Using a socio-technical maturity model to assist in the sustainability of ICT4D projects

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Table of Contents

List of Figures and Tables

Abstract

In this mini-dissertation the author, through a process of Dialectical analysis, using Interviews (with participants in ICT4D projects), Observations (of ICT4D projects) and Document analysis (of documentation about ICT4D projects), attempts to define what is necessary for the technical success of an ICT4D (Information and Communication System for Development) project. The author attempts this definition by using technical maturity models as a basis for determining what the current level of success or sustainability for an ICT4D project is. The author goes further by defining and creating his own technical maturity model, for ICT4D projects, and then refining it based on his Observations, a series of Interviews and Document analysis. This final revised model, and the process used to create it, is used to answer the question of whether a technical maturity model can be used in an ICT4D project and to what extent such a model will assist in the sustainability of an ICT4D project.

1. Introduction

ICT4D (Information and Communication Technology for Development), or the process of developing ICT systems for the express purpose of providing some form of socio-economic or human development, is a growing and fast developing field. ICT4D projects differ greatly in scope and size, some only require an investment of skills and expertise, and very little in the way of capital, equipment or infrastructure. Other ICT4D projects are extensive projects that range over a long periods of time with large amounts of financial backing from either the state or large donor organisations.

This paper will largely focus on the smaller kind of ICT4D project, very often the type that is supported and funded by an academic institution and focuses on one or two small communities. One reason for this is that the author's own experience with ICT4D projects has been through his involvement with academically supported projects. Another important reason for focusing on academic projects is that the project members of an academic project are based in some type of academic institution and thus there is some assumption about what skills they will have that can impact the project. Generally there is an assumption that someone who teaches or researches in the field of ICT also has the practical skills necessary to use, install and maintain ICT systems. Thus many of the observations will be more true for this smaller kind of project and not as relevant for larger projects.

It is the espoused benefits which an ICT4D project can deliver to a community or society in terms of development that has resulted in ICT4D being one of the primary vehicles through which various organisations and agencies are attempting to perform socio-economic development.
This wide spread acceptance of ICT4D, has resulted in its very own challenges due to the socio-political nature of ICT4D projects. Getting political support or community buy-in are just some of the issues that can hamper the success of an ICT4D project and that can make it a very complex project to manage and deliver successfully.

ICT4D clearly requires both the technical aspects associated with any IT project and the social aspects of human development. However, the success of an ICT4D project depends on many factors, principally what is the meaning of success and how it is measured.

1.1. Problem Statement

Unfortunately, due to the multitude of socio-political issues that can influence the success or sustainability of an ICT4D project, the underlying technical issues that are critical for the success of any ICT project, ICT4D included, are often marginalised. Ballantyne (2002), provides a list of general recommendations which should be made concerning ICT4D projects, for example:

"The report of the Digital Opportunity Initiative (Accenture *et al.*, 2001) concludes that:
1. Initiatives should be explicit about their development goals;
2. Initiatives should be driven by user demands;
3. ICT solutions should be 'built to last';

4. Initiatives should be sensitive to local conditions and limitations;
5. The interests of key stakeholders must be aligned with the goals of the intervention;

The G8 DOT Force (2001) calls for 'fresh thinking' to address the need for:

1. Holistic approaches with multi-stakeholder involvement;
2. Leveraging linkages and partnerships into the global economy;
3. National ICT strategies which also permit bottom-up approaches;
4. Taking advantage of new and emerging technologies;
5. New approaches to development assistance." (Ballantyne; 2002)

None or very few of these recommendations concentrates on the technical issues at all, and rather focus on the assumption of the ICT abilities available, e.g. building ICT solutions to last and taking advantage of new and emerging technologies. While these recommendations, as goals, are worthy of focus, little more is provided in terms of the importance of these recommendations.

On the other hand Montealegre (1999), in a review of development literature, emphasises the need for such a focus:

"The studies emphasize the potential use and the content of IT for solving problems confronting LDCs (Less Developed Countries). However, *substantive issues regarding the process of developing and implementing IT*, and the effects it has on the processes through which people were working, are generally ignored." (Montealegre: 1999) (Author's emphasis - italics)

This use of ICT4D, has seen a large surge in acceptance in the development communities in the last decade or two due to the increased availability of ICT in the general. There was a substantial influx of money, time and expertise in developing countries and a lot of hype and attention is given to ICT4D. In fact, this reaction in the field of ICT4D echoes what was happening in the so-called 'dot com boom'. Heeks describes this period as follows:

"Donors, attracted by a combination of hype and hope generated by ICTs, have altered their funding priorities and pushed ICTs up the development agenda." (Heeks: 2002a)

Unfortunately, similarly to the 'dot com boom', there has been a significant degree of failure of ICT4D. While the actual statistics are difficult to measure, as the failure of an ICT system is largely subjective and can range from an acceptance failure to a total technical failure, nevertheless, there has been a general impression of ICT failure, especially in developing countries:

"In summary, the evidence base is not strong - and it urgently needs strengthening – but it all points in one direction: toward high rates of IS failