The private entity linked to the living lab was still in its inception stages and at the time of the study being undertaken, there was no commercialisation of the CISs yet; only plans for the future.

The distance between the developers and the users means that user participation is limited to certain stages of development only: Feasibility/ User requirements elicitation and Testing stages. Use of SDMs is voluntary, depending on the preference and experience of the students and none of the CISs are in full operation; as the CIS is either undergoing testing or is incomplete. This is mostly due to the students being the sole developers in the Living Lab.

The conclusion of this case is that there is partial use of SDMs with no coordinated decision or mechanism to check the extent of SDMs use. This makes it difficult to offer a conclusion on the effectiveness of the SDM, and the findings are only able to rely on the perceptions of the respondents.

7.4.2 Application to C2

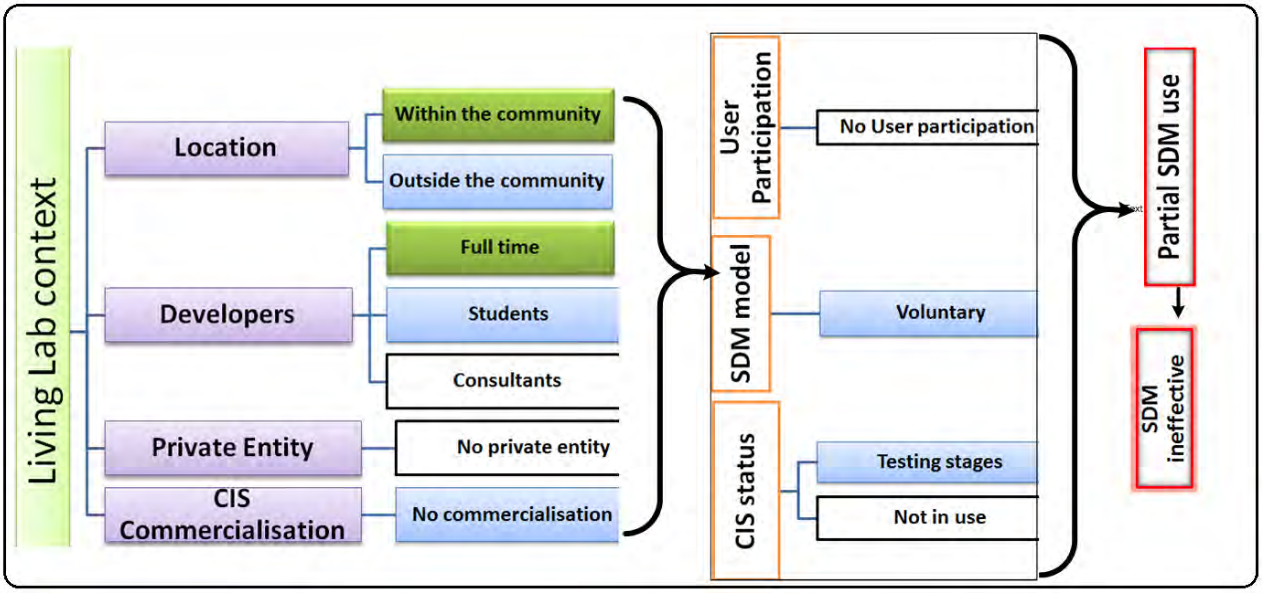


Figure 7-4: Framework for assessing use and effectiveness of SDMs when developing CISs: *Application to C2*

C2 covers a number of communities and has two physical offices; one in a rural community and one in a central urban area. The advantage of its presence in one of the rural communities is that people from the surrounding areas can make use of support and services provided in the Living Lab; also it becomes easy for the developers to obtain quick feedback when needed. Developers from this Living Lab include full-time staff members, students and consultants. In terms of user participation, the developers do not take advantage of the Living Lab's presence in the community by involving users in their CIS development effort. This is due to the perception that users do not know what they want from the system and are thus not in a position to contribute towards its development. None of the systems developed in C2 are in full operation; some are still undergoing testing and one is incomplete. This was attributed to the number of people being involved in developing one system, with students leaving upon completing their studies. Although C2 is linked to an existing private entity, this entity's role is support in terms of financial stability and not focused on developing structures and standards for system development. There is thus no standard model used when developing CISs in this Living Lab, and the SDM model depends on developer discretion or experience.

7.4.3 Application to C3

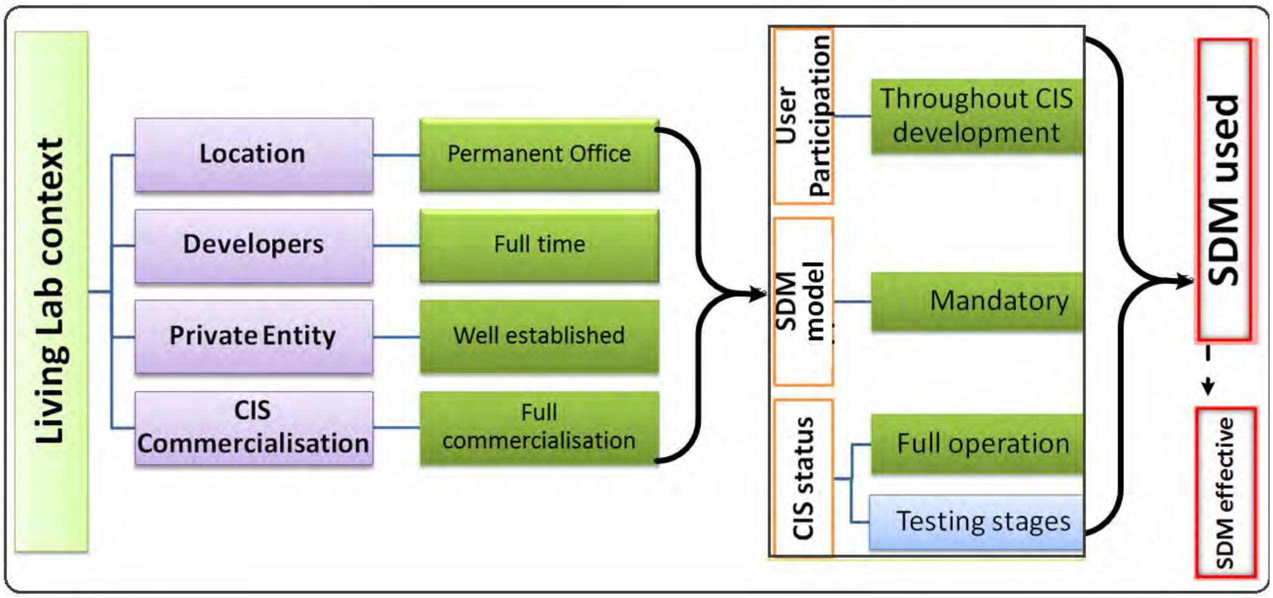


Figure 7-5: Framework for assessing use and effectiveness of SDMs when developing CISs: ***Application to C3***

Due to the mobile nature of their CIS application, C3 serves a broad spectrum of users, not only users within the community where it is located, but users from virtually anywhere where one can connect to the application (Parker & Wills, 2009). The Living Lab, however, does have permanent presence in their primary location, Athlone. Looking at the Living Lab context factors, C3 is associated with variables that are colour coded in green. There is a well-established private company where the CISs are developed and commercialised that is associated with this Living Lab. Concerning the CIS context factors, due to a permanent presence and the fact that the developers easily receive feedback from users of mobile technology, user participation is perceived to exist throughout the CIS development stages. According to the respondents, an agile model approach has been adopted as an SDM model for developing CISs in the Living Lab. Respondents moreover indicated that the CIS in C3 is fully operational, indicating that use was made of an SDM when developing CISs at C3. In this case it is easy to check effectiveness of the SDM as the system is complete, in use and an adapted model has been used.

7.5 The recommended SDM framework for developing disadvantaged community systems

The second outcome of this study is a recommendation on the SDM framework to be used when developing CISs intended for disadvantaged communities. The aim is to assist Living Labs or any other institutions in making decisions about the best methodology to use when developing CIS for such communities. The recommended SDM framework takes the following aspects into account:

1. Factors identified and used in developing the proposed framework for evaluating the use and effectiveness SDM when developing CISs for disadvantaged communities, as per Figure 7.1.
2. Based on the definition of a SDM from chapter 4 the recommended SDM will encompass a system development approach, a SDM, a system development process framework and a system development technique. These points are represented in an onion model graphic in Figure 7.3. The onion model emphasises a process-based approach to selecting a SDM and the importance of context in selecting a system development methodology (Faridani, 2011).

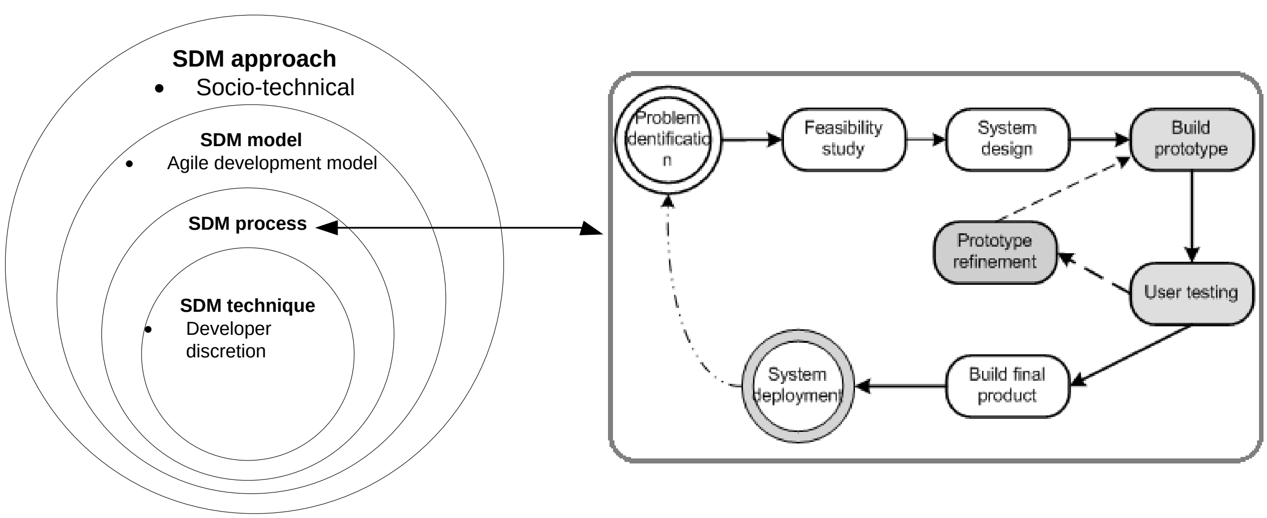


Figure 7-6 General SDM framework adapted from (Avison & Fitzgerald, 2006)

3. Contingency approach to information systems development. A number of SDMs were mentioned in Chapter 4. This SDM framework does not make reference to any particular SDM as the contingency approach to system is recommended for developing CISs for use by disadvantaged communities.

While the framework does not prescribe any particular methodology, an SDM process is suggested in 7.5.3.

7.5.1 System development Approach

By its nature, a community information system is developed for a community of people and is preferred over a process based approach to development. The focus needs to move away from technology or processes to an approach that understands the role of the users and the developers in the system. The socio-technical theory referred to in Chapter 2 acknowledges the importance of considering people and structure through the social pillar of the theory. Due to the nature of users of the CISs in disadvantaged communities, a socio-technical approach is recommended for these systems. Adopting such an approach in an ISDM would accentuate holistic consideration of the system development environment (Boahene, 1999).

7.5.2 System development model

Flexibility, user involvement and rapid development are essential when developing these CISs and an agile model is recommended. Amongst the advantages of agile based methodologies Koch (2011) mentions early customer involvement, iterative development, adaptation to change, a productive and motivated development team and early warnings of any potential problems. Faridani (2011) adds that the agile model is also good in facilitating management of the system development project as milestones are set and there is accountability for anything that does not conform to agreed specifications.

This model has already been adopted by C3 and although not formalised, developers from C1 also follow it. Teams developing CISs are small, so the system development methodology should choose a framework that will assist in optimising efficiency of the said team.

7.5.3 System development process

An iterative process is preferable to a linear process as followed in the waterfall framework. The iterations are important to allow continuous feedback from the users. All the case studies mentioned a certain level of prototyping during development, and C2R2 even goes further to mention that prototyping is used as part of requirement elicitation. This is important in cases of information for illiterate users so as to create an awareness of the potential role the system could play in changing their livelihood.

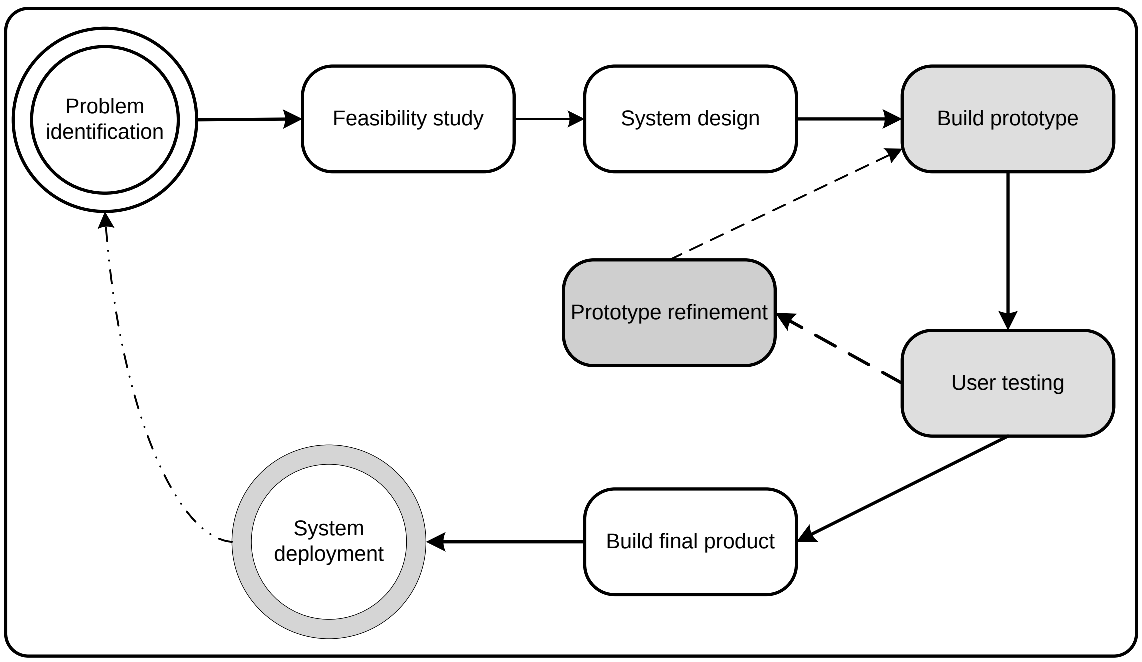


Figure 7-7 Proposed SDM process model for developing CISs for disadvantaged communities

This SDM process model depicted in Figure 7-4 uses an iterative prototyping model to ensure improved user participation during the development process. The shaded processes indicate where there is intense user involvement through interaction and where various iterations of the development are taking place. Table 7-4 outlines the description of all the phases.

Table 7-4 Phases

SDM process phase	**Description**
Problem Identification	Unlike in an organisation setting, a rural community system is usually conceived from the identification of the need by the developers, not the users (community) (Donner, *et.al*, 2008). Developers must work with the community to ensure sensitivity to the needs and current state of the community's components (people, structures or governance, groups and communication, other systems).
Feasibility study	This stage encompasses decisions about capabilities of the Living Lab to carry out the development of the system and obtain the high level requirements of the CIS. Inclusion of developers familiar with the environment is a key to the process and as identified above, a champion from the community must be involved.
System design	Once the developers understand the community needs and have established ability to develop the system, the system design can take place. According to C3 there are times where a system is needed urgently indicating that the design should be completed rapidly.
Build prototype	A prototype can be built using known tools. It is important that the first iteration is as simple as possible to enable easy user understanding of the artefact (Donner, *et.al*, 2008).
User testing	Users are given an opportunity to experiment on the prototype and offer feedback on necessary changes.
Prototype refinement	This stage takes place if further changes to the system are still required; the purpose is to revisit the design to adjust it to the required changes from the users. Once completed, the next stage is to incorporate the changes to the prototype.
Build final product	If users are satisfied with the system, the final product it built.
System deployment	The system is then implemented. Continuous *Iteration* and *Testing* are vital as part of implementation to ensure that users fully understand the functionality of the system (Bourgeois and Horan, 2007). Although the process ends at system deployment, the extra dotted line going back to problem indication takes future needs into account, i.e. maintenance or enhancement.

7.5.4 System development Tools and Techniques

There are various techniques used in the market. The selected technique should be straightforward for the lay user to understand and it should explain the processes and artefacts in the simplest possible way. Tools such as simple Data Flow Diagrams assist people with limited literacy, particularly where users all lack computer skills

7.6 CHAPTER SUMMARY

Two frameworks were developed in this chapter, as per objectives of this study. The first was the framework for evaluating the use and effectiveness of a SDM and the second a SDM framework for developing CISs, including a suggested SDM process to be followed when developing the said CISs. Propositions established in Chapter 6 assisted in identification of factors influencing the use and effectiveness of SDMs. These factors are a combination of issues associated with the Living Lab environment and those relating to the CIS development context. Using the Technology Organisation Environment theoretical framework, these factors were used to develop a framework that may be used to evaluate use and effectiveness of SDMs in Living Labs.

An extension of this framework used variables to apply the framework to the current study. Some of the conclusions drawn from this assessment are:

- **C1:** There was partial use of SDMs with no coordinated decision or mechanism to check the extent of SDMs' use. This made it difficult to reach a conclusion on the effectiveness of the SDM, with the assessment having to rely on the perceptions of the respondents.
- **C2**: None of the systems developed in C2 were in full operation, some were still undergoing testing and one was incomplete. This was attributed to the number of people involved in developing one system and students leaving upon completion of their studies. There was thus no standard model used when developing CISs in the living lab, with the selected SDM model dependent upon developer discretion or experience.
- **C3:** Due to a permanent presence at the facility and the fact that developers easily received feedback from mobile users, user participation was perceived as being constant throughout the CIS development stages. In this instance it was straightforward to assess the

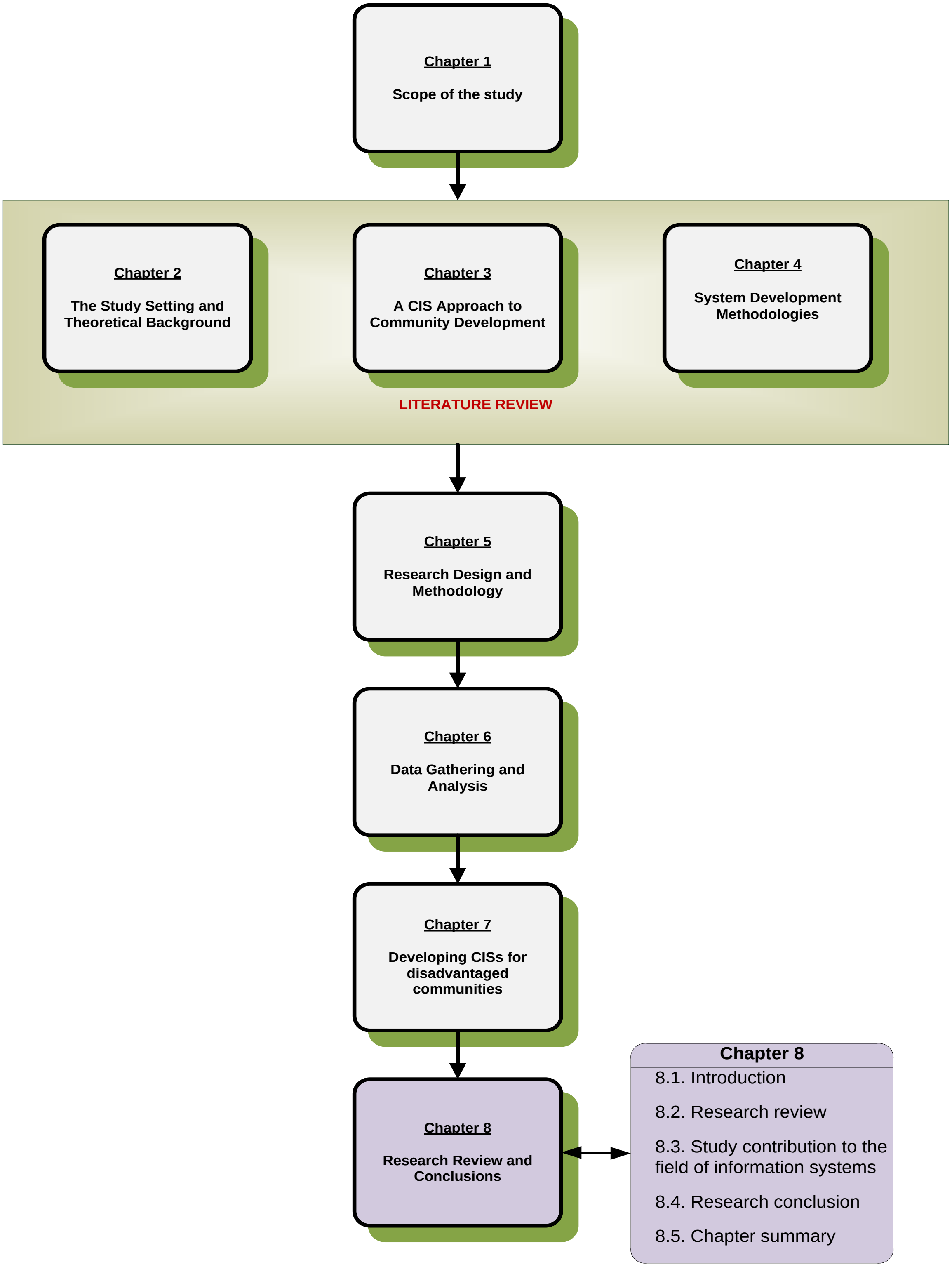
effectiveness of the SDM as the system was complete, it was in use and an adapted model is being used.

Living Labs which have a full-time presence in the community seem to do better in terms of standards and controls when it comes to system development. Linkage to a private company or companies also strengthens these standards.

The SDM framework uses a process-based method in selecting an SDM based on a socio-technical approach to development, agile mode and prototyping. This is to ensure a holistic tactic in the development of the systems, taking into account the dynamics of the communities who will be using the CIS. A process was suggested, incorporating the development of a prototype that goes through various iterations until the user is satisfied with the system.

The following chapter concludes the study by reviewing its most important aspects.

CHAPTER 8. RESEARCH REVIEW AND CONCLUSION



8.1 INTRODUCTION

This aim of this study was to investigate the use of SDMs when developing systems for disadvantaged communities and whether these SDMs are effective towards achieving system objectives. The focus was on initiatives aimed at using information and communication technologies with a view to improving living standards for under-developed communities.

An interpretive enquiry was conducted where three Living Labs were chosen for the study. A literature review and document analysis provided secondary data for the study. This is recorded in Chapters 2, 3 and 4. Chapter 2 provided a context for the literature review through an introduction to ICT4D, where development as a concept is defined at length and a link established on how ICT contributes to improvement of living standards. The chapter also presented some background information on South Africa and the role played by the Government towards ensuring the improved status of ICT. Theories used in the research are also outlined in Chapter 2. Chapter 3 provided an examination and discussion of CISs whilst Chapter 4 described and discussed system development methodologies.

Three case studies were chosen for the primary research where audio recorded semi-formal interviews were conducted. As drivers of ICT4D initiatives in disadvantaged communities, Living Labs were chosen as relevant cases for this research and three were used as case studies. The basic criteria for selection of a Living Lab was that it had to be involved in initiatives that used ICT for socio-economic development, and that it was involved in development of some of the systems for use by the disadvantaged communities.

Chapter 5 addresses the research design and methodology while Chapter 6 details how data gathering was conducted and also presents the data analysis. Atlas.ti™ was used as a computer based analytical tool. Themes were used to present data from the interviews and findings of the study were presented through a cross-case analysis.

A review of the study effort is conducted by looking back at the research objectives and whether they have been addressed by the study. An account of how research questions were addressed is also outlined. Contributions of the study are offered, followed by the research conclusions.

8.2 RESEARCH REVIEW

8.2.1 Addressing the research objectives

To ensure completeness of an enquiry it is important that there is a link between research objectives, research methods and data collection (Maxwell, 2005). The case study interviews were conducted mindful of the original objectives of the study. The two primary objectives of the study were:

-To develop a framework for evaluating the use and effectiveness of SDMs when developing CISs for disadvantaged communities in South Africa.

-To recommend a SDM framework for developing CIS disadvantaged communities in South Africa.

In order to achieve these primary objectives, secondary objectives were formulated. Themes identified during data analysis were related to at least one or more study objectives. These secondary objectives were:

8.2.1.1 Establishing existence of information systems aimed at addressing socio-economic development issues for disadvantaged communities around South Africa.

In his analysis of ICT4D trends, Heeks (2009) acknowledges that ICT4D initiatives need to change from being aimed at ensuring access to basic computing, to specific systems aimed at addressing the social and economic needs of disadvantaged communities; hence, CISs. According to findings from the literature, the evolution of CIS may be traced back to the late 1980s. Chapter 3 outlined a number of CIS initiatives in South Africa. Most of these initiatives are domain based, i.e. addressing a particular community problem such as E-Health, e-Agriculture and e-Education, which are some of the common business domains. One example in South Africa is Tsilitwa Telehealth system, which facilitates communication between nurses in rural communities and doctors from a hospital more than 50 kilometres away (Turker, et al., 2007).

Interviews revealed that there was an awareness of the need for community specific systems towards solving developmental problems of a particular community. Seven Living Labs were contacted for the initial fact finding stage of this research and all of them indicated that there was either an existing CIS or plans to develop one as soon as possible. Poverty, poor infrastructure, poor computer literacy, unmet basic human needs and systems not addressing users' needs were some of the challenges identified when using CISs. In general, while challenges do exist, nevertheless there is a growing use of CISs aimed at improving living standards for disadvantaged communities.

8.2.1.2 Identifying whether SDMs are followed when developing CISs in South African disadvantaged areas.

On average, the three Living Labs investigated in the study have been in existence for about four years, with one or no full-time developer on site. A Living Lab approach to socio-economic development is a new phenomenon, which means that institutions have not matured enough to have adopted any working methodologies.

As discussed in Chapter 4, the use of SDMs is important in ensuring the success of the developed systems and that the system meets the requirements of the users. The objectives of an SDM are discussed in Section 4.2.2. According to the findings obtained from the interviews conducted, there is no formalised SDM followed in any of the Living Labs researched. However, while one Living Lab, C3, has identified an agile approach to developing systems, developers are not limited to any particular SDM. A reference to prototype development was made in the other two cases; those of C1 and C2, although this was not formalised practice. Discussions on SDM use were covered at length in Sections 6.3 and 6.4.

8.2.1.3 Establishing from the Living Labs factors which influence the use and effectiveness of SDMs when developing CISs for South African disadvantaged communities.

Interviews and data analysis through thematic analysis assisted in identifying some factors that are believed to influence the use and effectiveness of CIS by Living Labs. These factors include location of the Living Lab, employment status of the developers, choice of SDM model and linkage of a Living Lab to a private entity. Using TOE, these aspects were grouped into factors associated with the Living Labs environment as well as those factors associated with the CIS development context. The framework addressing the first primary objective of this study was constructed using these factors.

8.2.1.4 Establishing how Living Labs should develop CISs for disadvantaged communities.

This sub-objective was directly related to the second primary objective of this study. This was completed and the framework took the social nature of communities, merging agile development and prototyping, into account. A feasible process for the building of the CISs utilising prototype iterations to influence user participation during development was also suggested.

8.2.2 Research questions answered

To achieve the research objectives, the following primary research questions were asked:

1. *Are SDMs used in the development of CISs for the disadvantaged communities of South Africa?*
2. *How effective are SDMs in the development of CISs for disadvantaged areas in South Africa?*

As indicated elsewhere in this thesis, multiple case studies were conducted in order to be able to answer the research questions. According to Olivier (2004) the case design method is generally preferred because it facilitates comparisons between cases and contributes to an enhanced conclusion. A literature review and semi-structured interviews were the mode used for data collection; the literature review included examining documents, reports and the website of the

Living Lab while interviews were conducted face-to-face and telephonically. Secondary questions were developed in order to answer the primary questions; the former of which were listed in Section 1.5.1.

Table 8.1 illustrates how and where the secondary research questions were addressed indicating that some were addressed by the literature review and some were addressed through data collected from the research interviews.

Table 8-1 Secondary research questions, a process-based research framework (based on work by Roode, 1993)

REF	Questions	Mode of Address:
What is?		
SQ1.1	What is ICT for socio-economic development?	Chapter 2 and 3
SQ1.2	What are community information systems?	Chapter 3
SQ1.3	What is the main objective of the CIS?	Chapter 3 and Chapter 6 | Interviews
SQ1.4	What are SDMs?	Chapter 4
SQ1.5	What effect does the use of an SDM have on the successful implementation of a CIS?	Chapter 6 | Interviews
SQ1.6	What factors specific to the Living Labs affect the use and effectiveness of SDMs when developing CISs?	Chapter 6 and Chapter 7 | Interviews
Why is?		
SQ2.1	Why are CISs important for the socio-economic development in South African disadvantaged communities?	Chapter 3 | Interviews
SQ2.2	Why is it necessary to choose a particular SDM in the development of ICT systems for socio-economic development?	Chapter 4
SQ2.3	Why is there still minimal user involvement during the development of CISs?	Chapter 6 | Interviews
How does?		
SQ3.1	How are SDMs chosen?	Chapter 4
SQ3.1	How are CISs developed?	Chapter 3 and Chapter 6 | Interviews
How should?		
SQ4.1	How should the use and effectiveness of ISDMs for community information systems be evaluated?	Chapter 6 and Chapter 7 | Interviews
SQ4.1	How should SDM be selected when developing CISs?	Chapter 6 and Chapter 7 | Interviews

8.3 Study contribution to the field of information systems

This study make both theoretical and practical contributions to the field of information systems.

8.31 Contribution to Theory

This study is important in that the literature review revealed that there is currently no similar study being researched on system development methodologies for development of CISs by Living Labs or community centres in South Africa. It presents a new perspective on ICT4D research as there is currently no evidence of research on the use and effectiveness of SDMs when developing systems for disadvantaged communities. Minimal literature and research on SDMs for CISs exists; this research therefore contributes to the existing body of knowledge.

The framework for evaluating the use and effectiveness of SDMs in the development of CISs for disadvantaged communities presents factors and variables that could be used to evaluate SDM use and effectiveness.

8.3.2 Practical Contribution

On a practical level, this study provides the following frameworks:

1. A framework to assess the use and effectiveness of SDMs when developing CISs for disadvantaged communities, it evaluates the various aspects that have an influence on the use and effectiveness of SDMs for building CISs. The systematic approach to evaluation encourages awareness concerning the diverse actors involved in the process of CIS development. It is envisaged that this framework will be transferable to other environments, if adapted to the context of (that) particular environment.

2. An SDM framework for developing CISs for disadvantaged communities. This framework puts an emphasis on user participation and suggests a prototype using a SDM process.

8.4 RESEARCH CONCLUSIONS

8.4.1 Limitations

No research is perfect and the researcher must acknowledge their imperfection and effects of such imperfection. According to Cooper & Schindler (2006) it is important for researchers to report flaws with frankness in their research.

The Living Labs are a new concept in South Africa, with none of them having been in existence for more than ten years (Herselman, Marais, & Roux, 2009; Cunningham, Herselman, & Cunningham, 2011). To add to this, ICT4D initiatives are focused on ensuring access to technology and have now evolved to a point of deployment of CIS, aimed at solving specific community problems (Heeks R. , 2009). There are currently thus few Living Labs developing CISs for disadvantaged communities which were in a position to contribute to a limited sample. This limitation was however overcome by the use of multiple case studies which enabled elicitation of diverse views from different perspectives.

The lack of user involvement in the study was a further limitation. Attempts were made to interview users, but due to their poor understanding of the process and easy dismissal of their involvement during development it was decided that the study would concentrate on the developers and the management teams. The managers contacted, particularly those from C1 and C2, also easily dismissed the practicality of interviewing the users. The main reason given was difficulty in establishing which users to interview during the fact finding stages, before the development of the system. This was different to traditional organisations where users are easily identifiable and share some common characteristics. Systems that were not in use at that time contributed to this problem since interviews with contemporary users (at that time) were thus not feasible.

8.4.2 Future research

Future research could be conducted to investigate the following:

-
- Investigating the extent of use of people based system development methodologies, such as ETHICS, when developing information systems aimed at uplifting living standards for disadvantaged communities.

8.5 Chapter summary

Results from the study have demonstrated that there are gaps in the use of an SDM when developing systems for socio-economic development. The processes followed during development cannot be linked to any particular methodology and are also ad hoc, which makes it difficult to monitor the effectiveness of these methodologies.

Living Labs which have a full-time presence in the community seem to do better in terms of standards and controls when it comes to system development. These labs are consolidated by linkages to private companies. This is evident from C3 which has full-time staff at the Living Lab providing a thriving system that is being globally implemented.

User involvement has been identified as important for the successful development of CISs. Due to poor computer literacy skills, some basic computer training is necessary, particularly in rural communities, before introducing specific systems.

Finally, it is hoped that the recommended framework will assist towards standardising the development process for CISs aimed at improving living conditions of disadvantaged communities.

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APPENDIX

The contents of the appendix section are as follows:

APP1 : INTERVIEW QUESTIONS

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

RESEARCH INTERVIEWS:

Research Topic:

The Use and Effectiveness of System Development Methodologies When Developing Community Based Information Systems

STUDENT NAME: Ms N. Wayi

PROMOTER: Prof. M. Huisman

PURPOSE OF THIS INTERVIEW:

The aim of this interview is to elicit information about the extent of use and effectiveness of Information Systems Development Methodologies (SDMs) when developing community systems for disadvantaged areas (referred to as a "community based information systems")'.

- Information obtained from this interview will be used for research purposes only, towards contribution to the improvement of system development practise. Your personal information will only be used for follow up or verification purposes and will not be shared with any other party.
- Please be as sincere and informal as possible

QUESTIONS TO DEVELOPERS/ MANAGERS

1. SECTION 1. GENERAL INFORMATION ABOUT THE LIVING LAB

i. Name of your Living Lab:
ii. Location of the Living Lab:
iii. When was it (the Living Lab) established?
iv. Who were involved in establishing the Living Lab?
v. Who are the main stakeholders of the Living Lab?
vi. What is the key focus of the Living Lab?
vii. How many disadvantaged community based Information Systems do you have in your Living Lab?

viii. Did you do any kind of development to the community based Information System your Living Lab is using? Please explain.
(T*his includes customising a purchased application or altering a part of the system developed by another company or individual)*

NB: *If the response to the above question is* **NO**, *the participant need to only answers the last section of questionnaire (Participant Information) and ignore the rest of the questions as they do not apply to their particular situation*.

2. SECTION 2. INFORMATION ABOUT THE COMMUNITY BASED INFORMATION SYSTEM

i. Name of the System?
ii. Primary objective of the system?
iii. How long did it take to develop the system?
iv. Was the system usable immediately after its release?
v. How were users introduced to the system?

3. SECTION 3. USE OF INFORMATION SYSTEMS DEVELOPMENT METHODOLOGY DURING DEVELOPMENT

i. How many people were part of the system development team?
ii. Were the people involved in development from the same organisation/ institution?
iii. What was your role during the development of this community based system referred to in Section 2 (above)?
iv. What factors were considered in making the decision to follow a particular SDM when developing this system?
v. What SDM was used when developing this system?
vi. Can you give brief information about the SDM used in developing this system? i.e. the process followed.
vii. What factors informed the decision to use the selected SDM?
viii. What model best describes your chosen methodology? (i.e. Process-based, Object- based, Socio-Technical, or People based model)
ix. Would you consider this SDM choice appropriate towards meeting the goals of the proposed system? If Yes, what made this SDM the most appropriate choice for this system?
x. What role does a SDM contribute towards successful implementation of a system?
xi. What System Development Tools were used during development?
xii. Are there any community specific tools that could be used during development?

4. SECTION 4: EXTENT OF USER PARTICIPATION (CONSULTATION) DURING DEVELOPMENT

i. Who are the users of the system?
ii. What role did the users play towards the development of the system?
iii. If there was user involvement, how were the users selected?
iv. What initiatives were made to ensure that the community users have an understanding of their role during system development and the role that the system plays towards development in their community?

APP1 : Interview Questions

SECTION 5. EFFECTIVENESS OF SDM

i. How do you feel about effectiveness of this selected Method?
ii. In your view, what is an effective SDM?
iii. How would you alter the development process to improve effectiveness?
iv. Can you elaborate about a specific part during system development that caused some challenges?
v. How successful was your development projects?
vi. From the lessons learnt during the development of the system:
   a. What technical factors do you feel need to be considered when developing a community-based system.
   b. What Social factors do you feel need to be considered when developing a community-based system.
vii. Do you think SDMs are necessary when developing community based systems?
viii. What would you do differently when developing future community based system?

5. SECTION 7. INFORMATION ABOUT THE PARTICIPANT

i. Name:
ii. Gender:
iii. Role in the Living Lab:
iv. For how long have you been involved (working) with this Living Lab?

QUESTIONS TO USERS

1. SECTION 1. GENERAL INFORMATION ABOUT THE LIVING LAB

i. Name of your Living Lab:
ii. Location of the Living Lab:
iii. What is the key focus of the Living Lab?

2. SECTION 2. THE SYSTEM AND EXTENT OF USER PARTICIPATION (CONSULTATION) DURING DEVELOPMENT

i. Name of the System?
ii. Primary objective of the system?
iii. What was the level of your involvement during the development of the system? *If YES, what was their role?*
iv. Were there any efforts made to ensure that the community users have an understanding of the system and the role that it plays in the community? Please explain.
v. How are you benefiting from the system?
vi. Do you think user involvement is necessary when developing community based systems?

3. SECTION 7. INFORMATION ABOUT THE PARTICIPANT

i. Name:

APP1 : Interview Questions

ii. Gender:
iii. Role in the Living Lab:
iv. Role in the Community:
v. For how long have you been involved (working) with this Living Lab?
vi. What was your role during the development of the rural community based system referred to in Section 2 (above)?

APP2: Participant Consent Form

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

CONSENT FORM TO PARTICIPATE IN RESEARCH

The aim of this interview is to elicit information about the extent of use and effectiveness of Information Systems Development Methodologies when developing rural community based information systems.

Topic: The Use and Effectiveness of System Development Methodologies when developing Community Based Information Systems

Thank you for availing your time to participate in this research study conducted by Prof. M. Huisman and Miss N. Wayi, a PhD student, from North West University (Contact details at the bottom of this document). You were selected as a possible participant in this study because you are part of a Living Lab that has developed a community based information system.

Please feel free to ask the researcher to explain anything that is not clear to you.

You have the right to query concerns regarding the study at any time and immediately report any new problems during the study to the researcher.

1. PURPOSE OF THE STUDY

The aim of this questionnaire is to elicit information about the extent of use and effectiveness of Information Systems Development Methodologies when developing rural community systems.

2. **PROCEDURES**

This interview should take about 20 minutes of your time.

3. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

The study is aimed at contributing to the System development process for rural community based systems. It is envisaged that this study will recommend a System Development Framework for developing community based systems.

4. PAYMENT FOR PARTICIPATION

Please note that you **will not** be paid to participate in this project.

5. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will be kept private (confidential) and will be used only for the purpose of reporting on this study. Your privacy and confidentiality will be maintained by means of limiting access to your data and only the mentioned researchers will be able to access it. All of the work we do with the data (coding) will also not reflect your identity and all the data sheets that have been collected will be stored in a secure place for three years, after which they will be destroyed and not shared with any other person without your permission.

6. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact either:

The Student:

Ms. N Wayi (Tel: 043 704 7072/ 082 661 9998) Nwayi@ufh.ac.za

University of Fort Hare, East London Campus

The Supervisor

Prof. M. Huisman (Tel: 018 299 2537) magda.huisman@nwu.ac.za

North West University, Potchefstroom Campus

APP2: Participant Consent Form

Signature of research subject

The information above was described to me as the participant by the researcher in English. I was given the opportunity to ask questions and these questions were answered to my satisfaction.

[I hereby consent to participate in this study] I have been given a copy of this form.

____

Name of Participant

____ ______________

Signature of Participant Date

Signature of investigator

I declare that I explained the information given in this document to __________________ [*name of the subject/participant]. [H*e/she] was encouraged and given an opportunity to ask me any questions. This conversation was conducted in English.

____ ______________

Signature of Investigator Date

APP3: Language Editor's certificate

CERTIFICATE

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TO WHOM IT MAY CONCERN

This is to certify that I have edited the following document for English style, language usage, logic and consistency; it is the responsibility of the author to accept or reject the suggested changes in order to finalise the document.

Author: Ms N Wayi

Item: Thesis on **THE USE AND EFFECTIVENESS OF SYSTEM DEVELOPMENT METHODOLOGIES DURING THE DEVELOPMENT OF COMMUNITY BASED SYSTEMS IN SOUTH AFRICA**

Sincerely

DLevey

DAVID LEVEY
2013-12-02

APP4: Paper Outputs

The references for the papers listed below are as follows:

1. Wayi, N., & Huisman, M. (2013). Factors influencing the use of system development methodologies when developing community information systems in Living Labs. To be presented at Ineer (International Network for Engineering Education and Research) 2013, Cape Town, South Africa, 8-12 December 2013.10.04
2. Wayi, N & Huisman, M. (2012) *An Actor- Network Theory Based Approach For Designing Rural Community Based Information Systems in South Africa.* IDIA Conference,
3. Wayi, N & Huisman, M. (2010) *A System Development Methodology Framework for Development of Rural Community Information Systems in South Africa.* IDIA Conference, 3-5 November 2010
4. Wayi, N & Huisman, M. (2008) *Community Information Systems in South Africa*. SAICSIT Post-Graduate Symposium. October 2008 (not peer- reviewed)

APP4.1: Paper presented at the Postgraduate Symposium- SAICSIT Conference 2008 (Not peer reviewed)

Community Information Systems in South Africa

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ABSTRACT

Information and communication technologies (ICTs) have been earmarked as mechanisms that could be used in enhancing the socio-economic status of rural communities in developed and developing countries. It has been more than a decade now that governments and community associations from all-over the globe undertook to embark in practices and initiatives that ensure that people in rural communities have access to some form of ICT. The primary focus of these initiatives was to bring ICTs closer to people who have no such access. The ICTs provide a platform for rural community Information systems (CISs), which are now a new focus in the area of ICT for socio-economic development. CISs are content based information system that can provide electronic services like Health, agriculture, education, government and on several other issues depending on a particular community's needs. Social vision and community based view on the development and implementation of the systems are some of the critical success factors for the community ICT initiatives. There have been several socio-technical challenges like illiteracy, culture, language, costs, infrastructure; which have an impact in the success or sustainability of a particular CIS. This paper looks at CISs as means to improve socio-economic conditions of people in rural communities; challenges with CIS implementation and how these CISs could be implemented appropriately to benefit the intended communities.

Categories and Subject Descriptors
H.4.3 **[Information systems Application]**: Communications Applications- *Information browsers.*

General Terms
Documentation, Human Factors, Languages

Keywords
Information and communication technology, community information systems, e-government, and socio-economic development.

1. INTRODUCTION

People living in rural communities of South Africa still live under low socio-economic conditions with poor education, transportation infrastructure and access to telecommunication services. It becomes difficult and expensive for these people to access service like government or telecommunication as they often have to travel kilometres to a nearby urban area [Moshapho and Hanrahan, 2005].

Information and Communication Technologies have been identified as a potential intervention to address problems facing people in rural communities [Benjamin 2001]. There is a worldwide belief that introduction of CISs as means to communication would play a big part in advancing development in the third world countries, like South Africa. This is due to the fact that, unlike about 10 years ago technologies like Cellphones or public access terminals are increasingly being available to people in rural communities.

Community information systems [CISs] available through relevant ICTs could provide information and assistance in areas like health, agriculture, government and general information affecting the community [Gurstein, 2000]. CIS refer to web-based information systems that act as a link between a poor communities and services in urban areas, making it easy for people to get information and help without incurring any added costs. According to Rao [2004] CISs are necessary for any community as they provide people with information about their physical and social surroundings and other information they can use for public purposes, and can help to foster a sense of community. Farmers in rural areas are examples of entities that benefit from online solutions provided by the more experienced counterparts.

2. METHODOLOGY

Online literature review is the methodology used in this research. A review of literature, statistics and case studies in the area of systems aiding socio-economic development has been conducted. This was accompanied by a scoping exercise to check the profiles of currently operating community information systems. The purpose of this exercise was to get knowledge of various issues surrounding implementation of community information systems. Pilot studies have also been conducted in telecentre from North-West, Gauteng and Limpopo provinces to find out about the extent of implementation and use of the Government Gateway system. Government gateway is an initiative by the South African government to improve access to government based information and services to the public in South Africa. Out of five sites visited, only one site has a gateway service although it is not fully operational.

3. SOCIO-ECONOMIC DEVELOPMET

Hameed [2005] defines *Socio-economic development* refers development associated with social and economic issues of a country or a society using GDP, life expectancy, literacy and levels of employment as indicators. Development encompasses a change from the current situation to a "better" situation. When dealing with communities, there are factors that are linked to a need for development and those factors need to be treated with sensitivity as they might determine the success or failure of the development efforts. Amin [1990] mentions economic, political and cultural or social forces as factors that might determine expansion or collapse of development.

Applying a systems' approach in development is important as different communities have different developmental needs. Todaro [1991] stated that no development is complete if it focuses on only one factor. Several factors affecting the community have to be integrated. This does not only apply to ICT for development; economic, political and social/cultural factors need to be taken into consideration. Amin [1990] further argues that there is a need for wisdom that implies acceptance of plurality of these factors.

Information and Communication Technologies have evolved for more than 5 decades and their capabilities can be applied to all the modes of business and non-business operations [Frenzel, 2004]. Coupled with these capabilities is the rapid growth and use of internet and networking applications across the world, bringing businesses and people closer together. Life with Information technology has become much easier due convenience of being able to do what would normally take a long time, involving to the moving around, in a shortest time in one place. Walsham [1998] argues that due to ICT and CISs time and distance barriers have been removed. Borders are no longer a deterrent for people to communicate and with ICT everyone becomes part of the global universe.

According to Morales- *Gómez & Melesse* [1998] for ICTs to make a significant contribution to facilitating the development and building of human resource capacities of people in disadvantaged communities, it has to be carefully planned and targeted. Avgerou [1998] concurs with this statement as she states that information technology as a powerful working instrument is one of the changes that need to be considered in the understanding and explanation of socio-economic trends. There are various means in which CISs can be applicable to communities, like aiding in learning for scholars and students at large; providing means of communication and information on aspects relevant to those communities.

Although providing ICT to poor communities help in speeding up their development, success is not always guaranteed. Putting a technology in a poor community is not the only thing that should be in the developer's mind. There are other issues that need to be considered. Information technology is developed by the people for the people [Roode, 1993] and thus the needs of people need to be taken into consideration. A consideration of people's needs is more important than planting computers and systems that are meaningless to people's circumstances.

4. INITIATIVES FOR SOCIO-ECONOMIC DEVELOPMENT

Just more than a decade ago, use of ICTs by people in remote rural areas seemed to be an impractical dream. The advent of technologies like the Internet and Cellphones led to a rapid change. Innovations in ICTs are making it possible for people even in the most remote areas to have access to ICTs. Governments from developed and developing countries have committed to ensuring universal access to ICTs by citizens living in developing countries, more especially residents in rural areas. In South Africa initiatives like the rolling out of Telecentres to rural communities are a step towards the information emancipation of people in rural communities. According to Benjamin [2000], these centres offer ICT based services like the Internet, faxing and photocopying. Some of these Telecentres offer electronic government (e-government) gateway services as CISs, through which people can access online government services thus limiting costs and risks associated with travelling to towns for these services. There is however a considerable number of government gateway sites that are not fully operational.

There are several global challenges with the implementation of the community based information systems, these challenges have an influence on the ultimate failure or success of these systems [Coombs, Doherty, Loan- Clarke, 1999]; [Rao, 2004]. Coombs *et.al* [1999] site, amongst other things, software development as one of the root causes to the challenges. Although, failure of business software development projects is one of the most researched topics, there is lack of research on software projects for communities.

As CISs have become important in socio-economic development, the processes involved in developing these systems should be structured in such a way that the socio-economic conditions of the users are taken into consideration. One mistake that developers make is to apply business process ignoring the social context of communities [Harris, 2001] which lead to challenges with these systems.

4.1 Universal Access as a goal of South African government

According to Oyedemi (2005) universal access is achieved when every person has reasonable means to access publicly available ICTs. The Institutions, NGOs, governments and residence involved in community information systems have a goal of ensuring that people have access to some form of ICT. The term has often been used as a means to curb the digital divide amongst nations, the developed and the developing. The following shows the disparities in the Internet usage between the nations of the world

Table 1: World internet usage and population statistics

World Regions	Population (2007 Est.)	Population % of World	Internet Usage, Latest Data	% Population (Penetration)	Usage % of World
Africa	[illegible]	14.2 %	[illegible]	[illegible]	[illegible]
Asia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Europe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Middle East	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
North America	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Latin America/Caribbean	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oceania / Australia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WORLD TOTAL	[illegible]	100.0 %	[illegible]	[illegible]	[illegible]

SOURCE: Internet world Statistics, 2007

Information from the above table shows that there is a lot that needs to be done in developing, more populated economies in

2

APP4.1: Paper presented at the Postgraduate Symposium- SAICSIT Conference 2008 (Not peer reviewed)

order to ensure fair amount of universal access to ICTs. Ojo [2005] believes that it would thus be ignorant to leave out socio-economic factors like education, economic conditions in discussing means to close this digital gab. This is due to the fact that factors like living standards and infrastructure have an impact on a person's choice of tools to use for everyday living.

As a deputy president of a newly elected democratic government Thabo Mbeki referred to South Africa as "two nations" in one country, with one nation being rich and mainly white and the other poor and mainly black [Benjamin, 2000]. To further narrow down this distinction between these "two nations" is that the former was urban based with access to telephones and related infrastructure and the latter was rural based with no access to telephone infrastructure. In 1996 the government established Universal Service agency (USA), now USAASA (The Universal Services and Access Agency of South Africa) to ensure a rollout of technologies (computers, faxes, telephones) to rural areas through Telecentres [Benjamin, 2000].

USAASA established in 1997 is playing a leading role in the introduction of a number of telecentres across South Africa [http://www.usaasa.org]. According to the Telecommunications Act No. 103 of 1996 the responsibilities of USAASA are centred on [James, 2000]:

- Promoting universal service
- Manage the Universal service fund
- Monitor research on universal service and universal access

The agency controls the Universal service fund, generated through licence fees from telecommunication operators in South Africa. USAASA has been distributing the ICTs through telecentres, which are usually located in Thusong centres in rural communities. A telecentres is an effort to provide access to telephone and other ICTs to remote communities [Benjamin, 2000]. A Thosong centre (formerly known as a multipurpose community centre) is a community information portal with a variety of services that are useful to the community, like youth projects, government departments, and commercial services.

4.2 Community information systems

A normal startup telecentre would offer services like telephone, fax, photocopying, internet or computer training [Short, 2001]. Once established these centres would have advanced applications like LAN connections [Phahlamohlaka and Lotriet, 2002] and systems enabling them connect to other learning or information services. The systems, CISs, become instrumental tools towards the community development. There are various categories of CISs that can be implemented in rural communities and these are provided below.

4.2.1 Community information hubs

In some instances the Telecentre provide local directories with information about things are happening around the community. Some even act as portals for all businesses, much like the Yellow Pages, providing information about a business, i.e. someone looking for a TV repairer, would find that information at the Telecentre [Benjamin, 2000]. These hubs provide information about various activities in the communities and sometimes users can take advantage of interactive content like BLOGS.

4.2.2 Field specific systems

These are system providing content specific to a particular field where members of communities in that field can benefit. According to profiles in the Internet Health, Language, ICT and Agriculture are the leading sectors with their own community systems:

- *e-Health*

These systems can provide electronic mediated health [Gurstein, 2000]. It would be an oversight to assume that content on a website could turn into a surgeon but these systems provide useful information on issues symptoms, remedies and prevention of various diseases. The *Haiti HIV information system and medical record support* is one such system [Fraser *et.al, 2004]*.

- *e-Agriculture*

In most of the rural communities in developing countries like South Africa, people in the community are still dependent on agriculture as their main economic activity and the lack of necessary infrastructures (like road) means that people stay far from the major centres for health or government information services. The centres are therefore used by the communities to get information on how to better their agriculture, and also to gain advice on different health issues, such as diseases that could be a threat to their trade [IVRP[1], 2001].

In an example on the importance of ICT for agricultural assistance to rural areas Desai [2005] uses a scenario of a sick goat to show the role played by a system in the centre towards the goat's recovery. In the example a farmer notices that one of the goats has a wound near its mouth and can not eat. The farmer then sends a web-cam picture of the goat from the system in the centre to the vet college and suggestions received help to cure the goat in two days. This is an example of how ICT is extending support to the lives of people in rural areas.

- *e-Education*

Siyabuswa Educational Improvement and Development Trust [SEIDET] is amongst some community initiatives that are regarded as successful in South Africa. Siyabuswa is a village located in Mpumalanga, about 150 kilometers from Pretoria. The objectives of SEIDET, as set out in their 10th Anniversary account [Ndala, 2002] are:

1. Provision of supplementary tuition for grades 10,11 and 12 learners with focus on English, Science, Mathematics and Commercial subjects
2. Promote community involvement in the education of the youth and the community

[1] IVRP- Information Village Research Project.

APP4.1: Paper presented at the Postgraduate Symposium- SAICSIT Conference 2008 (Not peer reviewed)

3. To forge links and working relationships between the community, tertiary institution and the private sector in all matters related to education
4. To seek placement and sponsorship for its students and provide career guidance to students

According to Phahlamohlaka and Lotriet (2001) the SEIDET project was formed in order to help the disadvantaged children of Siyabuswa with regard to mathematics and science education that prevented them from entrance to tertiary institutions and education. They [Phahlamohlaka and Lotriet, 2001] attribute the success of the SEIDET project to the united commitment and the participation from the community of Siyabuswa, who embraced the project as theirs.

4.2.3 Commercial systems

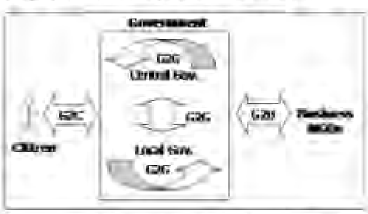
These systems could also be used by citizens as affordable marketing platforms for their business. An example would be for a rural subsistence farmer wanting to sell a cow, all hey would have to do would be to put information about the animal and the price so that people looking to buy a cow would know where to go.

According Morna and Kha [2000] who are advocates for the promotion of ICT use by women, the development of e-businesses offers many possibilities for wealth creation particularly for small and micro enterprises. The [Morna and Kha, 2000] also add that the use of ICTs could provide information vital for people in rural areas like agricultural prices and could be used for Commerce projects among women.

4.2.4 The government information gateway

The government's Gateway programme is aimed as ensuring access by the citizens to government services and information. The information is available in an website format and is available in several South African languages. According to [Moshapo and Hanrahan, 2004] geographic distance is the most significant barrier to people's acquisition of effective services that can only be access in affluent urban areas. This has been a major challenge to people in rural communities as they had to travel long distances for government services. An example is that people would travel long distances to the city only to be informed that the services they require are not available on the particular day.

In South Africa government gateway enhances electronic access to government information and service, thus reducing the geographical, language and income barriers [www.gov.za].



e-Governance Model (Backus, 2001)

Looking at the government model above. G2C refers to information shared between the government and the citizen and that does not only apply to citizens in urban areas. According to the South African *State Information Technology Agency* [SITA], the e-government Gateway creates opportunities to establish multi-functional, technology-enabled urban centres, which provides access to all government services, as well as other related commercial activities, in a single facility.

Morna and Kha [2000] believe that government gateway provide a platform where, through access to government information, local communities could pose their questions to government using these facilities. This means that unlike in a situation where people need to travel the whole day in order to interact with government, when information is available people would participate more in government policy and legislation making.

5. THE NEED FOR COMMUNITY INFORMATION SYSTEMS

Development encompasses a change from the current situation to a "better" situation. It should be noted that not all development could be regarded as such, until there is something else that triggers people's acceptance of the new situation in their lives. There are factors that are linked to a need for development and those factors need to be treated with sensitivity as they might determine the success or failure of the development efforts. Amin [1990] mentions economic, political and cultural or social forces as factors that might determine the expansion or collapse of development.

There is a worldwide belief that introduction of means to communication would play a bog par in the advancing development in the third world countries [Akpan, 2000]. With information people could be more informed and be able to better economic decision as there is knowledge about various aspects of business. The education gap is another reason for advancing information access for the less developed countries [Short, 2001]. The belief is that it is easier to reach people all over the world with the use of technologies like the Internet and CISs make possible such global connections amongst learners.

6. EXAMPLES OF EXISTING CISs

SA government online

This is the government gateway system aimed at proving government based information to the South African citizens and migrants. There have been plans to roll-out this system to Telecentres in South African rural areas but it seems that there are several glitches with such implementation.

SmartCape

The Smart Cape Access Point Project is an initiative of the City of Cape Town whose objective is to ensure that all citizens of Cape Town have access to basic information and communication technologies, free of charge. With Smart Cape, the City has developed a model for public access that allows computing facilities with Internet to be provided cost effectively, using open source software and existing infrastructure and resources. Libraries are currently the access points to the systems [http://www.smartcape.org.za].

4

APP4.1: Paper presented at the Postgraduate Symposium- SAICSIT Conference 2008 (Not peer reviewed)

Cosmo city community

Cosmo city is a new housing development in the Randburg area in Johannesburg. The Cosmo city community website covers information related and relevant to the community. The information covered includes *notice board, crime reporter, community policing forums and meeting dates* [http://www.cosmocitynews.co.za/home.htm]

7. CHALLENGES WITH IMPLEMENTATION OF RURAL COMMUNITY CENTRES IN SOUTH AFRICA.

Many CISs have been developed but they seem not to satisfy the requirements of the community users. Problems with these systems range from societal demands, interface issues and thus they are mostly socio-technical in nature [Harris, 2001]. The same argument applies to the government gateway systems aimed at rural communities, rolling out these systems does not seem to have proper method leading to waste and loss of infrastructure. Challenges with the implementation can be both social (language, culture, politics] and technical in nature [lack of telecommunication infrastructure

8. IMPLEMENTING COMMUNITY INFORMATION INITIATIVES

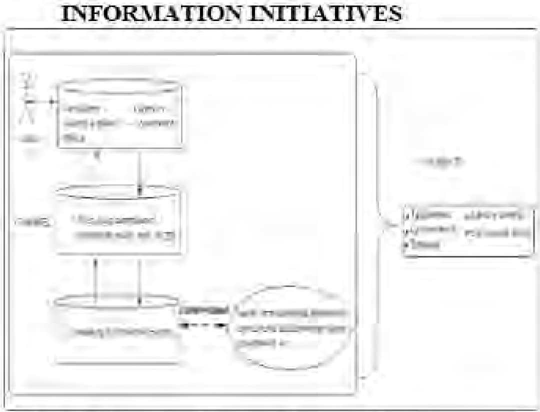


Figure1. Community Information System Architecture

Based on the e-government architecture by Heeks (2001) the figure above shows the basic model for a community information system. As can be seen the system is content based with information on various aspects of the community and information is available through channels like the web, help centre. The users in the systems are both recipients and contributors to the content of the system.

In order to solve the problems associated with challenges in implementing CISs, taking into account the fact that there is limited access to the Internet in the rural areas technologies like Cellphones, TV and VOIP could be working alternatives. According to Mavetera and Lemme [2006] technology can be developed or adapted to suit specific users such as cell phone SMS. This would also overcome the language barrier mentioned above.

9. CONCLUSION

Community Information technologies are important as channels to aid in social and economic development of people in rural areas. It is important that ignorance of the social and technological conditions necessary for the implementation and use of these technologies could limit or sometime render these systems useless. This paper looked at the importance of CISs, the categories, challenges and then a model was suggested on how these systems could better be implemented, taking into account technologies such as cellphones.

APP4.1: Paper presented at the Postgraduate Symposium- SAICSIT Conference 2008 (Not peer reviewed)

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APP4.2: Paper published in conference proceedings- IDIA Conference 2010 (Peer reviewed)

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IDIA2010 Conference

A System Development Methodology Framework for Development of Rural Community Based Information Systems in South Africa.

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ABSTRACT

For more than a decade researchers, development agencies and government have focussed on the use of Information and Communication Technologies to improve the socio-economic status of people in underdeveloped rural communities. In the past few years there has been remarkable recognition of the importance of developing systems that address specific needs of rural communities. Education, Health, Commerce, Government and Agriculture are amongst rural community needs that could be addressed by these systems.

System development is a complex process and studies have shown that if poorly conducted, the process could lead to failure of the system being developed. Due to differences in context and application, the processes followed in the development of the rural community systems need to differ from those of commercial applications. One such difference is the choice of the Information System Development Methodology [ISDM] used.

Following a methodological approach to Information Systems development is important as it improves discipline, standardization and monitoring towards a quality system. There are hundreds of Information System Development Methodologies available for use during development and choosing the wrong ISDM has been linked to problems such as systems being delivered late, over budget or not meeting the needs of the users. To improve success during the development of rural community systems, this paper proposes an Information System Development Methodology framework that could be adopted distinctively for rural community systems. This framework takes into account the social attributes of people in rural communities, the nature of the systems being developed and the role of the users in the systems being developed.

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Keywords
Information and Communication Technology, Rural Community Information Systems, System Development Methodologies, Socio-economic Development.

1 INTRODUCTION

The past two decades have seen an increasing focus on Information and Communication Technologies for Development (ICT4D). Institutions like NGOs (Non Governmental Organisations), Aid Agencies and some private companies continue committing funds to ICT4D. This interest in ICT4D was brought about by the realisation of the vital role that Information and Communication Technologies (ICTs) can play in accelerating rural social and economic development (Migiro & Wayi, 2007; Madon, Nicolau, Roode, & Walsham, 2009). A number of ICT initiatives have been implemented, not only as a means of curbing the digital divide but also to address various needs in rural communities. ICT initiatives provide resources and tools that serve individuals and communities by delivering access and empowerment in areas such as local economic development, cultural affairs, civic activism and community based health and environmental initiatives (Harris, Songan, Khoo, & Bala, 2000; Donner, Gandhi, Javid, Madhi, Ratan, & Toyama, 2008). In South Africa, Education, Telecommunication, Agriculture, Commerce and Crime- fighting are some of the areas where implementation of ICT initiatives could be instrumental in improving community living conditions.

ICT4D initiatives have evolved, with the initial focus being on reducing the digital divide by ensuring that people from rural communities have access to technology (Benjamin, 2001). The past few years have seen a change in focus in the recognition of the role of ICT in addressing the specific needs of communities through Community Information Systems (Community IS). This focus has led to the growth of a fresh discipline commonly known as Community Informatics, aimed at designing and implementing ICT based projects for communities. Due to the complexity of communities and a scarcity of off-the-shelf applications, most community systems have to be developed individually as an experiment for successive systems (Harrison & Zappen, 2005).

The nature of users of rural based Community IS necessitates that a development process different from the normal organisational processes has to be undertaken. Blake (2010) recommends broadening of the field of application development away from the traditional mathematical and engineering approach to consideration of social and human issues. This paper recommends a general ISDM framework to be used in developing Community IS.

Section 2 of this paper discusses Community IS, with examples of rural based Community Initiatives in South Africa. Section 3 outlines Information System Development Methodologies and section 4 presents the proposed framework for development of rural community systems.

2 COMMUNITY IS

Soanes, Sara, and Elliot (2009) define a community as body of people living in one place or united by one origin, interest, etc. As this paper's focus is on rural communities, the definition of 'community' will be adapted to mean a group of people belonging to a rural area, with ongoing interactions and common interests.

In general, South African rural communities are characterised by:

- Very low income per capita as compared to the general population, with high levels of unemployment (Akinsola, Herselman, & Jacobs, 2005): Most rural areas are characterised by massive reliance on social grants as the main source of income. The South African rate of poverty is 45%, but in rural areas this figure rises to more than 50% (Fourie, 2008).
- Dependence on natural goods: This leads to poor quality of life because of scarcity of essential goods and services. The lifestyle of the community often depends mainly on agriculture and livestock farming (Fourie, 2008), as there is no direct linkage to formal markets.
- Poor education: The majority of people in rural communities are illiterate and some have never had formal education (Rao, 2004). In some instances schools are far and learners are forced to walk a number of kilometres to reach their school.
- Poor infrastructure: Lack of roads, electricity, telecommunication infrastructure (Wayi, 2006; Akinsola, Herselman, & Jacobs, 2005). There is also a greater majority of people who listen to radio compared to those who watch television (Fourie, 2008).
- Information Systems illiteracy: There is limited knowledge about Information Systems and the role it can play in a rural community (Rao, 2004).
- Traditional Leadership: In South Africa specifically, traditional leadership is one of the attributes of a rural area.

Rural community based information systems have an important role to play in improving conditions faced by people in rural communities. The Siyabuswa Educational Improvement and Development Trust (SEIDET) project in Mpumalanga is an example of a prominent community based ICT project that has made inroads into the education field for rural communities (Phahlamohlaka, Braun, Romijn, & Roode, 2008).

Community IS is the umbrella term that refers to ICT applications implemented to address the social, economic, political or cultural goals of a community (Stillman & Henry, 2009). Rural communities in South Africa are still lagging behind in terms of participation in global activities. Relevant ICT systems, if well implemented, could offer a platform from which these communities would benefit.

Progress towards a more articulate theory is still very much deficient in the area of rural Community IS development (de Moor, 2007). This deficiency could be attributed to complexity and diversity of the Community IS area. Over the years it has been possible to introduce ICT into rural communities through community centres, as the focus was mainly to ensure access to computers. Development of specific systems is, however, more challenging as the system should be linked to community problems and be usable by the people faced with the problems. One of challenges with the development processes for Community IS is difficulty in ensuring availability of the same individual stakeholders and beneficiaries throughout the process (Vercon, 2009). Involving community stakeholders will improve continuity thus ensuring computers leave behind their definition as community technical tools to being tools used to emancipate rural communities.

2.1 Examples of Rural Community IS Initiatives in South Africa.

South Africa has implemented a number of ICT4D initiatives with community specific systems. Living labs around the country offer potential in terms of systems developed with the needs of the community in mind. Below is an outline of some living labs and some Community IS initiatives already in existence in South Africa.

2.1.1 Living Labs

European Network of Living Labs (ENOLL) defines a Living Lab as an open innovation environment in real-life settings in which user-driven innovation is the co-creation process for new services, products and societal infrastructures (European Network of Living Labs, 2010) . Living Labs started as pilot projects aimed at involving users in developing simple systems to be used to improve the social and economic conditions in rural communities.

A Living Lab approach to community development takes advantage of the diverse creativity of the participants and end-users to bring relevant solutions to rural communities. In South Africa universities, the Meraka Institute (division of the Centre for Scientific and Industrial Research), SAP consulting, the public sectors and some Telkom Centres of Excellence are some of the participants in the development of community systems (Chaffers, Guzman, & Merz, 2009; Herselman, Marais, & Roux, 2009). The systems that have been developed through living labs include enterprise based, logistics, agricultural and health based systems for rural communities.

Table 1 depicts some living labs that are found in rural communities around South Africa. Each system developed serves a distinct need of a particular community.

Table 1: Some Living Labs found in rural South African rural communities (Herselman, Marais, & Roux, 2009)

Living Lab	Information
Limpopo	This living lab was planned by the Provincial Government. A feasibility report completed in 2007 proposed four focus areas for the Limpopo living lab namely, community projects (in technology and innovation), innovation solutions, business development and incubation of Technology and innovation enterprises as well as training and development which are also part of the Limpopo ICT Institute.
Siyakhula	This came about through a partnership in the Eastern Cape between Universities of Rhodes and Fort Hare, established March 2006. Rural ICTs focussed on software applications, e-Services, Web 2.0, empowerment and community

	engagement.
Moutse	Partnership between the Ndlovu Medical Centre, Elandsdoorn Development Trust, INTEL and Meraka. Education, telemedicine and rural Connectivity.
Sekhukhune	Partnership between the Meraka Institute and SAP Research. Rural Micro-Service Enterprise creation and the development of ICT enabled collaborative work environments (e.g. collaborative procurement and logistics, collaborative stock management).
Soshanguve	Planned by Tshwane University of Technology (ICT Faculty); focussing on Education, Research, Community Development, and Job Creation.
Bushbuck Ridge	Partnership between SAP Research and Wits University. This system is Electronic Patient Health System for chronically ill patients in rural areas.

2.1.2 Other Initiatives

2.1.2.1 *Public Information Terminals*

Public information terminals (PiTs) are an initiative of the Department of Communications and the South African Post Office. PiTs are standalone units through which the public can access information from the government and business via the Internet (Snyman, 2008). These terminals are placed in post offices and Internet labs. Internet labs were later incorporated into what became known as Inter-net kiosks or citizen's post offices for previously disadvantaged areas (Snyman, 2008).

2.1.2.2 *Tsilitwa- Qumbu, Eastern Cape*

This is a Telehealth system in Tsilitwa, a rural village situated 50km north of Umtata. It is an initiative by the University of Cape Town to help nurses in clinics to communicate with the doctors who are in a hospital 20km away from the village. Through this system the clinic sister is thus able to interact with the doctor at the hospital through data, voice and video communication via a wireless system. This facilitates cost-effective healthcare for patients who would have had to travel long distances (Turker, *et al.*, 2007).

2.2 BENEFITS OF COMMUNITY IS

There are various socio-economic benefits associated with the introduction of Community IS in rural areas. McIver (2005) identifies the following potential benefits of a rural Community IS:

- *Poverty and hunger eradication:* through improved local access to information that impacts on local food production or other sectors of local economy such as tourism.
- *Education and literacy:* The supplementation or improvement of primary education might also be facilitated by Community based systems.
- *Reversing major diseases and improving health care*: The delivery of life-critical health information might also be facilitated and improved through Community based systems.

- *Gender equality*: opportunities will be afforded to women and girls to learn information technology (IT) skills in many parts of the world.

3 Information Systems Development Methodologies

Avison and Fitzgerald (2006) define Information System Development as a way of conceiving, analysing, designing and implementing information systems. A system development project is initiated when a need for a particular system is identified and this need is preceded by a desire to solve a problem, create a new product or extend features of an existing system. ISDMs are used by developers to structure the Information System Development process (de Vries, 2004) and there are hundreds of ISDMs in use today (Harris *et.al*, 2000).

The dictionary definition of a methodology is that it is a system of methods used in a particular area of study and a method is defined as a particular form of procedure for achieving something in a systematic way (Soanes, Sara, & Elliot, 2009). Another definition states that an ISDM is a combination of a system development approach, a system development method, a system development process model and a system development technique (Huisman & Iivari, 2006).

Further discussions on ISDM are presented below.

3.1 History of Information Systems Development Methodologies

System development is as old as the history of computing. There are vast differences in how systems were developed in the early stages of computing compared to how development is conducted today. The difficulties with software development could thus be attributed to the complex nature of software relative to hardware and an awareness of differences in system context (Jayaswal & Patton, 2006; Pressman, 2005). Over the years designers (or development teams) and users have changed the way they look at their information systems and realised the importance of collaboration towards bringing about a desired solution.

According to Avison and Fitzgerald (2006) ISDMs have undergone the following stages:

- *The Pre- methodology era:* This is the era from the beginning of computing to the early 1970s. Programming and solving technical problems was the emphasis with less understanding of business needs (Avison & Fitzgerald, 2006). .
- *Early- Methodology Era*: The early methodology era was characterised by a growing need to build computers through phases and stages (Avison & Fitzgerald, 2006).
- *Methodology Era*: The rigid nature of the System Development Lifecycle (SDLC) stages and some limitations including too much emphasis on documentation and technological focus leading to the continued proliferation of 'new' ISDM. Avison and Fitzgerald (2006) state that from the 1980s through the 1990s, practice and theory paved the way for the spread of methodologies in almost any software being developed.
- *Era of Methodology Reassessment*: The last stage is what they (Avison & Fitzgerald, 2006) regard as the review of methodologies by organisations from the 1990s. The review

was a response to failure in software projects attributed to the choice of a bad methodology or 'inappropriate' use of a particular methodology. Object orientation, agility and context engineering paved the way for growing research on social and technical considerations when choosing an ISDM (Bieber, McFall, Rice, & Gurstein, 2007).

These changes in methodologies are in response to the rapid evolution of information systems. User satisfaction, however, still is the measure of success of an information system (Schach, 2005).

3.2 SOCIO-TECHNICAL SYSTEMS APPROACH TO INFORMATION SYSTEMS DEVELOPMENT

The process of establishing a system involves more than constructing a solution to a defined problem. There are several activities and people involved in the process. A system is a collection of complementary and interacting components characterised by properties, capabilities, behaviour and a boundary which separates it from the environment (Mihailescu & Mihailescu, 2010). An Information system as a product of the system development process emanates from a desire to bring about a working solution to a complex set of organisational, human, or in this case, community problems. These problems call for an intensive process aimed at developing a suitable solution within organisational and environmental boundaries. The dilemma facing information systems developers is creating a system that responds to community needs, and is fit for use by the users (Schach, 2005).

The concern on social aspects responds to the recognition of the two pillars of an information system, the social pillar and the technical pillar. According to Patnayakuni and Ruppel (2008), the social pillar is made up of system developers, system users, the environment, the context and the social attributes of the system being developed. In agreement, Harrison and Zappen (2005) argue that the involvement of a significant number of a regular mass of community users is crucial to the design and development process. Users have a clear knowledge and understanding of community needs, environment, norms and boundaries. The technical pillar is made up of tools, techniques, devices, artefacts, methods, configurations, procedures and knowledge used by participants to acquire inputs, and transform them into a working system (Harris *et.al*, 2000). Acknowledgement and nurturing these pillars are important in improving performance during the system development process and as part of a holistic systems approach to system development to ensure user satisfaction.

Adopting a socio-technical systems approach in an ISDM would accentuate holistic consideration of the system development environment. Boahene (1999) and Avison and Fitzgerald (2006) agree on the significance of the environmental context of the intended information system. Harris *et.al* (2000) recommends the following list of aspects that make up an ISDM, which have to work together to produce the desired system:

- *Staff:* Skills, background knowledge, experience

- *Stakeholders*: Problems, interests, expectations
- *Power/ authority:* Organisational structure, influence
- *Procedure/ Process*: Sequence of steps, tasks, deliverables
- *Technology:* Computer language, hardware platforms, tools
- *Requirements*: Stated, implied, anticipated and non- stated needs

3.3 SYSTEM DEVELOPMENT PROCESS

Information system problems are diverse and require different approaches to a solution and thus it would be impossible to have one methodology used in solving Information System Development needs of various system or organisations. Distinction in approach is important and could lead to a shift of thinking amongst various software categories.

Various methodological perspectives have been identified by various authors (Harris, *et.al,* 2000; Avison & Fitzgerald, 2006). Differences in problem context, scope and system size are some of the reasons behind the use of a variety of ISDMs by organisations. Although different, most ISDM are based on the traditional waterfall model. A system development team using this methodology (as per picture below) applies a linear process from problem identification to the delivery of implementation of the system (Hitchins, 2007). During the Requirements stage users and developers engage in discussions in order to have a common understanding of the system requirements (Schach, 2005).These requirements are then translated to a design which is then used to implement a system, after which the system is verified to check if it meets the initial requirements. Maintenance happens at the end of the chain to fix any problems or upgrade the system, when necessary.

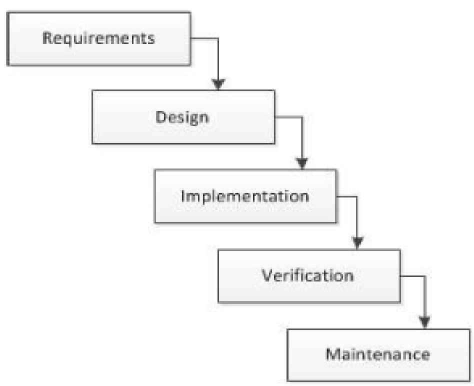

Figure 1 SDLC model (waterfall) (Schach, 2005)

4 A SYSTEM DEVELOPMENT METHODOLOGY FRAMEWORK FOR RURAL COMMUNITY IS

A general problem in Information System Development has been too much focus on technical issues when solving business problems. For a long time the need to engage stakeholders in developing a mutually-beneficial system has often been overlooked, as most traditional innovation support programmes take the form of infrastructure investment and the setting up of formal platforms – often under the premise of 'build it and they will come' (James, 2010). Failures of most Community IS initiatives can be linked to this mentality because the resultant system does not reflect on the needs of the communities but rather the aspirations of the designers.

The need for a development methodology for community systems arises from the differences in nature between organisations and communities. By their nature, rural communities are more complex than structured organisations. An organisation has well formulated policies, defined boundaries, usually with a single role of maximising shareholders' wealth. The social dynamics of rural communities cover a far wider spectrum compared to the limited structured social interaction found in organisations (Stillman & Henry, 2009). Unlike in an organisation setting, a rural community system is usually conceived from the identification of the need by the developers, not the users (community) as is usually the case in organisations (Donner, *et.al*, 2008). One of the attributes of a rural community is that there is limited knowledge about Information Systems and how it can be used to improve living standards. For a system to work, interplay between social and technical pillars of development is crucial. This means that the system developers have to spend more time trying to find the relevant stakeholders for the system and explaining the system to the community users (Harrison & Zappen, 2005).

Various elements of the framework are presented below, followed by a diagrammatic presentation.

4.1 RURAL COMMUNITY IS DEVELOPMENT: THE ENVIRONMENT

Based on discussions from this paper, the following table is an adaptation of socio-technical environmental issues facing development as introduced by Boahene (1999). These factors must be considered during the development of the rural community system.

Table 2: Environmental Factors Affecting Development, adapted from Boahene (1999)

ELEMENTS	CHARACTERISTICS
Staff	Staff members include the people working in the centres where the rural community IS will be housed, the development team and the administrators.
Stakeholders	The facilitators, the developers, the users and community leadership are stakeholders in a rural community. Sensitivity to experience, language and social characteristics of the community stakeholders should be respected.

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Power/ authority	Securing a buy-in from top management of funding institutions and community leaders like the chiefs is vital to the success of the development process. Developers must be familiar with procedures and protocol followed to access community leadership. Culture and norms of the rural community could also be a hindrance to the success of the development process.
Procedure/ Process	The recommended process is presented in the following section.
Technology	Includes computer language, hardware platforms, networks, tools, notes that will be used during development.
User's Needs	Emphasis on holistic user participation throughout the process to ensure better understanding of stated, implied, anticipated and non- stated needs.

4.2 COMMUNITY ISDM SELECTION

In selecting an ISDM, the attributes of a rural community and the above socio-technical issues of system development must be considered. Taking these into account, a rural Community IS development methodology in South Africa should:

- *Be simple:* As stated in Section 2 of this paper, on average, people from rural areas are illiterate and have a limited understanding of Information Systems. Meraka Institute, Universities and SAP are some of the main drivers of the Living Labs initiative. This means that initiators do not emanate from the community. The whole software lifecycle management and user interface must be simplified (Merz, De Louw, & Ulrich, 2007).
- *Be flexible:* The chosen methodology should be flexible in many respects. Rural communities are ruled by a traditional leader who may demand some changes to one or more aspects of the system development and that could affect the pre-defined processes. Obtaining commitment from community leaders is important; it was instrumental in the case of Connected Kids System in Troy, New York (Harrison & Zappen, 2005). Another issue that needs flexibility is the fact that one system could be used to address various problems from different users, i.e. health, agriculture and rural businesses.
- *Involve Users*. It is crucial that a wide range of stakeholders are involved during development (Bieber, *et.al*, 2007). The level of user knowledge of community dynamics, the proposed system and the system development process is as important.
- *Accommodate the social context*: The importance of taking into account the socio-economic conditions of the community could never be over-emphasised. Methodology must embed the needs of the community, as they may emerge before or after the technology is installed (Harris, *et.al*, 2000). The chosen system development methodology must aim to address the social, economic and technical needs of the community.

4.3 RURAL COMMUNITY ISDM PROCESS

A generic software development methodology process consists of sequential stages from *Requirements, Design, Implementation, Verification and Maintenance.* Requirements and Design are the most challenging stages when developing a community based Information Systems

(Donner, *et.al*, 2008; Bourgeois & Horan, 2007; Bieber, *et.al,* 2007). Challenges in these stages are due to the extent of ground work that has to be undertaken in building awareness and acceptance amongst the users, given problems of illiteracy and other social factors. It then becomes impossible to apply a linear process when developing a system for a rural community. Continuous user participation and process iteration are unavoidable.

4.3.1 Requirements

Language and technology are important factors during requirements stages in a community based Information System. An Iterative process should be followed from needs identification to requirements analysis (Bourgeois & Horan, 2007). It is always advisable to include amongst the developers someone who has an in-depth understanding of the community language and community culture and circumstances. During requirements there is a need for understanding of the current state of the community's components (people, structures or governance, groups and communication, other systems) (Bieber, *et.al*, 2007).

4.3.2 Design

Design includes a series of meetings between the user and the developer to identify various system features and needs and convert them into a design for a system. The purpose is to ensure that the system is developed according to the user's needs. Various tools are used during design (Schach, 2005) but must be simple and explained using the local language. A series of iterative designs using simple tools is necessary in order to be easily understood by the community users (Donner, *et.al*, 2008).

4.3.3 Implementation and Verification

The developers are the most active people during this stage but constant communication with the users is necessary to ensure that there is a mutual understanding of the system functionality. A prototype approach is necessary with constant tests and feedback from the users (Bourgeois & Horan, 2007). Continuous *Iteration* and *Testing* are vital as part of implementation to ensure that users fully understand the functionality of the system.

4.3.4 Operation and Maintenance

Community emancipation through Community IS can only be achieved when the developed system is working, as per the context and the needs of the community (Donner, *et.al*, 2008). Rural communities are characterised by a lack of technological infrastructure and thus it might be difficult for the community users to contact the developers in case of a need for system maintenance or upgrade. Communication lines should be well established and strong relations with the community leaders (Harrison & Zappen, 2005) would be instrumental in ensuring that system errors are reported.

4.4 FRAMEWORK PRESENTATION

As per the above discussions, this framework (as portrayed in Figure 2 below) starts with the identification of the problem or opportunity, which necessitates development of a Community IS. This is one aspect that differentiates a Community ISDM from a traditional System development methodology. When developing a system for a particular organisation, the background information about that particular organisation can easily be accessed from available documents, unlike in a rural community setting where a developer is expected to draw information from various community members. Social and technical issues are then analysed in order to gain a thorough understanding of the environment. This is followed by a system development lifecycle process, leading to a working and well maintained system.

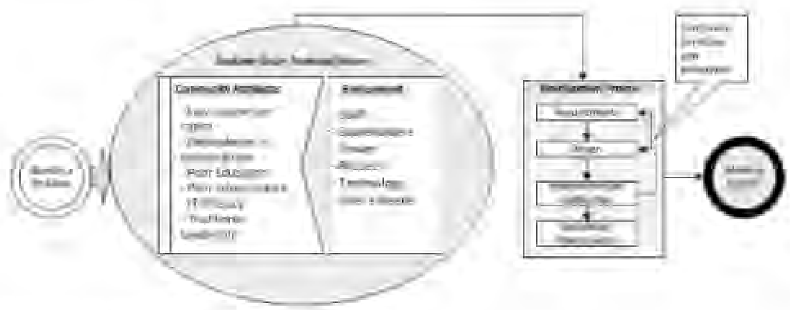

Figure 2. A rural community ISDM framework.

5 RESEARCH METHODOLOGY

Desktop research was used in writing this paper. Most references used are from journal papers and conference proceedings in the areas of Agriculture for rural development and . On the basis of the scoping exercise, a more in-depth search and analysis of published academic and scholarly articles, practitioner reports and documented case studies was undertaken. These sources helped to craft an informed analysis of a community ISDM aimed at improving success and sustainability of ICT based socio-economic development initiatives for rural communities.

6 CONCLUSION

This paper recommends a framework for system development methodologies for community based systems. The framework took into account the social and technical pillars of system development, characteristics of a rural community and some examples of community systems already available in some South African rural communities. User participation, process iteration and the understanding of a rural community environment are identified as important ingredients contributing towards a successful rural community system.

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APP4.3: Paper published in conference proceedings- IDIA Conference 2012 (Peer reviewed)

An Actor- Network Theory based approach for Designing Rural Community based Information Systems in South Africa

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ABSTRACT

Community Information Systems (CIS) have emerged as important tools to address the socio- economic needs of communities earmarked for development. CIS have an important role to play in improving conditions faced by people in rural communities.

System development is a complex process and studies have shown that if poorly conducted, the process could lead to failure of the system being developed. Due to differences in context and application, the design process followed during the development of rural community systems should be different from the process followed during development of commercial applications..

To improve success during the development of rural community systems, this paper proposes an Actor- Network Theory (ANT) based Information System Design process framework that could be adopted distinctively for rural community systems. ANT is used as a design approach to ensure participation of rural communication users, developers and other stakeholders of the system. This theory offers a process based approach to ensure sufficient user involvement during CIS design.

Keywords

Information and Communication Technology, Community Information Systems, Information Systems Design Socio-economic Development, Actor- Network Theory.

Introduction

People living in disadvantaged communities still live under low socio-economic conditions with poor per-capita income, education, infrastructure and access to telecommunication services. ICT4D (Information and Communication Technologies for Development) that are not carefully targeted according to the needs of a disadvantaged community would face challenges and might end up not being used. A number of ICT (Information and Communication Technologies) initiatives have been implemented, not only as a means of curbing the digital divide but also to address various challenges and needs in disadvantaged communities. ICT initiatives provide resources and tools that serve individuals and communities by delivering access and empowerment in areas such as local economic development, cultural affairs, civic activism and community based health and environmental initiatives (Harris, Songan, Khoo, & Bala, 2000; Donner, Gandhi, Javid, Madhi, Ratan, & Toyama, 2008).

ICT4D initiatives have evolved, with the initial focus being on reducing the digital divide by ensuring that people from rural communities have access to technology. The past few years have seen a change in focus in the recognition of the role of ICT in addressing the specific needs of communities through Community Information Systems (CIS) (Heeks, ICT4D 2.0: The Next phase of applying ICT for International Development, 2008). This focus has led to the growth of a fresh discipline commonly known as Community Informatics, aimed at designing and implementing ICT based projects for communities. Due to the complexity of communities and a scarcity of off-the-shelf applications, most community systems have to be developed individually as an experiment for successive systems (Harrison & Zappen, 2005).

The nature of users of rural based CIS necessitates that a development process different from normal organisational processes, has to be undertaken. Blake (2010) recommends broadening of the field of application development away from the traditional mathematical and engineering approach to consideration of social and human issues. In this way computer scientists or system developers, who are used to developing in familiar environments, are able to interact with potential users of the system within the development setting. This paper recommends an Actor- Network Theory (ANT) based design approach from Community Information Systems. Using ANT could lead to a better understanding of the dynamics and objectives of all parties linked to CIS.

Community Information Systems

1.1 The Nature of Community Information Systems

As mentioned above, ICT4D initiatives have been around since the late 1980s and have evolved over time. The realisation of a need to curb the digital divide led to a flood of initiatives aimed at bringing information technologies closer to the people and later, to the need to provide systems customised to people's needs.

The systems, CISs, become instrumental tools towards community development as they address an identified challenge from the community. Based on the e-government architecture by Heeks (2001), figure 1 below shows the basic model for a CIS.

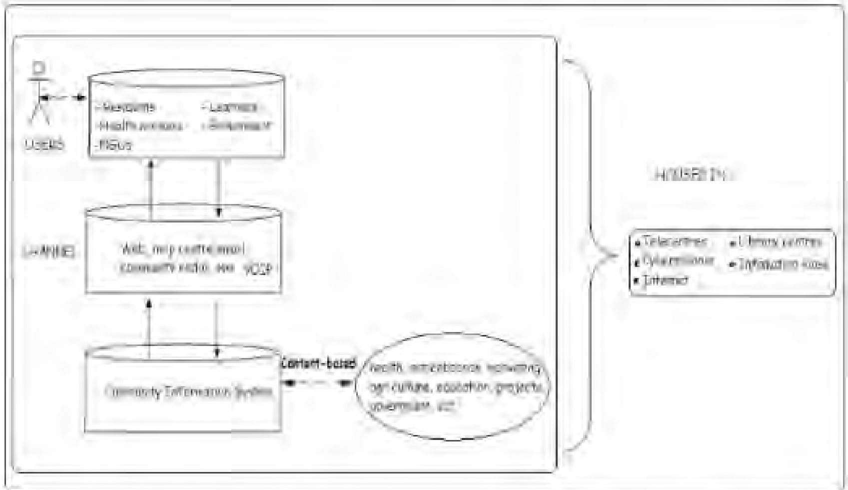

Figure 1: A Basic model of a CIS for development, adapted from (Heeks, 2002)

The initial model by Heeks (2002), is made up of four elements; the environment, information systems, technology and information. The environment includes markets, socio-cultural, political, economic and technical aspects, while the information systems element consists of the people and process aspects, with information and knowledge at the core. The above diagram also shows the system as being content based with information on various aspects of the community (as will be seen in the CISs examples later in this paper) and information is available through channels like the web and help centres. The model above shows users in the system are both recipients and contributors to the content of the system.

CISs evolved from various other attempts by governments and agencies to bring ICT services closer to the people. The following section discusses how community challenges could be solved by using systems aimed at communities.

1.2 Addressing community needs through CISs

Developing community based information systems have an important role to play in improving conditions faced by people in developing communities (Heeks, 2009; von Braun, 2010). CIS is the umbrella term that refers to ICT applications implemented to address the social, economic, political or cultural goals of a community (Stillman & Henry, 2009). Relevant ICT systems, if well implemented, could offer a platform from which these communities would benefit. Disadvantaged communities, like rural areas in South Africa, are still lagging behind in terms of participation in global activities. This could be attributed to certain challenges which could affect successful implementation of ICT4D initiatives.

In general, South African rural communities are characterised by issues like very low income per capita, poor education, poor infrastructure, traditional leadership and Information Systems illiteracy (Rao, 2004; Akinsola, Herselman, & Jacobs, 2005).

These lead to challenges with the introduction of an ICT4D initiative in rural communities. For example, if there is a certain system that has been identified as a solution to community problems, there would have to be a number of workshops and computer literacy skills training to ensure effective use of the system. This is not the case in affluent communities, as most people already have basic computer skills.

1.3 Benefits of CIS

There are various socio-economic benefits associated with the introduction of CIS in rural areas. McIver (2005) identifies the following potential benefits of a rural CIS:

- *Poverty and hunger eradication:* through improved local access to information that impacts on local food production or other sectors of local economy such as tourism.
- *Education and literacy:* The supplementation or improvement of primary education might also be facilitated by Community based systems.
- *Reversing major diseases and improving health care*: The delivery of life-critical health information might also be facilitated and improved through Community based systems.
- *Gender equality*: opportunities will be afforded to women and girls to learn information technology (IT) skills in many parts of the world.

Information Systems Design

Avison and Fitzgerald (2006) define Information System Development as a way of conceiving, analysing, designing and implementing information systems. A system development project is initiated when a need for a particular system is identified and this need is preceded by a desire to solve a problem, create a new product or extend features of an existing system. The main challenge in development of most ICT4D systems is that the need is often established by people outside the rural community or the village.

Methodologies are used by developers to structure Information System Development (de Vries, 2004). Although different, most system development phases are based on the traditional System Development Life Cycle (SDLC) model¸ that applies a linear process from problem identification (feasibility study in this case) to the delivery of maintenance of the system (Hitchins, 2007). A generic software development methodology process consists of sequential stages from *Requirements, Design, Implementation, Verification and Maintenance.* Requirements and Design are the most challenging stages when developing a community based Information System (Donner, *at al*, 2008; Bourgeois & Horan, 2007; Bieber, *et al,* 2007). A brief summary of these is presented in Table 1 below.

Table 1: Common SDLC Phases (Avison & Fitzgerald, 2006)

SDLC Phase	Description
Feasibility Study/ Requirements	One the problem has been identified, the feasibility studies are conducted to establish whether the system is needed or not; taking into account the legal, organisational, technical and economic justification of the need for the system (Bieber, *et al*, 2007).
Systems Design	Design is about the design of both the computer and manual parts of the system. Design includes a series of meetings between the user and the developer to identify various system features and needs and convert them into a design for a system. **As the focus of the study, design is further discussed below.**
Implementation	This is where the actual work towards the system is carried out. During implementation the computer program is written and tested, including purchasing and installation of new hardware and software.
Verification and Maintenance	This stage takes place once the system is operational. It deals with the changes, fixing of bugs and upgrades to the system

1.4 Understanding design

A general definition of Information Systems Design is that it is a process in which various techniques, tools and principles are applied to defining the system towards its development. During SDLC, the System Analysis and the System Design phases are like the backbone towards the accomplished work of the developed system while a more thorough and detailed look at the user requirements is undertaken. Analysis looks at what the system is all about and what it is required to do, whilst Design looks at how this can be accomplished. If these two phases are conducted properly, it becomes much easier for the system programmers to implement the system.

The desire to develop a working and acceptable finished system, the experience of the team, re-use possibilities and personal preferences are the drivers of the design process (O'Docherty, 2005). Design is an ever growing field in a number of industries so much so that there are various tools, techniques and processes that have been established towards solving design problems. There are also various areas of the system that are covered during the design process. Avison & Fitzgerald (2006) identify the following areas that design should cover:

i. Input data and how the data is to be captured (entered in the system)
ii. Outputs of the system
iii. Process, many carried out by the computer program involved in converting the inputs to outputs
iv. Structure of the computer and manual files that might be referenced in the system
v. Security and backup provisions to be made

vi. System testing and implementation plan

1.5 User Centred Design

According to IBM (2009) designing a user based system requires focusing on the product's potential users from the very beginning and checking each step of the way with these users to ensure they like and are comfortable with the final design. User participation is thus the core of a good user- based design. Constant communication with the users is necessary during design to ensure that there is a mutual understanding of the system functionality. Some of the tools used for user participation are Design Prototypes, Scenarios to ensure mutual understanding and feedback from the users (Bourgeois & Horan, 2007). Scenarios are stories and pictures that assist the users in having a mental picture of the current situation and the benefits of the potential solution and thus users can easily feel the impact of the system before its installation (Rosson & Carroll, 2002).

One desirable characteristic with prototyping is that the design goes into a cycle of modification and re- testing until it meets functional and usability criteria from the user's point of view (IBM, 2009). Iteration is necessary when designing community based systems to ensure that users reach a point where they understand the connection of various facets from their system design model.

Participatory design is not without its challenges as it becomes difficult to work with people who know nothing or very little about ICT. Reporting an experience from action research conducted when developing the Muti system, Blake (2010) observes that methods like participatory design become impractical until the participants acquire sufficient ICT literacy. This challenge is also compounded when in many cases developers or computer scientists do not speak the same language as the people in the community. According to Heeks (2009), low efficacy, be it caused by culture or any other reasons, has a negative impact on rural community users as they do not believe in their abilities, often blaming themselves for any problem with the system.
These challenges do not necessitate ignorance of users during design but rather call for an intensive user based approach to designing rural community system.

1.6 Challenges with development of community information systems

Due to the complexity of rural communities, developing community based information systems is difficult (Chambers, 1994; Bidwell, 2010; Kapuire, Bidwell, & Blake, 2010). This is because of differences in terms of things like culture, language and leadership structures compared to encountered in structured organisations. Requirements and Design are thus the most challenging stages when developing a community based Information Systems (Donner, *et al*, 2008; Bourgeois & Horan, 2007; Bieber, *et al,* 2007). Challenges in these stages are due to the extent of groundwork that has to be undertaken in building awareness and acceptance amongst the users, given the afore mentioned challenges and other social factors. The system development in ICT4D initiatives has a complex architecture, as there are different parties involved and sometimes with different objectives. For an example in case of the typical living labs in South Africa, the parties include Academics, Supporting organisations (private or NGO), students, communities (Cunningham, Herselman, & Cunningham, 2011; SAFIPA, 2011) and sometimes these parties all have different goals. For an example a student who is involved in designing the community system might have obtaining his or her degree as the main objective and that means someone else might have to continue with completing the development of that system, in the absence of the student. It then becomes impossible to apply a linear process when developing a system for a rural community. The need for continuous user participation and process iteration are unavoidable.

Progress towards a more articulate theory is still very much deficient in the area of CIS development (de Moor, 2007). This deficiency could be attributed to complexity and diversity of the CIS area. Development of specific systems is, however, more challenging as the system should be linked to community problems and be usable by the people faced with the problems. One of the challenges with the development processes for CIS is difficulty in ensuring availability of the same individual stakeholders and beneficiaries throughout the process (Vercon, 2009). Involving community stakeholders is important as it improves continuity thus ensuring that computers leave behind their definition not only as community technical tools but also tools used to emancipate disadvantaged communities.

Actor - Network Theory

According to Stanforth (2006), as a concept, ANT was developed by Michel Callon, Bruno Latour and John Law during the 1980s. ANT examines the motivations and actions of actors who form elements of the network. These networks are heterogonous entities like people, organisations, etc. with aligned interests aimed at achieving a common purpose. ANT as a framework can either be used in an analytical way describing things or in a normative way spelling out how things should be done. One distinguishing factor with ANT is that it follows a dynamic model based on a process of negotiation between actors, without any prior assumptions (Ayyad, 2009). In this case, it will be used to describe a participatory process that could be followed when designing a system for use in rural community.

Actors in ANT can be human or non- human, like technologies (Walsham, 1997). ANT is grounded on the *sociology of translation* to provide a picture of power relationships amongst actors who are simultaneously obliged to remain faithful to their alliances (Callon, 1986). ANT aims to understand how the networks are formed, the types of relations that are part of the network, how actors are enrolled and what is done to ensure that each actor fits in as an important part of the network in order to achieve stability. Doolin & Lowe (2002) argue that each actor is important, removal or addition of actor affects the functioning of the network. The question on user participation during design is linked to how actors are enrolled and what is done to ensure that each actor is an important part of the whole network. The moments of translation offer an interaction in which actors are able to construct common meaning to their different world. Four moments of translation are *problematisation, interessment, enrolment and mobilisation,* during which the identity of actors, the possibility of interaction and the margins of manoeuvre are negotiated and delimited (Callon, 1986).

i. <u>Problematisation:</u> actors are identified with the objective of solving the problem and the principal actor establishes themselves as an indispensable actor whose aim is to make sure that there is common understanding between all actors (Stanforth, 2006). An obligatory passage point (OPP) is identified as a solution to the problem at hand; it is a situation that must take place for the process to be regarded as satisfactory. Roode (2003) likens the OPP to a bridge from one side to another side, so unless the OPP is undertaken one cannot reach the other side.

ii. *Interessment:* the group of actors with a problem are isolated and synergies are built in order to impede other possible alliances. During Interessment actors are persuaded to identify with their roles.

iii. *Enrolment*: alliances are consolidated through bargaining and mutual concessions. At this stage the actors are persuaded to act their roles (Callon, 1986).

iv. *Mobilisation*: involves determining the legitimacy of the spokesperson and of different actors becoming spokespersons for the different groups they represent. It is important that appropriate tools are used. An amateur video had to be produced in order to ensure that people start paying attention to the message from researchers working on the Text-Free User Interface design (Donner, Gandhi, Javid, Madhi, Ratan, & Toyama, 2008). This means that initiators have to study the context and the current practises of the communities in order to get their attention.

The product of these moments of translation should be actor's awareness of the context of other actors and alignment of each towards the OPP. The chief actor has a responsibility not to only translate amongst other actors but also to identify aspects that should not be inscribed towards the network objectives (Esnault, Zeiliger, & Vermeulin, 2006).

ANT can be instrumental as an approach towards a user- centred design for rural community information systems. Amongst other reasons, there is acknowledgement of the crucial role that each actor plays as they bring their unique domain expertise (Esnault, Zeiliger, & Vermeulin, 2006). In the case of rural community based information systems, using ANT for system design could improve the extent to which several actors within that rural community intervention embrace ICT systems as their bridge to development. This also include the choosing appropriate tools to use when designing the system.

APP4.3: Paper published in conference proceedings- IDIA Conference 2012 (Peer reviewed)

A Design approach for Community based Community Information Systems

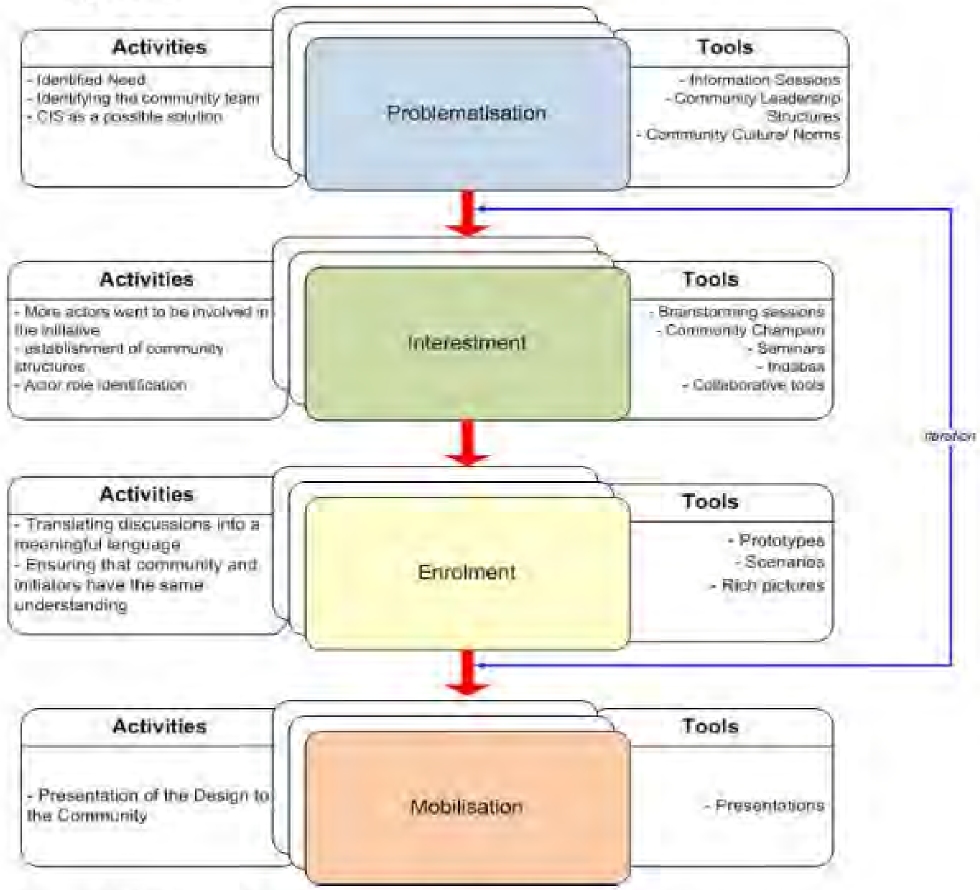

Figure 2. ANT based Design approach for rural community based systems

Differences in culture, traditional leadership structures, and education are some of the factors that complicate the design processes for rural community based systems. In selecting a design approach for Community systems, the attributes of a rural community and the socio-technical issues of system development were taken into account. The above has been developed taking into account the challenges facing people in rural communities, challenges with designing CIS and the opportunities available for communities. It should be noted that there are no time limits for any of the activities in the network; for example training could take a few days for some but more time for others. The chief actor has the prerogative to remove activities that are not part of the network (Esnault, Zeiliger, & Vermeulin, 2006).

At each stage of the network, the activities and tools identified are aimed at building closer relationships between various actors and thus strengthening the need to understand each actor's role in the network. Actors with diverse interests and power bases sometimes succeed in translating their interests into the development and use of ICT applications (Stanforth, 2006). Iteration is necessary at each level to ensure that all users have the same understanding and thus are able to actively participate.

Research Methodology

Desktop research was used in writing this paper. Most references used are from journal papers and conference proceedings in the areas of ICT4D. On the basis of the scoping exercise, a more in-depth search and analysis of published academic and scholarly articles, practitioner reports and documented case studies was undertaken. These sources helped to craft an informed analysis of a design approach aimed at improving success and usability of ICT based socio-economic development initiatives for rural communities.

Conclusion

This paper, an ANT based approach for the design of community based systems, suggests an approach that could be followed when designing a community based information system. The approach took into account all the pillars of social systems and the characteristics of a rural community. User participation, prototypes and the understanding of a rural community environment are identified as important ingredients contributing towards a successful rural community system. Process iteration has been recommended as the core ingredient during design of community based system to ensure that there is proper representation and participation of all the partners affected by development.

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APP4.3: Paper published in conference proceedings- IDIA Conference 2012 (Peer reviewed)

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APP4.4: Paper to be presented and published in conference proceedings- Ineer Conference December 2013 (Peer reviewed)

Factors influencing the use of system development methodologies when developing community information systems in living labs

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Abstract

The focus of Information and communication technology for development initiatives have changes from ensuring access to Information and communication technologies for disadvantaged communities to addressing specific needs of communities through Community information systems. These Community information systems have to be developed due to complexity of communities as compared to organisations and also lack of ready off-the-shelf systems addressing specific community needs. There is insufficient evidence on the use of system development methodologies (SDMs) when developing community based systems. This paper investigates factors influencing the use of SDMs during the development of community based systems in disadvantaged communities. Qualitative case studies have been conducted from three living labs around South Africa and the data was analysed using Atlas.ti.

Keywords: *Information and Communication Technology for Development, Community Information Systems, System Development Methodologies, Technology-Organisation-Environment framework, Contingency approach.*

1. Introduction

Information and Communication Technologies for Development (ICT4D) initiatives have evolved over time. Initially the main focus was closing the digital divide through ensuring access to basic Information and Communication Technologies (ICTs) and this era is termed 'ICT4D 1.0' by as it marked the massive rollout of telecentres to underdeveloped communities. This era experienced massive implementation setbacks as the focus turned to be on taking computers to people with little focus on how computers can be used towards improved living standards. The current era is termed 'ICT4D 2.1'presents a shift from a supply- driven focus to a more demand- driven, where the community recipients are actively involved . Using technology towards meeting the tailored needs of the poor communities is the focus of this new era. There has been remarkable recognition of the importance of developing systems that address specific needs of disadvantaged communities; Education, Health, Commerce, Government and Agriculture are amongst disadvantaged community needs that could be addressed by these systems.

A number of community information systems (CIS) have been developed to address the community challenges. CIS is the umbrella term that refers to ICT applications implemented to address the social, economic, political or cultural goals of a community . These CIS are designed and build for use by memembers of a community to support a host of different social, economic and cultural goals . Due to the complex nature of community and their environment, developing systems from scratch is necessary as it would be difficult to obtain an off-the-shelf community information systems. This means that systems have to be developed individually as an experiment for successive systems . The dilemma facing information systems developers is creating a system that responds to community needs, and is fit for use by the users . There is currently no evidence of use of System Development Methodologies when developing community information systems aimed at socio- economic development. This is not in line with practise in system development where it is believed that software methodology rules must be based on underlying domain . As developers of CISs living labs are confronted with the responsibility of ensuring that the chosen system development methodology takes into account the various dynamics of a particular community. The question addressed in this study is: what factors influence the decision to use a system development methodology when developing CIS in living labs.

This paper identifies factors that influence the use and effectiveness of system development methodologies when developing ICT4D community information systems. A case study from three South African Living labs was conducted. These factors are presented using the Technology-Organisation-Environment (TOE).

This paper first presents a background onto CIS and then dynamics of system development methodologies are outlined. Then, the factors are identified and a framework is presented.

2. Addressing Community Needs through CIS

The definition of a community is no longer limited to people belonging to the same geographical location ; with new definitions people could be worlds apart but still be part of one community. Beyond physical location, communities are also differentiated by common values and interests . Proliferation of internet technologies has also led to an even wider definition of a community where electronic media is used to communicate, commonly known as virtual community. Virtual communities are becoming even larger due to the popularity of Social Networks and the growing mobile phone industry, which makes it possible for people in the most disadvantaged communities to have interactions with the people from any class.
The adapted definition of 'a community' for this study is: "a *group of people facing similar socio-economic challenges, with ongoing interactions and common interests*".

ICT initiatives provide resources and tools that serve individuals and communities by delivering access and empowerment in areas such as local economic development, cultural affairs, civic activism and community based health and environmental initiatives . CISs play an important role in providing information needs of the community, and provide solutions to general (community notices, crime fighting, indigenous knowledge and risk management information) social (health, education, social services and access to government) and commercial (agriculture and entrepreneurial) needs of the community.

2.1 Using the Living Labs approach to Address Community Needs

South Africa has implemented a number of ICT4D initiatives with community specific systems. Living labs around the country offer potential in terms of systems developed with the needs of the community in mind. The living labs approach to ICT4D is aimed at facilitating innovation by early involvement of the users and experimentation in real world setting to bring upon community innovation . Unlike the telecentres which had few stakeholders, living labs benefits from the variety of stakeholders and partners who are committed to innovation. The multi-stakeholder technique is instrumental in ensuring that development initiatives are not only aimed at meeting the needs of one party, but are inclusive enough to take into account the needs of various parties involved. Involvement of multi-stakeholders also brings hope that disadvantaged communities will indeed be the core beneficiaries of these initiatives. This is possible because living labs draw on the notion of external ideas as a resource to support innovation processes that lead to usable community

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products and services .

Each living lab is managed differently and serves or addresses the needs of a different community. Some of the living labs have already developed a community system/s whereas some are still planning to introduce the systems. Systems that have been developed through living labs include enterprise based, logistics, agricultural and health based systems for communities. Some systems developed are aimed at ensuring the effectiveness and efficiency of processes and accountability amongst the involved stakeholders .

3. Developing CIS aimed at socio-economic development

Information System Development is a way of conceiving, analysing, designing and implementing information systems . A working system is the desirable product of any system development project. With ICT4D, the challenge is that the need for a particular CIS is usually initiated by someone who is outside the particular community in need.

The need for specific methodologies for developing community systems arises from the differences in nature between organisations and communities. By their nature, communities are more complex than structured organisations. Organisations have well formulated policies, defined boundaries, usually with a single role of maximising shareholders' wealth whereas for making profit is usually not the initial focus when developing CIS. The social dynamics of disadvantaged communities cover a far wider spectrum compared to the limited structured social interaction found in organisations . Poor information systems literacy, as identified above, means that the system developers would have to spend more time training users on using computers and also explain the system at length to the community users.

4. Theoretical background

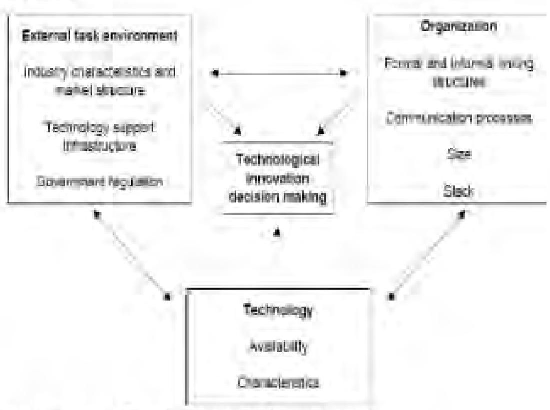

Figure 1: Technology-Organisation-Environment framework

Technology-Organisation-Environment framework comprises three elements; technology context, organisational context and external environment. According to Information Systems research the TOE framework has been widely used for adoption, assimilation and diffusion of technology and technological practices in organisations. This is due to the holistic approach that this framework presents in assessing the various elements affecting adoption. The TOE framework has solid theoretical basis and consistent emperical support in presenting both constraints and opportunities for technological innovation .

APP4.4: Paper to be presented and published in conference proceedings- Ineer Conference December 2013 (Peer reviewed)

5. Research Methodology

An interpretive paradigm has been chosen for this study. This was conducted through qualitative multiple case studies. The case study is a widely accepted research method in information systems. In a case study the research subjects are investigated in order to reach a particular conclusion about the enquiry. A case study is defined as an empirical enquiry investigating a contemporary phenomenon within a real life context when the boundaries between the phenomenon and the real life context are not clearly evident . The benefit of a case study is the ability to examine data within a context specified by the researcher. The main purpose is not to generate general laws, but to understand phenomena in their context .

In selecting the case studies, two conditions were to be met. The first condition was that to be part of the study, the initiative should be a Living lab. There are several ICT based community initiatives aimed at using ICT4D towards improving the living standards of people from disadvantaged communities. These initiatives vary from providing/ distributing technology to facilitating the use of technology or developing technology (Bergvall- Karebom, Holst, & Stahlbrost, 2009). This then meant that for this study, specification of the second condition was necessary which was that the living lab chosen should be or should have been involved in development of a system towards development. Development in this case does not only apply to developing from scratch, but includes changing some aspects of the system so that it meets the identified purpose.

Research conducted identified at least ten living labs operating in South Africa . Initial questions were sent to eight living labs to establish if they meet the criterion for the study and also to establish their interest in participating in the research. Based on the responses received, five living labs met the criteria for being part of the study but one refused to participate citing that the living lab only participates on research done with partners. During the visit for interviews, it was established that one of the four remaining living labs was still planning on developing the system and that left only three case studies.

Unstructured interviews were conducted in a sample that includes Managers or Coordinators of the living labs, System Developers and workers (when necessary).

For easy reference and to ensure confidentiality of identities of respondents, the following codes are used for case studies and respondents:

Table 1: Interview participants

Case Reference	Respondent Group	Respondent Reference
C1	Management team	C1M1
	Developer	C1D1
	Developer	C1D2
	Developer	C1D3
C2*	Management team	C2M1
	Developer/ Management team	C2DM1
	Developer/ Management team	C2DM2
	Developer	C2D1
C3	Management team	C3M1
	User	C3U1
	User	C3U2

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	Developer/ Management team	C3DM1
	Developer	C3D1

Data from the interviews was analysed through thematic analysis using Atlas.ti™ and cross case analysis is used to present a holistic picture from these multiple case studies. Atlas.ti™ enables researchers to efficiently store, organise, manage and reconfigure data to enable easy human analytical use. Instead of manually grouping chunks of text, researchers can make use of Atlas.ti™ to categorise data into codes or themes relevant to the study in question

6. Research Findings

From the interviews, there is a general consensus from the respondents that there is no formal decision on an SDM to be used for developing CISs. C3, however, have established their development methodology, although still not widely used nor documented. There is also awareness of the importance of using a methodological approach when developing a system. Importance of user input has also emerged as one aspect that needs to be considered during system development.

Another interesting finding from the study is the establishment of private companies that are linked to the living lab aimed at improving sustainability of living lab and also to ensure standards are adhered to during system development and to facilitate commercialisation of the systems developed. Research propositions below are used to summarise the findings from the study.

6.1 Research Propositions

The following propositions were compiled from interview responses:

a) Proposition 1

There is flexibility in choosing an SDM approach when developing CIS (C1, C2). The more mature the living lab is, the more formal its SDM approach is (C3).

b) Proposition 2

CIS developed in living labs are at different stages of deployment. C1 has not enjoyed stability in its development efforts due to the student focused development which results in poor continuity once a student finishes his or her studies. Most of the systems in C1 are not in use as there are some bugs that have not been solved. This situation is different from C2 who not only relies on student but also has full time developers on site thus student departure does not affect completion of the system. The CIS in C3 has gone through stages of development and is not in full use and this is due to a more stable environment offered by the full time developers from the private entity linked to the living lab.

c) Proposition 3

There are differing levels of user involvement during CIS development in the living labs (C1, C2, C3). User involvement is limited to the early stages of the CIS development process and during the system testing stages of the project (C1, C2). Some users of the C3 CIS are located in the living lab and thus easily become part of the CIS development process.

d) Proposition 4

Private entities are believed to be crucial towards better management of system development and commercialisation of CISs (C1, C2, C3). C2 and C3 have an already established private entity linked to the living lab and thus there are permanent employees. For C1 the private entity is still in the formation stages and thus students are still key part of system development.

e) Proposition 5

The nature of developers used depends on the circumstances of the living lab and the system at hand.

f) Proposition 6

Developers believe that SDMs are necessary to ensure that CIS development is a success (C1, C2, C

3).

g) Proposition 7

Various contingent factors play part in the choice of a particular SDM to use when developing CIS (C1, C2, C3). Developers from C1 and C2 believe that size and the technological complexity of the CIS at hand play a role in the decision on whether to use SDM or not. C2M2 states "I think to do the job does not want a full methodology. If we a complex process where a database, you have to have a methodology". C3 on the other side add that urgency also plays a part in the decision to use SDM as sometime systems are needed urgently and thus the SDM used must accommodate the time pressures.

h) Proposition 8

SDM selection should be flexible, taking into account the community environment (C1, C3). It is important that user circumstances are taken into account when selecting an SDM.

6.2 Factors influencing the use of System development methodologies when developing CISs by living labs

Consideration of the system development environment is important when making decisions about an SDM to be used . This became apparent during the interviews as there is constant reference to the living lab environment, the users, and the CIS being developed.

The propositions were instrumental towards identification of two components that have an impact on the use and effectiveness of SDM in living labs; the first one encompass factors relating to the living lab environment and the second component on factors relating to CIS development environement. Each of the factors is further expanded by variables which enable assessment of impact to one or more other factors. Interaction between the factors and their variables give a better understanding of what lead to use or non-use of SDMs and thus their effectiveness. The two components are:

a) Nature of the living lab as it applies to CIS development.

These are factors specific to the living lab which have an impact on the decisions about CIS development.

1. Location of the living lab. Physical presence of the living lab has an impact on the extent of use or effectiveness of SDMs. People sharing the similar office space are most likely to adopt a particular approach to developing systems.

2. Employment status of the developer. This is often associated with *staff* . This component is about the experience and the work arrangements of the project team. The tenure and responsibilities of the developers on development of the system has an impact on number of SDM areas, like the process, methodology use, user participation,etc.

3. Existence of the private entity linked to the living lab. Presence of a private entity supporting CIS development in the living lab has an impact on decisions surrounding SDM. For example, an established entity means that there is more structure and more learning from the system development processes.

4. The CIS. The impact of the size and complexity of the CIS was one of the statements that came more often from the respondents. Dependency on other systems, size and urgency of the system as contributers to the choice of a SDM .

b) CIS development factors.

These factors relate to the development environment of the CIS. The factors under this component are:

1. User participation: User participation has been identified as one of the key factors for the living labs.

2. SDM approach: Several factors on the living lab environment have an impact on decisions surrounding the use of an SDM approach when developing CISs

3. *CIS deployment status:* This is an account of whether the CIS was in use or not after it development

Mapped into the elements of TOE, these factors can be presented as follows:

Table 2: Mapping of identified factors into TOE elements

Technology	Organisation	Environment
- The CIS - CIS deployment	- Employment status of the developers - Existence of the private entity linked to the living lab - SDM approach	- Location of the living lab - User participation

Living lab environment factors have an influence on the way in which the CIS is developed and deployed in the living lab. The decision to use an SDM has an impact on the deployment status of the CIS and the success of the system can be used to measure effectiveness of SDM.
An example can be used of a living lab with a permanent office, full-time developers, well established private entity and a complex CIS. An SDM is most likely to be used when developing this CIS due to stability created by same people developing systems and thus learning through experience over time. Also the fact that there is a private entity means that there is an expectation for more structured processes. This also affects the deployment status of the CIS. A conclusion can be made that living labs under these circumstances are most likely to make use of SDM and a working CIS has positive effect on perception about SDM effectiveness. This can demonstrated into the framework in figure 2 below.

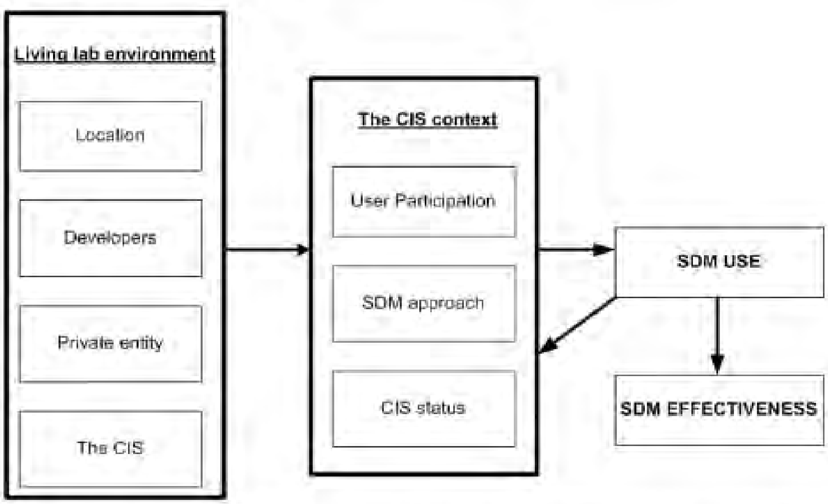

Figure 2: Framework for assessing the use and effectiveness of SDMs during development of CIS in living labs.

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7. Conclusion

Results from the study have shown that there are gaps in the use of an SDM when developing systems for socio- economic development. Factors associated with the living lab environment have an impact on how CISs are developed. Living labs which have full- time presence in the community seem to do better in terms of standards and controls when it comes to system development. A linkage to a private company has also been established as a positive factor towards use of SDMs. This is evident from C3 which has full-time staff at the living lab and a thriving system that is being implemented globally. User involvement has also been identified as important towards successful development of CISs.

Based on TOE, the proposed framework shows relationship between the nature of the living lab and the CIS development context and their impact on the use and consequently effectiveness of SDMs when developing CISs.

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APP4.4: Paper to be presented and published in conference proceedings- Ineer Conference December 2013 (Peer reviewed)

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APP5: Thematic Coding

This sections presents sample list of codes used during thematic coding and also a sample network diagram.

APP5.1: Sample list of all codes

HU: Final LLProject
File: [C:\Users\nwayi\Desktop\Final Project\HU\Final LLProject.hpr7]
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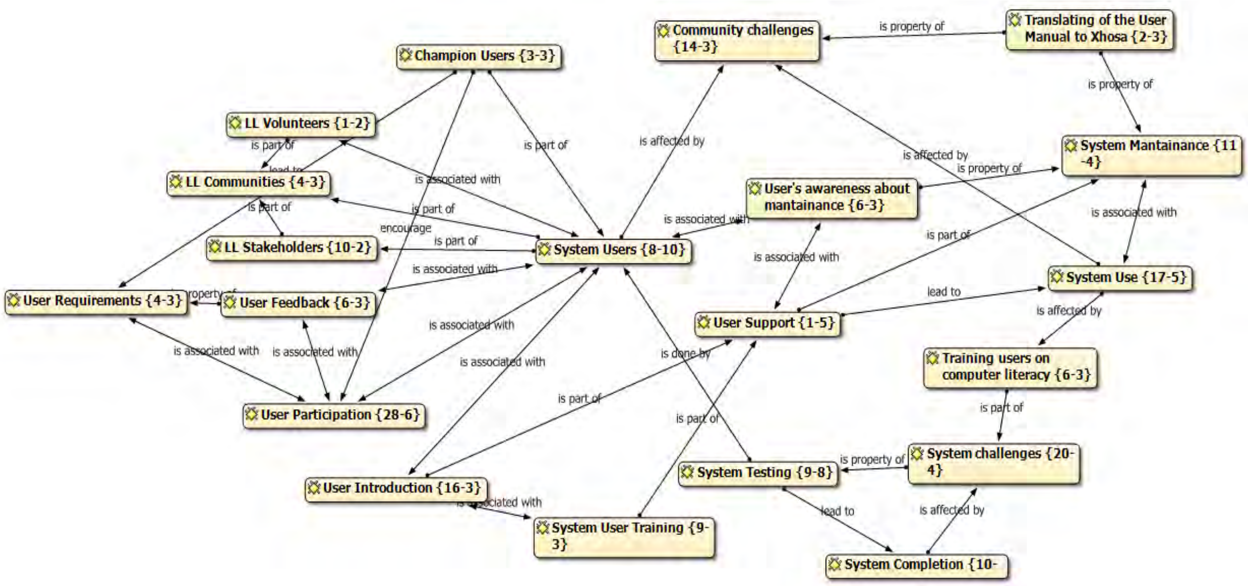
"Flying the plane whilst you'r..
Another project
Before you even starting worki..
Champion Users
Choice of a Platform
Community challenges
Conflicting statement on the company
Conflicting statements about the SDM used
Development Team organisations
During the development of the ..
Importance of Documentation
Importance of SDM
In the beginning it was the fo..
Individual role
Iterative development important for effectiveness
Learning from system challenges
LL Communities
LL Establishers
LL Establishment
LL Financial Support
LL Focus
LL Location
LL Stakeholder roles
LL Stakeholders
LL Volunteers
Main System
miGox.
Misunderstanding what development is
Pilot Process
Policy on Methodology Use
SDM Effectiveness
SDM Features
SDM process
SDM Selection factors

APP5: Thematic Coding

SDM Tools
SDM Use
Student Individual Systems
Students working independently
System Architecture
System challenges
System Commercialisation
System Completion
System Development Length
System Development Methodology
System Development Model
System Development Platform
System Development Team
System Mantainance
System Name
System Number
System Objective
System replication
System Success factors
System Testing
System Trial version
System Use
System User Training
System Users
Training users on computer literacy
Translating of the User Manual to Xhosa
User's awareness about maintenance
User Feedback
User Introduction
User Participation
User Requirements
User Support

APP5: Thematic Coding

APP5.2: sample network diagram: <u>User involvement</u>



APP5: Thematic Coding

APP5.3: All quotations, codes, themes and families

Respondernt	Quotation	Code	Theme	Family
C2M1	new students from the university of .... in Finland where they came in and they partnered with the new students in the university of Limpopo,	Temporal developers	**Development Team**	**Developers**
C1D2	to come and assist? ja people from Saab- Grintek, especially for networking they come and assist	Maintanance by industry partners	**Development Team**	**Developers**
C1D3	It's all partime and we got only one permanent person at the beginning of this year,so which ends now.	Temporal developers	**Development Team**	**Developers**
C1D3	Ammmmh the development team including developers and designers, system architecs, students. We talking about maybe 28.	Temporal developers	**Development Team**	**Developers**
C1D1	Yes Fort Hare		**Development Team**	**Developers**
C1M1	The final product we've had some consultants working on the project	Main sytem	**Development Team**	**Developers**
C1M1	Ok, its hard to actually tell where a person is attached to. For an example I'm attached to both. Reeds System is based at Rhodes not because we wanted Rhodes not because we wanted Rhodes but its more convinient to be at Rhodes, given the space and can give up the contracts on time.	Private company to manade System development	**Development Team**	**Developers**
C1M1	There are Advisors, proximately 10 including advisors and project leads.	Varied development team	**Development Team**	**Developers**
C2DM1	My role was more on Development and Technical assistance because I am actually the one who is configuring the systems	Multiple roles	**Individual Role**	**Developers**
C2M1	Co - Ordination	Co- ordinator	**Individual Role**	**Developers**
C2M1	You know from where I'm sitting because I don't have content myself, I had to make sure that the content owners and the developers meet on a regular basis and ironing out all the issues you know just to make sure they are on the same page and also to manage the implementation plan,	Doing multiple roles	**Individual Role**	**Developers**
C2M1	Ummh I'm responsible for information society development in the province.	Multiple roles	**Individual Role**	**Developers**
C3U2	I am the main admin	system admin	**Individual Role**	**Developers**
C3U2	I train the user	trainer	**Individual Role**	**Developers**
C1D2	i am more basically involved on developing the application that will help the community.	Student developer	**Individual Role**	**Developers**
C1D3	Developer	Student developer	**Individual Role**	**Developers**
C1D1	I was a developer	Student developer	**Individual Role**	**Developers**
C1M1	I cannot really tell how to develop therefore I cannot tell what I could do differently.	Clueless about development issues	**Individual Role**	**Developers**
C1M1	I usually Co-ordinate the trips, mostly the co-ordination. I never really took part in the interviews.	No involvement in development	**Individual Role**	**Developers**
C2M1	It was not developed by us, specifically but it was developed with a co - coordinating that developed by the unit students.	Co- ordinated development	**System Development Team**	**Developers**
C2M1	3 students from the University of Limpopo, and there were 1 graphical, 1 graphic..... and then 3 Developers again from the University of Finland(In Finland), so about 6 Developers	Varied development team	**System Development Team**	**Developers**
C3DM1	And its for coding it was four but for R & D I would say approximately nineteen people who would come and give feedback.......	Conflicting statement on the development team	**System Development Team**	**Developers**
C3DM1	The core development team were always by the team of 4.	Core development team	**System Development Team**	**Developers**
C1D2	there are many because there are two institutions that are involved, some researchers are from Rhodes and some are from Forte Hare of which I cannot say the exact number because researchers live when they are done and new ones come.	Temporal developers	**System Development Team**	**Developers**
C1D1	Five to six people were involved.	Conflicting statement on the development team	**System Development Team**	**Developers**
C1M1	There are Advisors, proximately 10 including advisors and project leads.	Project Advisers	**System Development Team**	**Developers**
C2DM2	We have to remember the environment that they were working in.	Awareness of user circumstances importan	**Community Challenges**	**Living Lab**

C2DM2	because the house was focus on deep rural environment because we are actually at odds with the data being collected by research for South Africa, although it is good as we agree in many things but in terms of ownership of cell phones we disagree. They have Limpopo at 82% ownership and ours findings are 63%. On the level of income, it doesn't make logical point that with the income levels they can actually support that number. On the other side we do have community access points where members of the community can go and have access to the computers.	Awareness of user circumstances importan	**Community Challenges**	**Living Lab**
C2DM2	there is electricity- they don't have sewerage and water.	Basic needs not met	**Community Challenges**	**Living Lab**
C2DM2	People are looking for water, I can't even get a glass of water. So they will ask where are we?. You understand where they are coming from.	Basic needs not met	**Community Challenges**	**Living Lab**
C2DM2		Coordinating ICT with other community p	**Community Challenges**	**Living Lab**
C2DM2	Well there's a bore holes running for 30m and that was the target they were installed. Now, we got this is a private funding and its protection safe the water it's going to be 60m. So now what I want to do is to sort those things together, and one of my biggest problems is we are not coordinating other elements. In other words we are using ICT as enabler.	Coordinating ICT with other community p	**Community Challenges**	**Living Lab**
C2DM2	It was done 2116 respondents, it was only who owns a computer. And only 27 who owns a computer.	No computer ownership	**Community Challenges**	**Living Lab**
C2DM2	do that instead of somebody going around to find R5000.00 for a computer	No computer ownership	**Community Challenges**	**Living Lab**
C2DM2	because they do not have money to purchase computers. Their disposable income is so low. Their needs are far more related to basic needs and to them ICT is not that important.	No computer ownership	**Community Challenges**	**Living Lab**
C2DM2	We got to have, what I would say the basic which is unbelievable because they gone to each school for a computer course and I do a before, a pre post and past post-test on what they know and what they learnt. And it's unbelievable to see that pre-test their level of knowledge is very poor yet they've been on training skills and the big is thing is they have nothing to practice on, they consolidate the information they have learnt they have no infrastructure to do it on.	Train users on computer usage	**Community Challenges**	**Living Lab**
C3U2	Often you find that documents are in PDF or in formats that are not easily read from the cell-phone.	Technology familiarity	**Community Challenges**	**Living Lab**
C2M1	In institutions we would say; the officer of the Premier has been instrumentally invited for and the department of economic development.	Multi partners	**LL Establishment**	**Living Lab**
C2DM1	This unit was established previously at the office of the premier	Provincial government	**LL Establishment**	**Living Lab**
C2M1	Aah ja you know we have a feasibility study, i think that's what Jacques was trying to show you, ja where we have a visibility study of, of the living Lab but umh I think where we are sitting it's more of a co - ordination rule of all the other bits and pieces of the living Labs in the province.	Feasibility studies	**LL Establishment**	**Living Lab**
C3DM1	as for partners we've got a community partner called Impact Direct.	Partners	**LL Establishment**	**Living Lab**
C3DM1	Officially as a name is was on 2009 but we started already in 2008, ja as Reconstructive Living lab. Beginning of 2008, thats when we started the journey as the project.		**LL Establishment**	**Living Lab**
C3DM1	The Company is the viable company. The company can pay the living lab through R & D. the living lab benefits as it is still used for R & D whilst the company deals with operations and commercialisation side of the business.	Research and Development	**LL Financial Support**	**Living Lab**
C1D2	Its Themba, researchers (Rhodes and Fort Hare) and also the guys from SAAB- Grintek and the industry partners. And Telkom also they have to be involved because they are the people who pop-out the money if there's something that needs to be bought	Partners	**LL Financial Support**	**Living Lab**
C1M1	They are the ones responsible for putting the money and all that.		**LL Financial Support**	**Living Lab**
C2D1	but in terms of system development ehh What are you talking about	Misunderstanding what development is	**LL Focus**	**Living Lab**
C2M1	Because if you think about the information society, we're thinking we, we, we're advocating for the use of the ICT tools.	Eliminate digital divide	**LL Focus**	**Living Lab**
C2M1	For information society development and we'll have to telecommunication and infrastructure, to look at umh the infrastructure that is needed in Limpopo.	ICT infrastructure	**LL Focus**	**Living Lab**
C2M1	I think currently we've been looking at ICTSMMEs	ICT SMMEs	**LL Focus**	**Living Lab**

C2M1	Building your information society	Information society	**LL Focus**	**Living Lab**
C2DM2	Yes and training in basic ICT and Life skills.	Computer skills	**LL Focus**	**Living Lab**
C2DM2	We are involved in focusing on job creation, SMME incubation	SMMEs	**LL Focus**	**Living Lab**
C3DM1	About bringing about resolutions for local problems.	Rural development	**LL Focus**	**Living Lab**
C3U1	Because some people sometimes just feel a little bit off-track or they are not seeing the point of living that type of thing; but its not really that serious but if you have someone you can talk to, it really helps a lot and from there then you can make decisions again on how to take the next step forward. We also encountered that we have a lot of young people that have got problems with study programme so we advice them how to workout some programme that suit their need.	Addressing society challenges	**LL Focus**	**Living Lab**
C3U1	We also encountered that we have a lot of young people that have got problems with study programme so we advice them how to workout some programme that suit their need.	Addressing society challenges	**LL Focus**	**Living Lab**
C3U1	So they are aware of our service so they are also aware that we will refer people to them so at the same time they can come in and give us special training on how to deal with these people online.	NGOs	**LL Focus**	**Living Lab**
C3D1	Mostly female, ages 18 to 28	Addressing society challenges	**LL Focus**	**Living Lab**
C3U2	To give hope and guidance most importantly because these people come online ranging from 15years even 13years and older and have serious problems, family problems and these people needs help. So i think this actually means a lot to me	Addressing society challenges	**LL Focus**	**Living Lab**
C1D2	And try to strategise, kungabikho the digital divide so that people in rural area can be able to access what the people in areas such as township can access, so that they can do things like e- commerce. the major thing is that it is the development of the rural community	Eliminate digital divide	**LL Focus**	**Living Lab**
C1D2	to develop the rural community	Rural development	**LL Focus**	**Living Lab**
C1M1	Ehm Developing applications relevant for rural communities to improve the socio-economic development.	Application development	**LL Focus**	**Living Lab**
C2M1	Do we have a physical structure of the living Lab? No, not really.	No physical office	**LL Location**	**Living Lab**
C1D2	it is located between Dwesa and Cwebe		**LL Location**	**Living Lab**
C2DM1	And the department of the economic development, environment and tourism are looking at the broader landscape of SMMEs	Provincial government	**LL Stakeholders**	**Living Lab**
C2M1	The communities of course first of all, umh I think the universities as well, if you think about in terms of research	Multiple partners	**LL Stakeholders**	**Living Lab**
C2M1	Department of Sport, Arts and Culture because they own the content.	Provincial government	**LL Stakeholders**	**Living Lab**
C2M1	I think currently we've been looking at ICTSMMEs		**LL Stakeholders**	**Living Lab**
C3DM1	There are also International partners, extended to the other parts of the world..	International Partners	**LL Stakeholders**	**Living Lab**
C3DM1	the main stakeholders are the community first, and then we other partners, key community partners like Hard Labs, Impact Direct, we work with a number of universities. We also work with the Department of Development		**LL Stakeholders**	**Living Lab**
C1D2	The academia, the Academics which is Fort Hare and Rhodes, and also the industry partners and the industry partners and the community because the community has to be involved in everything that is happening	Industry support	**LL Stakeholders**	**Living Lab**
C1D2	there are 15 communities. do they share the system? how many systems are there	Users	**LL Stakeholders**	**Living Lab**
C1D2	Thandi, who is researcher And Themba. There are also industry partners, which is telkom, Sub-Grintek from Pretoria?		**LL Stakeholders**	**Living Lab**
C1M1	Is the community, like in the Dwesa and the surrounding areas, ehm the TOC at the universities of Fort Hare and Rhodes and those immediately bring in the two varsity's industry- Telecommunications industry and the government through the DTI. And let me also add COFISA and SAFIPA.		**LL Stakeholders**	**Living Lab**
C3DM1	as for partners we've got a community partner called Impact Direct........	Community members	**LL Stakeholders**	**Living Lab**
C3DM1	And the because i was at CPUT at that time, CPUT eeeeh was the other partner.		**LL Stakeholders**	**Living Lab**
C1D2	Thandi, who is researcher And Themba. There are also industry partners, which is telkom, Sub-Grintek from Pretoria?	Multiple partners	**LL Stakeholders**	**Living Lab**
C1D2	e institutions, which is Rhodes and University of Fort Hare	Universities	**LL Stakeholders**	**Living Lab**
C2DM1	you know what, I have education background in which you learn about different models. And at my former employer you work on a customised model and when I came to this environment obviously, I sort of developed my own model.	Customised SDM	**SDM Selection factors**	**SDM**
C3DM1	I do think that in the living lab context you have to be inflexible, especially if you're working on community driven activities.	Flexible SDM to meet the environment	**SDM Selection factors**	**SDM**

C1D2	but its not specified. there's no, you don't have an instruction that says you have to use a particular methodology	Conflicting statements on SDM selection	**SDM Selection factors**	**SDM**
C1D2	but its not specified. there's no, you don't have an instruction that says you have to use a particular methodology	Individual decision	**SDM Selection factors**	**SDM**
C1D2	Usually they do that. The sit and decide on which	Negotiate the process	**SDM Selection factors**	**SDM**
C1D1	Yes in our development of our system first we look at the fact that it was the new initiative	System context	**SDM Selection factors**	**SDM**
C2M1	think about a year now	Study tenure	**Development Length**	**SDM**
C3DM1	It was built over the weekend.................	Quick development	**Development Length**	**SDM**
C3M1	its an-going thing. it started way back in 2008.	Continous requirement specification	**Development Length**	**SDM**
C1D2	two years. Most students have to do their projects in two years.	Study tenure	**Development Length**	**SDM**
C1D3	Its taking,its just started at beginning of 2009, I would say about two year	Study tenure	**Development Length**	**SDM**
C1D1	For the first one I took me just, eh actualy including the system - starting from scratch Ithink I would say one and half year, one and a half years.	Study tenure	**Development Length**	**SDM**
C1M1	The first version is supposed to be released soon, I will say one and half year.	Study tenure	**Development Length**	**SDM**
C1D1	Yes, the user manual that detail everything about the system.	User Manual	**Documentation**	**SDM**
C3DM1	agile approach	Agile	**SDM Approach**	**SDM**
C1D3	we could say it was agile	Agile	**SDM Approach**	**SDM**
C1D3	Eeeh in that short Yes, We just, we could say it was agile............................	Agile	**SDM Approach**	**SDM**
C1M1	Ehm, in this case of the iterative one make sure you do the circle many time. Don't just do it once or twice make sure you repeat many many times until you get it right	Iterate and show users	**SDM Approach**	**SDM**
C3DM1	ja i mean many challenges, and also to think about the tough time when developing........... resources, and developers who want to develop according to their own belief or understanding.	Student developer	**SDM Challenges**	**SDM**
C1D1	Ja but myself I wouldn't say the literacy as the.	Computer illeteracy	**SDM Challenges**	**SDM**
C1D1	althought the challenge now might be using that access to the internet.	No access to internet	**SDM Challenges**	**SDM**
C1D1	Eh, of cause Initially the was that problem of patience from the participates because I needed more time with them at least an hour for training and then after that use it. So it was challenging that I couldn't get enough time like to get the teachers because why? the teachers were busy with their own chore. So now getting that time I would occupy maybe 20 teachers in a school was difficult so I would get three or two, three or two. At the end of the day I got enough number to validate	Users unavailable	**SDM Challenges**	**SDM**
C1D1	Ok right, I will repeat again the fact that we had a challenge in having that interaction. I would use that platform.	Users unavailable	**SDM Challenges**	**SDM**
C1M1	Its an area where computers are unknown let alone the internet. So selling the things on the internet is actually even worse. We were developing the system whilst at the same time trying to teach the people how to use the computer. So its not like to you arrive in this place and everyone knows how to use a computer.	Computer illeteracy	**SDM Challenges**	**SDM**
C1M1	The person touches the computer for the first time,	Computer illeteracy	**SDM Challenges**	**SDM**
C1M1	They are trying to establish the company, not yet there.	Private company to manade System development	**SDM Challenges**	**SDM**
C1M1	It had its bug because that's what happens when you ask students to do stuff.	System bugs	**SDM Challenges**	**SDM**
C1M1	But you have to keep in mind that for the website to be on the top on Google, it needs to have lots of hits. So it didn't arrive that high but at the same time we publicized the presence of that thing. But until you have so many hits from so many people from all over the show and all over about selling arts and craft you cannot go that far in Google. I'm sure you've noticed it.	Website not getting hits	**SDM Challenges**	**SDM**
C2DM1	The lesson is that if you don't involve users involved in the early stages you are going to have some problems. You might have a functional system that is not being used.	Involve users early	**SDM Effectiveness**	**SDM**
C2DM1	The user are satisfied with the system and their role in development so I would say that I am happy. As I said it can still be made better.	User satisfation	**SDM Effectiveness**	**SDM**
C2DM1	I think if you don't follow a methodology its like you're taking a gamble.	With no SDM you gamble	**SDM Effectiveness**	**SDM**
C2DM1	Sometimes you may hit the jackpot and sometimes you're going to fail.	With no SDM you gamble	**SDM Effectiveness**	**SDM**

C2DM2	I think it really depends on the complexity of the task	No need for Methodology small system	**SDM Effectiveness**	**SDM**
C3DM1	I would say eerrrr we must not think about a methodology. Methodology is about the best way of developing what you want to achieve......	Best approach for the task	**SDM Effectiveness**	**SDM**
C3DM1	here must be some form of process, yes. I do think that in the living lab context you have to be inflexible, especially if you're working on community driven activities. The worse thing is if you'd try and match the community with your cycle, rather let you cycle match the environment.	Flexible SDM to meet the environment	**SDM Effectiveness**	**SDM**
C3DM1	I think from the initial stages to where we are right now I would definitely say yes. Of coz one of the things once you become to expand and you now looking at taking a global company out of the product, there are other things that you have to consider, like putting up customer support. When you're structuring a company out of the product, that becomes a tedious journey. For us we actually decided to start a company to manage the product so that the company is managed separately and the living lab has part ownership in the product.	Private company to manade System development	**SDM Effectiveness**	**SDM**
C3DM1	To us its effective. It has taken the product to a place where it is good enough to build a company over........	SDM improved product succes	**SDM Effectiveness**	**SDM**
C1D2	Ja it will help. Its helping, its helping. If you know the document that you need to do, you see the progress. You see the stuff that you need to do as well, but if you don't have a document that shows you that I have done this and this, you won't know the process that you have.	Documentation	**SDM Effectiveness**	**SDM**
C1D2	if we don't use some methodology, how are we going to complete a project. that means someone can do a project for five years of which its gonna be a waste of time, its time consuming. that's why there researcher will only work with the sytem for the period of two years and afterwards you have to be done with the project.	Time wasted if no SDM	**SDM Effectiveness**	**SDM**
C1D2	If we do not have a particular system development methodology that we have to follow, it will be time consuming as there will be wasting of time for us to develop an application. How would you know that how far are you, what is it that is needed to be done and the timing of your project.	Time wasted if no SDM	**SDM Effectiveness**	**SDM**
C1D1	Yes. The methodology helps to ensure that the users participate in the process of edeveloping the system	SDM important for user participation	**SDM Effectiveness**	**SDM**
C1D1	Based on the results on how the system has been used since it was first introduces, i would say this is the best approach.	System working means SDM approach is good	**SDM Effectiveness**	**SDM**
C1M1	It seems very effective on the context like this because you work on the problem that you have to test different version it before	Iterate and show users	**SDM Effectiveness**	**SDM**
C1M1	Probably it does, otherwise you will not know what you are doing.	No direction with no SDM	**SDM Effectiveness**	**SDM**
C1M1	Yes, documentation helps as well to show what steps have you used.	User Manual	**SDM Effectiveness**	**SDM**
C1M1	Probably it does, otherwise you will not know what you are doing.	With no SDM you gamble	**SDM Effectiveness**	**SDM**
C2DM1	The methodology doesn't even have to be formalised, like in a textbook but you have to understand that there are certain stages that you have to follow. You have to understand the requirement, come up with some form of a solution. You have to understand that this solution will not come out perfect on the first attempt. You have a way to fix those problems, and then implement.	No need for formalise SDM	**SDM Features**	**SDM**
C3DM1	we literally kind of build on- demand. That's why we call it the On-demand development. we call it the Milestone development life cycle. We look at what is the need and then work on that. That component of the system could be a matter of life and death	Milestone development cycle	**SDM Features**	**SDM**
C1D3	The thing was that after the initial release then we interviewed the users. Part of the training process was giving the feedback on how the system will be used and we tried to encourage the users to become part of the system.....................	User feedback	**SDM Features**	**SDM**

C2DM1	Basically its just we receive the request, immediately now that is where i deviate from your normal models. From your request you would normally go to the user requirement specification on your your feasibility study and that time of a thing. I deviate there. When I have a request here, I would say people have already know they want this sytem. I don't do the feasibility study, specially not on the open source system and so on. If is the bigger system we do it but then we do it for instance within the treasury when we need lots of funds. If it person comes me and says that I, for an example, need a GIS which is the next one which is on the table because I need to know where buildings exactly are because this company works with buildings and staff. Because it is just common sense, the GIS system will work for them. What I then do is ask if there is an open source system that can fill that gap. Now then if there is open source system that can possible fill the gap, I do the demonstration immediately. I don't look at his requirements.	Deviate from normal SDLC stages	**SDM Process**	**SDM**
C2DM1	Yes, you go back. You refine, you continue. I strongly believe that we have to show people what we do and make them part of the system.	Iterate and show users	**SDM Process**	**SDM**
C2DM1	the first thing I did was to analyse the entire system, all the tables and relationships from the database. I start too work on all the functions so that I can figure out what needs to change.	Match Open source system with the needs	**SDM Process**	**SDM**
C2DM1	I'l tell you why. I do that before the user- requirements specifications because in most cases people are not always aware of what technology can do for them. So when they see the demonstration, it opens their eyes to possibilities. After that demonstration, that when I do the user requirements.	Pilot system before user input	**SDM Process**	**SDM**
C2DM1	Sometimes there is no open system that i can find which matches what the user is looking for. In that case I skip that step and go straight to the user requirements. After the user requirements, if you still going to use the open source system. you start immediately with a pilot, start and test and configure until you have the final system which you implement. If you go to development with no open source system to configure, you go straight to develop.	Pilot system before user input	**SDM Process**	**SDM**
C2DM1	I'm born in South Africa, stat here and I will die here. I don't believe that things we learn in textbooks that work in America will necessarily work here. So I don't follow it strictly because I know how South Africa works. One of the reasons I do the demonstration first is to show the people what sytem can do for them, which would not be what Americans do as they assume that everyone knows what they want.	Pilot system before user input	**SDM Process**	**SDM**
C2DM1	Yes, i go to the basics. I get little information about the kind of the system that they are looking for.	Pilot system before user input	**SDM Process**	**SDM**
C2DM1	I'l tell you why. I do that before the user- requirements specifications because in most cases people are not always aware of what technology can do for them. So when they see the demonstration, it opens their eyes to possibilities. After that demonstration, that when I do the user requirements.	User do not know how helpful technology is	**SDM Process**	**SDM**
C3DM1	Yes, but whatever the process they follow it has to be an agile approach from the understanding that we are working with the real problems. Its basically “Flying the plane whilst you’re building it”. What we’ve decided is building as quick as possible; take it out there as fast as possible; get feedback as quick as possible- then reiterate. Same process over and over again.	Develop as quick as possible,	**SDM Process**	**SDM**
C3DM1	Well basically what happed is, after the feedback from the community and with the co- creators, they would say that they actually need this. What we would do would be list the priority and we start working with the highest priority first and then we eliminate some of them. Those become the priority list of what we’re working on. Then we draw milestones from the priority	Develop working milestone schedule	**SDM Process**	**SDM**
C3DM1	Yes, but whatever the process they follow it has to be an agile approach from the understanding that we are working with the real problems. Its basically “Flying the plane whilst you’re building it”. What we’ve decided is building as quick as possible; take it out there as fast as possible; get feedback as quick as possible- then reiterate. Same process over and over again.	Pilot system before user input	**SDM Process**	**SDM**
C3DM1	Yes, but whatever the process they follow it has to be an agile approach from the understanding that we are working with the real problems. Its basically “Flying the plane whilst you’re building it”. What we’ve decided is building as quick as possible; take it out there as fast as possible; get feedback as quick as possible- then reiterate. Same process over and over again.	User requirements specification	**SDM Process**	**SDM**
C1D2	ja we sit and discuss and follow the procedure. there is documentation like i would have to do this in this way and then next month. you need to follow the procedure and make sure you meet the deadline	Negotiate the process	**SDM Process**	**SDM**
C1D3	No because the system can be defined as very small kind, OK it needs to have community impact and its needed immediately and its a small system. i would say don't worry the methodology, its a one man job - go ahead and do it.	No need for Methodology small system	**SDM Process**	**SDM**
C1D1	the first thing that we were implementing. We needed that continous interaction with the users so that we know where we....	Conflicting statements on where the process starts	**SDM Process**	**SDM**

C1D1	Yes in our development of our system first we look at the fact that it was the new initiative and hadn't been implemented elsewhere so we actually choose methodology in which we will need a continuous system Requirement specification by that we need to know where to change in the system.	Continous requirement specification	**SDM Process**	**SDM**
C1D1	We developed a working prototype, we deployed it, tested it and then from there on we used the feedback from the users to develop some other aspects of the system.	Pilot system before user input	**SDM Process**	**SDM**
C1D1	we will need a continuous system Requirement qualification by that we need to know where to change in the system	User requirements specification	**SDM Process**	**SDM**
C1D1	The first thing we developed a system that was meant to be used for the first time by users simply a system. That would be able to connect us with the internet, and then gather information pertaining to the use of the system. Then from there we asked some questions from the people that used a system whether is satisfy their needs. But now from there we used that feedback to continue developing the system.	User requirements specification	**SDM Process**	**SDM**
C1M1	The fact that you're doing this for the first time, you realise you need to consult with the community members in order, until you get the system running.	Early community consultation important	**SDM Process**	**SDM**
C1M1	Initially you talk to the intended users about the intended system. Do a trial version from the ideas collected the first time. The trial version was done by the researchers. The programmers will develop the system from the concepts and then the try it on users and then they keep on repeating the cycle.	Pilot system before user input	**SDM Process**	**SDM**
C1M1	Initially you talk to the intended users about the intended system. Do a trial version from the ideas collected the first time. The trial version was done by the researchers. The programmers will develop the system from the concepts and then the try it on users and then they keep on repeating the cycle.	User requirements specification	**SDM Process**	**SDM**
C3DM1	We've made a choice of agile type of the development ….. If you're working in co- creation with community, if someone has a need for something to be implemented now to help someone's life. You can't wait and say that we have to go through and wait for the whole traditional process of SDLC. Because we are working with real people problems, we can't wait. We can't say we have to first do analysis and all that, we can't do that	Flexible SDM to meet the environment	**SDM Selection factors**	**SDM**
C3DM1	here must be some form of process, yes. I do think that in the living lab context you have to be inflexible, especially if you're working on community driven activities. The worse thing is if you'd try and match the community with your cycle, rather let you cycle match the environment.	Flexible SDM to meet the environment	**SDM Selection factors**	**SDM**
C3DM1	once you try to match people into your cycle then you're trying to force people into a different way....	Flexible SDM to meet the environment	**SDM Selection factors**	**SDM**
C1D2	e software which is PhP, and also mySQL which is on the database	No standard development language	**SDM Tools**	**SDM**
C1D1	Ok, The first thing actually is that the system was based on Open source software, then eh we use a CaKe (???) PHP as the main language for development. We used PhP for the development of our framework, Radus server for the development of our databases. We used Chilly Spot for creating our hot spot manager.	No standard development language	**SDM Tools**	**SDM**
C1M1	Never checked the details of what the researchers use.	No knowledge of SDM tools	**SDM Tools**	**SDM**
C2DM1	Ya, it is sort of combination of prototyping and a bit of waterfall.	Mixture of SDM approaches	**SDM Use**	**SDM**
C2DM1	The methodology doesn't even have to be formalised, like in a textbook but you have to understand that there are certain stages that you have to follow. You have to understand the requirement, come up with some form of a solution. You have to understand that this solution will not come out perfect on the first attempt. You have a way to fix those problems, and then implement.	No formal approach	**SDM Use**	**SDM**
C3DM1	I do think that in the living lab context you have to be inflexible, especially if you're working on community driven activities.	Flexible SDM to meet the environment	**SDM Use**	**SDM**
C3DM1	In fact we have it down on paper and we call is a Milestone development life cycle	In-house SDM	**SDM Use**	**SDM**
C3DM1	Yes, product development. More like a strategic direction around the product.	Product based	**SDM Use**	**SDM**
C1D2	eh a system development methodology- you can choose eh the normal SDLC, waterfall methodology or you can use XP, the the Scrum and all those kinds of methodologies	No formal approach	**SDM Use**	**SDM**
C1D2	Actually I could say this is the waterfall model because you have to develop first and then do testing and evaluate.	No formal approach	**SDM Use**	**SDM**
C1D3	We actually, the thing is that Ummmmh...... developing methodology, ...ummhhhh.............our developing methodology was in fact, basically we did not have one	No Methodology	**SDM Use**	**SDM**
C1D3	Emmmm No because the system can be defined as very small kind, OK it needs to have community impact and its needed immediately and its a small system. i would say don't worry the methodology, its a one man job - go ahead and do it. And give that impact on the ground and back to the critical	No need for Methodology small system	**SDM Use**	**SDM**
C1D1	We used Prototyping.	Pilot system before user input	**SDM Use**	**SDM**
C1M1	They seem to try to get people to use evolutionary prototyping for the trial version	Pilot system before user input	**SDM Use**	**SDM**

C2DM1	In Limpopo we are not the richest province. Open source normally comes with lowest cost of ownership and it is more customisable. If I tell you if you go and implement this kind of a solution on a proprietary system, i would come into millions whereas now the only cost is the hours we have worked on, a really cost saver. The second thing is that when I got open source I don't have to worry about license requirements. As long as I understand the open source license because there are several open source license requirements. Because first of all I look at what open source license is this system under and then I do the demonstration	Open source	**Sys Development Platform**	**SDM**
C2DM1	the open source system that we use is WeB 2 Project.	Open source	**Sys Development Platform**	**SDM**
C1D1	It is right that we use open source software because it is cheap and anyone can use it.	Affordability	**Sys Development Platform**	**SDM**
C1D1	The first thing actually is that the system was based on Open source software, then eh we use a CaKe (???) PHP as the main language for development	Open source	**Sys Development Platform**	**SDM**
C1M1	They're all developed on open source	Open source	**Sys Development Platform**	**SDM**
C1D2	for now the challenge was the bank, whereby there was a problem with standard bank. you know when you're buying something online you have to put your bank details but now they're in a process of solving that problem	Technology incompatibility	**System Challenges**	**SDM**
C1D2	researchers live when they are done and new ones come.	Study tenure	**System Challenges**	**SDM**
C3DM1	whilst the company deals with operations and commercialisation side of the business.	Private company to manade System development	**System commercialisation**	**SDM**
C3DM1	We understood that it is difficult to try and do it at the same space. It becomes a bit messy; at one side you want to experiment, and on the other side its R & D and on business side you have to come up with solutions. That's why we had to separate the two and have a commercial entity to take care of that. That's the process we currently follow with all the systems that we build	Separate rural development from system development	**System commercialisation**	**SDM**
C1M1	it should be replicated for other rural systems like Dwesa.	System replication	**System commercialisation**	**SDM**
C2D1	I've been working on open source	Open source	**System development platfor**	**SDM**
C2DM2	but the development phase took about 4months.	development duration	**System development platform**	**SDM**
C2DM2	We focus on open source.	Open source	**System development platform**	**SDM**
C3U1	MxIt gave us a platform to work from,	Mxit platform	**System development platform**	**SDM**
C3D1	it is used with MxIt.	Mxit platform	**System development platform**	**SDM**
C2DM2	student that was doing grade 12	Student developer	**System Development Team**	**SDM**
C3D1	I was the only developer and used to writers to provide the concise version.	Full time developers	**System Development Team**	**SDM**
C2DM1	I'l tell you why. I do that before the user- requirements specifications because in most cases people are not always aware of what technology can do for them. So when they see the demonstration, it opens their eyes to possibilities. After that demonstration, that when I do the user requirements.	No user requirements	**User Participation**	**SDM**
C2DM1	Sometimes there is no open system that i can find which matches what the user is looking for. In that case I skip that step and go straight to the user requirements.	No user requirements	**User Participation**	**SDM**
C3DM1	JamiiX.	Final product	**Main System**	**System**
C1D2	but they share the application but now what we are focusing on is to extend the applications so that even people from other communities can be able to use the same system cause now the system only focused on three schools but now we expanded	Linking more communities	**Main System**	**System**
C1D2	But mostly in most applications and networking stuff for accessing the Internet and now they're putting a mobile wii max system.	System improvement	**Main System**	**System**
C1D2	we're now developing this middleware so that system can interact.	System improvement	**Main System**	**System**

C1D1	You see, this approach actually. you see our system needed ehm interaction with the other systems in this project. It was a challenge in that we didn't have a platform for which there would be that interaction or interconnectivity between the applications. But then now as I speak the project is embarked on different approach when developing applications. We have introduced a system on which we need to have a middleware platform which will enable us to connect third party applications so that we have that easy interaction and interconnectivity between applications. Right, based on that application platform. If my system is introduced on that, then it will be very easy to get information.	System improvement	**Main System**	**System**
C1M1	But the final project is the one called Teleweaver that integrates several little applications onto one	Final product	**Main System**	**System**
C1M1	Teleweaver.	Final product	**Main System**	**System**
C1D3	They were involved, they were just not involved on meta,the are being involved in general literacy and computer literacy but they don't understand how to shape the system.	Computer illeteracy	**SDM Challenges**	**System**
C2M1	and simply because umh you do the students and you know the students are not at university for a long period, so it's rotating, they come and go because we started with the new students from the university of	Study tenure	**Student individual systems**	**System**
C1D2	w its like you're building something, this one comes in here, this one builds this part and the other one builds this part	Several students developing parts of the system	**Student individual systems**	**System**
C1D2	I'm not sure how many systems, there are application that are already developed.	Several systems	**Student individual systems**	**System**
C1D2	k, ok. There are lots of systems that have been developed; the e-commerce system, the Help- Desk system is also being developed.	Several systems	**Student individual systems**	**System**
C1D1	I'm looking at technological sustainability of ICT for development projects	Several students developing parts of the system	**Student individual systems**	**System**
C1D1	Look at this. I started with my application which was addressing in financial aspect with Siyakhula living project.	Several systems	**Student individual systems**	**System**
C1D1	I can say my system depended on other system so I was not alone in developing it because I was depending on other people's information. Five to six people were involved.	Several systems	**Student individual systems**	**System**
C1M1	But the final project is the one called Teleweaver that integrates several little applications onto one platform.	Final product	**Student individual systems**	**System**
C1M1	The first guy that made it in 2007, he collected the concept and put it up a website.	Several students developing parts of the system	**Student individual systems**	**System**
C1M1	Ok the students have done the individual thing;	Several systems	**Student individual systems**	**System**
C3DM1	"Flying the plane whilst you're building it"	Minimum viable product	**SDM Process**	**System**
C3DM1	I would say it's not a prototype but we say it's a Minimum viable product.	Minimum viable product	**SDM Process**	**System**
C2DM2	but it's very difficult to do that there are so many obstacles and bureaucracy with the whole thing. Although the idea is fair but to actually enact it is a challenge. That's what will battle with all the time, with everything we do there is just so much bureaucracy. It actually kill the project, we actually bypassed.	Compensation for the tool	**System Challenges**	**System**
C2DM2	But unfortunately they don't have internet because we don't have funding	No internet	**Community Challenges**	**System**
C2DM2	problem at that time was with open source you that some of the later versions of MS document, like word and Excel are not totally accessible	Technology incompatibility	**System Challenges**	**System**
C3M1	We then used it with G-Talk but we grew so much that we couldn't handle it and it crashed.	Technology incompatibility	**System Challenges**	**System**
C3U1	with the system, as the Jamiix can sometimes we depend, it really depends on how the internet connection is, cause if the internet connection is not good then its difficult for us to get conversations. It it also depends on how many people are on the system cause as counters we must make sure that we there are enough people so if a rush comes in, then the system distributes enough people to everyone but if we are not enough people on our side then it means that there is Buckle extent and the conversation can't go through properly	Internet connectivity	**Community Challenges**	**System**
C3D1	so much dependency on the functions from another application. If one of the functions go down, it affects the users. Another challenge is that the information is only available in English and thus other people might not be able to fully understand the information.	Several systems	**System Challenges**	**System**
C2D1	I am still trying to find a way of distributing it in any way.	Exploring distribution mechanisms	**System commercialisation**	**System**
C2DM1	Yes it's been released. No the, the project management one is being used by the organization	Private company to manade System development	**System commercialisation**	**System**
C3DM1	It has taken the product to a place where it is good enough to build a company over........	System replication	**System commercialisation**	**System**
C3M1	.That's when we decided that we needed to do something of out own. We got someone to develop something for us. Then Jamiix grew into a campus.	Full time developers	**System commercialisation**	**System**

C3M1	That is outsourced by Movigo technology. This is a full company that is owned by the founders	Private company to manade System develo	**System commercialisation**	**System**
C1D1	In fact you can say for ICT development projects because it applies to other similar initiatives like SLL although I was developing it in the context of Siyakhula	Going beyond the LL	**System commercialisation**	**System**
C1M1	Both Rhodes and Fort Hare because half the people carry business cards from both places. You can't undersell one place. They are trying to establish the company, not yet there.	Conflicting statement on the company	**System commercialisation**	**System**
C1M1	well, teleweaver is supposed to have a version in the Dwesa community but at the same time it should be replicated for other rural systems like Dwesa. We're going beyond what a researcher can do. Even the municipality they want to use the system	System replication	**System commercialisation**	**System**
C2D1	Yes my boss has been using it for a year now	System usable	**System Status**	**System**
C2DM1	The E-heritage is there but is locked up to ……….. because we want to do some customization.	Incomplete system	**System Status**	**System**
C2M1	It is not yet available, but it is going, it is a work based, it's still under development but it is a work based system	Incomplete system	**System Status**	**System**
C2M1	mh we still have to roll that out, we can say it's complete, but we haven't rolled it out yet.	Incomplete system	**System Status**	**System**
C2DM2	I'm still currently testing it,	Syst being tested	**System Status**	**System**
C1M1	It hasn't been. They've done like trial versions but the final one hasn't been released.	Incomplete system	**System Status**	**System**
C1M1	Well it's not up there yet.	Incomplete system	**System Status**	**System**
C1M1	The first version is supposed to be released soon,	Trial version	**System Status**	**System**
C2DM2	That was form of quality assurance and further amendments were done to the program. But it does work.	User feedback	**System Maintenance**	**System**
C2DM2	Yes, they come to us. Sometimes the inavertedly delete it and we have to re-install it. I think I might say this is a semi-formal question?	User feedback	**System Maintenance**	**System**
C3U1	hm we as the organization are responsible, and then myself I am the admin person that switches the system on and off but we work hand in hand with the developers that developed the system.	User feedback	**System Maintenance**	**System**
C3U1	But should there be any technicalities then we then just get them to assist us	Various media to report system problems	**System Maintenance**	**System**
C1D2	We get it when we come here. we get it from the people of the community. one of us researchers come often. i can't specify exactly when we come	Frequent visits to site	**System Maintenance**	**System**
C1D2	ja for now the y do, they just report to us or to Themba that the system is not working what should we do. and then the researchers will come and solve the problem. Just like when the Internet is down, and now we also train them to know what is that they can do for it to work again.	Reporting system problems	**System Maintenance**	**System**
C1D2	If there is a problem there should be one person who can deal with that problem.	System accountability	**System Maintenance**	**System**
C1D1	At the moment I'm currently assisting but the schools themselves, the schools where there are access nodes they are able to access the.., I mean to use the system. But now they only call us in times when they have problems, like in the event when they have a breakdown on network. Then they just call, of cause we also communicate through email.	Various media to report system problems	**System Maintenance**	**System**
C1M1	Yes, maintenance will also be done by Reedhouse system	Private company to manade System	**System Maintenance**	**System**
C1M1	in fact even some varsity students struggle with maintenance.	Students struggle to maintain	**System Maintenance**	**System**
C3DM1	We have about four. Jamiix; We built the project for education project called MY HELP, and Navigo, I think about nine	Several systems	**System Name**	**System**
C1D2	I'm not sure how many systems, there are application that are already developed.	Several systems	**System Name**	**System**
C1D1	just called a Revenue Management System of Siyakhula living project	Several systems	**System Name**	**System**
C1M1	Teleweaver.	Final product	**System Name**	**System**
C1M1	I don't even know how many they are several	Several systems	**System Name**	**System**
C2DM1	So we want to digitize it and then make it available to them	Digitise community content	**System Objective**	**System**
C2M1	Umh to make the, the museum information available to the public, because of more on museum artefacts, that's where we're digitising the museum artefacts and the heritage, the ultimate goal is to have the heritage of the province being digitized, but that will be for the public. Ja that will be for public consumption.	Digitise community content	**System Objective**	**System**
C2DM2	We've been focusing on e-learning, creation of a DVD or CD	E- learning	**System Objective**	**System**
C2DM2	And then modifying it for the use in rural environment and current education of system employed within grade 8 to 12 what we did was to capture past examination papers so that they could actually be on the CD so that they train or revise	Electronic student learning support	**System Objective**	**System**
C2DM2	It is to help students to pass the grade 12 exams.	Electronic student learning support	**System Objective**	**System**
C2DM2	And in accompany with that we downloaded the Wikipedia to help the young students to access information for their school project. The Wikipedia has interactive information for their school project.	Electronic student learning support	**System Objective**	**System**

C2DM2	And instead of buying a laptop what they advise is to buy a 30Gig, 20Gig is for open source software and 10Gig for the run files which will be open source files.	Electronic student learning support	**System Objective**	**System**
C2DM2	so that instead of somebody going around to find R5000.00 for a computer, they will be able to use this USB will boot up,	Electronic student learning support	**System Objective**	**System**
C2DM2	We developed on a 30Gig memory stick a complete open source operating software with all the associated files,	Open source	**System Objective**	**System**
C2DM2	it doesn't matter which software you are using like Microsoft, all the got to do is to redirect, there's a booting sequence in the USB and then it will display all the software with all files.	Platform independent tool	**System Objective**	**System**
C3DM1	Basically they are used to provide service to the community or to.........because there are nine systems we building......	Effectiveness of technology for community development	**System Objective**	**System**
C3DM1	JamiiX is basically the primary, the thing about JamiiX allows you to manage conversations as enterprise level.	Manage text based conversations	**System Objective**	**System**
C3DM1	Basically what is does is to think of a call centre but instead of people calling in, people use chat. The call centres have systems that manages voice calls but,JamiiX is a system that manages chat. People chat to a Jamiix, lets say you are at Fort Hare and chatting to student counselling and the student counselling staff would be using Jamiix.....	Manage text based conversations	**System Objective**	**System**
C3M1	Yes, but Jamiix is not only for counselling but can be used as an online contact centre.	System multiuse	**System Objective**	**System**
C3U1	yes to give a vital support to drug addicts and also people facing vital ills.	Social	**System Objective**	**System**
C3U1	to talk; to share where they are at and then from there we can establish that we need this person to go to a one-on-one or this person only needs to be given by us	Addressing society challenges	**System Objective**	**System**
C3U1	Otherwise you don't have a way of following up so what we basically do is, we are like the very grass cal level; where we get the people to feel comfortable	User feedback	**System Objective**	**System**
C3D1	We used writers to convert that information into short versions that easily be accessible.	Technology familiarity	**System Objective**	**System**
C3U2	Jamiix is a very powerful chat site where we cousel daily users from drug addict, rape, educational problems, relationships, pregnancies so basically everything we counsel. and we basically have six counsellors chatting with people online.	Addressing society challenges	**System Objective**	**System**
C1D2	but they share the application but now what we are focusing on is to extend the applications so that even people from other communities can be able to use the same system cause now the system only focused on three schools but now we expanded more so that people in other communities will be able to use it.	Effectiveness of technology for community development	**System Objective**	**System**
C1D2	I think the major part is to enable the rural community to use the technology and see the effective part of the technology. Because now, when we're talking about technology, these people didn't see a need for technology because it doesn't help them but now because we're taking the technology to the people, we come with the technology and develop for the people. Now they can be able to use the system, and they can be able to see the effectiveness of the system to them. So the major part is to enable them to see the good part of the technology.	Effectiveness of technology for community development	**System Objective**	**System**
C1D2	its more education purpose and development purpose. we do also have commercial where people do stuff and can sell stuff. we developed the application called e-commerce so that people can sell their things	ICT for Education	**System Objective**	**System**
C1D3	Its to check desire for the fun to the activities involving the use of ICT's for education.	ICT for Education	**System Objective**	**System**
C1D1	addressing in financial aspect with Siyakhula living project	Effectiveness of technology for community development	**System Objective**	**System**
C1M1	Its to incorporate all the individual applications developed by the researchers into one project.	System improvement	**System Objective**	**System**
C2D1	At this point my boss is using it and three other people, they are testing it.	System usable	**System Status**	**System**
C2DM2	I'm still currently testing it	System usable	**System Status**	**System**
C3M1	it was usable but there were bugs.	Incomplete system	**System Status**	**System**
C3M1	it was more easy for the users, but maybe more difficult for the support staff. Users just use a normal social network.	Technology familiarity	**System Status**	**System**
C3U1	Eer firstly it was rolled out to school	Early development	**System Status**	**System**
C3U1	And then also MxIt, rolled out to their users because the systems runs through MxIt as wel	Mxit platform	**System Status**	**System**
C3D1	yes, it is used with MxIt. People are able to comment and give feedback on the system.	Mxit platform	**System Status**	**System**
C2DM1	We tested it and we realized that this is what we want	System testing	**System success factors**	**System**
C2DM1	What I find with this methodology is that if you do the testing and the pilot with the users, they don't even realise that its now being implemented because they're so much part of the process. They're are so introduced to it that they don't see it as something new. But if you take the Bing bang approach and say on the 1st of March we are going to implement the new system. Everyone gets scared.	User involvement important	**System success factors**	**System**
C2DM1	once you try to match people into your cycle then you're trying to force people into a different way....		**System success factors**	**System**
C1D3	Yes, involvement of users will make it successful.	User involvement important	**System success factors**	**System**

C1M1	YOu have to also pin down a champion from that community to interact with when you need to get information.	Community champion	**System success factors**	**System**
C1M1	First of all you need to ensure that community is literate and make sure they become computer literate. You have to be willing to invest quite a bit of time to go out and interact with the community on your intentions.	Train users on computer usage	**System success factors**	**System**
C1D1	And then of coz the first thing that I had to do with it, I let it run for a certain period of time because I needed data to be captured.	System testing	**System Testing**	**System**
C1D1	Yes because it was tested,	System testing	**System Testing**	**System**
C1D1	Yes because it was tested, we took it down here and tested it with the users.	System testing	**System Testing**	**System**
C1M1	They've done like trial versions but the final one hasn't been released.	Pilot system before user input	**System Testing**	**System**
C2DM1	We already packed to use the system. The, the data that we use in the pilot we didn't throw it away	Continous requirement specification	**System use**	**System**
C1D2	They use the system for education purposes but you have train them how to use the system	ICT for Education	**System Objective**	**System**
C1D2	You have a look at what they put online and you check what's their impact of the system to them. We're now trying, that's where my project gets in, we're trying to run the system to be integrated on the middleware that is in Grahamstown so that if its having a problem we could deal with one problem. The major projects will be all combined in one thing. so that problems with the system can be solved by one person	Pilot system before user input	**System Status**	**System**
C1D3	We are training doing online and offline,	Train users on computer usage	**User Training**	**Users**
C1D1	Yes because it was tested, we took it down here and tested it with the users.	System usable	**System Status**	**System**
C1M1	prototyping for the trial version	Pilot system before user input	**System Status**	**System**
C1M1	They've been trying them out. Its trial applications actually	Pilot system before user input	**System Status**	**System**
C1M1	I can't really answer much on that one because that was the first trial version	Trial version	**System Status**	**System**
C1D2	We trained them on how it work	Train users on computer usage	**User Traning**	**System**
C1D2	we send the students from Fort Hare to come and train the community. to come and help the community to be able to use the system, will they know what is it that they are using. From A to Z on how to use the system. What is it that they need to do. If the system is down what is it that you have to do as as as the user. So how are you.. are you able to use e-commerce?, are you able to use it in a way that is efffective to you? is there any problem that you with the particular thing that we developed	Train users on computer usage	**User Training**	**System**
C1D3	Part of the training process was giving the feedback on how the system will be used	Train users on computer usage	**User Training**	**System**
C1D1	after having them trained on various keys of the system.	Train users on computer usage	**User Training**	**System**
C3DM1	Most of the users or at the moment enterprises that does custom support services, different NGOs or ?	NGOs	**System Users**	**System**
C3DM1	Yes, we have people in Johannesburg and Port Elizabeth	Throughout South Africa	**System Users**	**System**
C1D2	yes people from the around, they can't see something that is happening. they have to be informed about what is going on	Community members	**System Users**	**System**
C1D2	ehh i consider the people from the community who come and use the system. for example for e-commerce its the people who bid and sell staff online, which means the people who use the e-commerce application for business.	Community members	**System Users**	**System**
C1D1	We also had some community eh members, eh we also used students	Community members	**System Users**	**System**
C1D1	The users, firstly it was targeting the teachers who were manning these access nodes in schools.	Teachers	**System Users**	**System**
C1D1	The user Manual.	User Manual	**Documentation**	**System**
C1D1	Yes, the user manual that detail everything about the system.	User Manual	**Documentation**	**System**
C2DM1	I'l tell you why. I do that before the user- requirements specifications because in most cases people are not always aware of what technology can do for them. So when they see the demonstration, it opens their eyes to possibilities. After that demonstration, that when I do the user requirements.	Pilot system before user input	**User feedback**	**System**
C2M1	e have to plan awareness raising workshop or meetings, so ja we have to take it out there, umh and launch it officially first we launch it because the system is written for the Department of Sport, Arts and Culture.	Workshops for feedback	**User feedback**	**System**
C1D1	Right, in our first experiment on the system the feedback was mainly based on the direct interaction, especially when they were checking on the system. Now we had a questionnaire to capture their reaction and then we processed and measured against our expectations. Then of cause at the moment, eh the main purpose of it is to really help them generate revenue right so now it is up to them to use it to their satisfaction, if it helps them. At the end of the day they are the ones who can tell you if it meets their expectations.	Pilot system before user input	**User feedback**	**System**
C1D1	We developed a working prototype, we deployed it, tested it and then from there on we used the feedback from the users to develop some other aspects of the system.	Pilot system before user input	**User feedback**	**System**
C1D1	Firstly I demonstrated the functionality of the system to them and then let them use the system after having them trained on various keys of the system.	Pilot system before user input	**User feedback**	**System**

C3DM1	he users to the system, Eeer as we were developing it they were part of the system as we were developing they would indicate what they like or don't like. Its still co- creation. , but now we still doing workshop with them like one day workshop on how to utilise the system.	Workshops for feedback	**User Introduction**	**System**
C1D3	ell, we were not able to actively involve them. We consulted them and we observed them during the training process	Observation during training	**User Introduction**	**System**
C1D1	Firstly demonstration. Actually we, in fact based on what was seen as challenges of the project we then started from there to develop the problem statement.	System demonstration	**User Introduction**	**System**
C1D1	Eh, of cause Initially the was that problem of patience from the participates because I needed more time with them at least an hour for training and then after that use it. So it was challenging that I couldn't get enough time like to get the teachers because why? the teachers were busy with their own chore.	Train users on computer usage	**User Introduction**	**System**
C1M1	The users were introduced on the system at various level. They were introduced at individual systems when the researchers were working on them. Like when the concept of the application has been gathered by the researchers, the users took part in that. I think thet did, they also do some checking with at least two community members if the final product being done by teleweaver look like something that they could possible use. So its at two levels. Initialy it was just the researchers when they were doing their projects and they proofed the concepts to communities.	Multi- stage process	**User Introduction**	**System**
C1M1	I think thet did, they also do some checking with at least two community members if the final product being done by teleweaver look like something that they could possible use.	Trial version	**User Introduction**	**System**
C2DM1	The other interesting thing you find is that during this process some strong users emerge who are interested in the system. You then start to work with them as they become power users and they become advocates for the system, they promote the system. They like the system and ask questions. They start to assist other users and motivate them and so on.	Community champion	**User Participation**	**System**
C2DM1	The lesson is that if you don't involve users involved in the early stages you are going to have some problems. You might have a functional system that is not being used.	Involve users early	**User Participation**	**System**
C2DM1	The key is to work with the users. If you treat them with respect, they will do the same with you and your system.	Involve users early	**User Participation**	**System**
C2DM1	Remember in the first engagement when they come with the request, they don't have detailed specifications. They come and they say we want a system that will solve a particular problem	Pilot system before user input	**User Participation**	**System**
C2DM1	I'l tell you why. I do that before the user- requirements specifications because in most cases people are not always aware of what technology can do for them.	User do not know how helpful technology is	**User Participation**	**System**
C2DM1	Yes, i go to the basics. I get little information about the kind of the system that they are looking for.	User requirements specification	**User Participation**	**System**
C2M1	that when they test it's not all the users that are there it's just the super user for instance	Community champion	**User Participation**	**System**
C3U2	i think for me i would say it is very approapriate for this system development methodology because we cannot do anything without considering the community and laso we cannot afford to do everything we want to do to meet the goals. We.. if we don't interact with the users, the stakeholders and industry partners the people who pop-up the money to tell them that this is the software we need to develop. we need sit down with these people and strategise on how are going to do our project and how are we going to make it....	Awareness of user circumstances important	**User Participation**	**System**
C1D2	We consider especially the interface. We need to be more aware of the fact that we are dealing with a rural community. So we have to consider the fact that there are old people, so you have to consider their eyes. So if you're going to interface where the login is very small and someone has to try to look around where is the login, that will be not satisfied for the people. It won't accomodate everyone, but now we need to look at the interface and check are the users satisfied with a particular interface? Where can we change? Because when you're developing the interface you can't just say 'ok right, I've developed this application'. Because i am a researcher I could search for a login but it someone from the rural community come and check the login, where is it? I would say its not satisfying for them, so we involve the users from the community if we're developing the interface. they advise if its ok or not.	Awareness of user circumstances important	**User Participation**	**System**
C1D2	a the user have to be involved. you cannot develop a system for the user if you don't include the user, the user has to know ukuba ok now this application i don't like it in this way, because as the we develop the application for the user, so the user	User involvement important	**User Participation**	**System**
C1D2	So we interact with the people and check how do they feel about the particular application that we are doing and how it can help them ... and try to teach them the new techniques of using technology	User requirements specification	**User Participation**	**System**
C1D1	a like when you have developed the system, one important thing you need to understand is that user. are users able to identify basic features so that was one of the things that we considered.	No access to internet	**User Participation**	**System**
C1D1	, that we developed a system based on our users.	User involvement important	**User Participation**	**System**
C1M1	they contributed to the research and as I said when various versions were done the users were consulted to make sure that the system is something that talks to them	User feedback	**User Participation**	**System**
C1M1	Before you even starting working on it, try as much as possible to define the thing that you want to do and usually the response is that they want to ensure that as many of them are involved during development.	User involvement important	**User Participation**	**System**

C1M1	Before you even starting working on it, try as much as possible to define the thing that you want to do and usually the response is that they want to ensure that as many of them are involved during development. Ty to involve many of them	User requirements specification	**User Participation**	**System**
C1M1	I mean the various student have gone to speak to various community.	User requirements specification	**User Participation**	**System**
C1D2	Ja, its in english but now we are dealing with the conversion of english to Xhosa so that we can accomodate	Language challenges	**User Traning**	**System**
C1D2	We send the students from Fort Hare to come and train the community. to come and help the community to be able to use the system, will they know what is it that they are using. From A to Z on how to use the system. What is it that they need to do. If the system is down what is it that you have to do as as as the user. So how are you.. are you able to use e-commerce?, are you able to use it in a way that is efffective to you? is there any problem that you with the particular thing that we developed.	Train users on computer usage	**User Traning**	**System**
C1D1	But we also intend to eh change it to the local language which is Xhosa, so whoever is not comfortable with English wil always rely on that. But its not a big job that one, its just to translate.	Language challenges	**User Traning**	**System**
C1M1	We were developing the system whilst at the same time trying to teach the people how to use the computer. So its not like to you arrive in this place and everyone knows how to use a computer.	Computer illeteracy	**User Traning**	**System**
C1M1	First of all you need to ensure that community is literate and make sure they become computer literate.	Train users on computer usage	**User Traning**	**System**
C2DM2	Yes the fundamentals of ICT are very limited. If there is a problem on the screen they don't know of the system hangs, they don't know what to do.	Training the trainers	**User Traning**	**Users**
C2DM2	I've got a young man who now doing a market garden,. Now this young man is using this, but for now he is using the spreadsheet and now he is more interested in the internet.	Coordinating ICT with other community p	**User Introduction**	**Users**
C2DM2	Many users were using older versions of Microsoft 20003, 2007 and they found no problem.	Technology incompatibility	**User Introduction**	**Users**
C2DM2	Instead of giving them ICT, You give them how to use ICT which work as the tool for their needs.	Train users on computer usage	**User Introduction**	**Users**
C3M1	It was mostly word of mouth but recently advertised to their users- that if they're looking for support could add us as a contact.	Social advertising	**User Introduction**	**Users**
C3U1	Oh do we like go to school and do programmes	Addressing society challenges	**User Introduction**	**Users**
C3U1	ah mostly with, id say with the work on the dashboard cause we need to know how to control the system	system control	**User Introduction**	**Users**
C3D1	its currently available on MixIt. We didn't do any campaigning or anything like that. There are capable of advertising that is done to advertise the tool.	Social advertising	**User Introduction**	**Users**
C2DM2	The real problem is, we have to look at the target audience. Now as we look back to the rural community and ask them for local content, they would great difficulty in perceiving what the need is. Many people can't think in the abstract.	Awareness of user circumstances importan	**User Participation**	**Users**
C2DM2	It has to be visible, in other words so much like an example, because many examples here their education is quiet poor. So people's understanding of what they can do with it and what it can bring me. They think in practical terms and that is one of the biggest problems. We talk of community content and theoretical concepts like forums.	Awareness of user circumstances importan	**User Participation**	**Users**
C2DM2	Yes, to involve users during early development- it's too much much to higher level.	Early community involvement too high lev	**User Participation**	**Users**
C2DM2	So here we are coming on and finding people at that level when don't understand the fundamentals.	Train users on computer usage	**User Participation**	**Users**
C3M1	Yes, but we didn't make a decision like let us go out and involve the user. Because in this case, Rlabs were the users of the system. Jamiix is not for the end- user but for the service provider. Then if you look at it in that way, the users were involved.	Informal user involvement	**User Participation**	**Users**
C3M1	We were involved from the user perspective in the sense that we were the ones to be using the system. We would interact and suggest changes depending on our needs for the system.	User feedback	**User Participation**	**Users**
C3U1	yes we have to cause, we need to know how to work with the system	User feedback	**User Participation**	**Users**
C3U1	Ja we were asked because the first system was completely different from the one that we have now	User feedback	**User Participation**	**Users**
C3U1	m not sure if the users are aware of that but cause we are a service that is online> We make sure that we have an online presence all the time and if we , if there should be any problems we put a status up next to our contact that says " that we are having problems"	User feedback	**User Participation**	**Users**
C3U1	Yes, Ja but we were involved as, in we could give input on what we want on the system	User involvement important	**User Participation**	**Users**
C3U2	I don't play any role in the development; we have developers		**User Participation**	**Users**
C1D3	after the initial release then we interviewed the users.	User feedback	**User Participation**	**Users**
C1M1	YOu have to also pin down a champion from that community to interact with when you need to get information	Community champion	**User Participation**	**Users**
C2DM2	President Mbeki ITC initiative	National Government	**LL Establishment**	**Living Lab**
C3M1	In the beginning it was the founder Marlon and his wife; then me, Craid and William	LL Founders	**LL Establishment**	**Living Lab**
C2DM2	Mokopane Multipurpose Community Centre	Centre location	**LL Location**	**Living Lab**
C2DM2	Rebone and also Mahueelelereng	Rural communities	**LL Location**	**Living Lab**
C2DM2	Mogalakwena a municipality, Limpopo Office of the Premier and now members, we shouldn't forget the role of the communities.	Provincial government	**LL Stakeholders**	**Living Lab**

C3M1	the community. People with several social problems	Addressing society challenges	**LL Stakeholders**	**Living Lab**
C3U1	I will refer, if I have someone that has alcohol problems/ drug problems then I will refer them to lifeline or I will refer them to NGO that deals with that, that specific illness that they a struggling with	NGOs	**LL Stakeholders**	**Living Lab**
C3U1	Yes we do information and also have research on that, we also work hand in hand with organization like childline and Right crisis	User feedback	**LL Stakeholders**	**Living Lab**
C3M1	We have a number of systems that are linked to the Jamiix system	Several systems	**Main System**	**System**
C2DM2	there was no formal structure that was employed.	No formal approach	**SDM Approach**	**SDM**
C3M1	Phased roll- out approach	Phased roll-out approach	**SDM Approach**	**SDM**
C3D1	it was basically agile	Agile	**SDM Approach**	**SDM**
C3M1	I would say eerrrr we must not first think about a methodology but what product must be developed.	Product based	**SDM Effectiveness**	**SDM**
C2DM2	It was a concept as we discussed, there was semi-formal approach. The concept was discuss and also the layout of the files. But when they were developing, the concept was in their heads.	No formal approach	**SDM Process**	**SDM**
C3D1	we set done and selected the appropriate documents	Negotiate the process	**SDM Process**	**SDM**
C2DM2	I think to do the job does not want a full methodology. If we a complex process where a database, you have to have a methodology.	No need for Methodology small system	**SDM Selection factors**	**SDM**
C2DM2	when it comes to your Methodology, I can late to that in on a scale that is miles in front and deep rural community, I do not think but it could work.	SDM not needed for rural CIS	**SDM Selection factors**	**SDM**
C3D1	the fact that we need feedback from the users about the system	User feedback	**SDM Selection factors**	**SDM**
C2DM2	Now that development actually used basically existing open source educational software.	SDM not used	**SDM Tools**	**SDM**
C3U2	name of the system is miGox	MiGox	**System Name**	**SDM**
C2DM2	the teacher assigned is supposed to have IT training but we saw its so limited we had to retrain.	Training the trainers	**User Traning**	**Users**
C3U1	We get special training.	Training on the system	**User Traning**	**Users**
C3U1	mobile Counseling Service in the world; so ja we were the first guys that were introduced to it and trained on the system	Training on the system	**User Traning**	**Users**
C2DM2	We have a current person that is looking at web design, We do have people that we are trying to train on web design, They don’t even understand the fundamental of bits and bytes, they don’t know what a binary system it.	Training the trainers	**User Traning**	**Users**
C3M1	They actually come and give us feedback, if they have problems like if messages cannot go through or offline.	User feedback	**User feedback**	**Users**
C3M1	We would interact and suggest changes depending on our needs for the system.	User involvement important	**User feedback**	**Users**
C3U1	er we can see by the amount of people that goes online plus chat with us	User feedback	**User feedback**	**Users**
C3U1	So we, we first have to see what is the needs, what do we want the system	User feedback	**User feedback**	**Users**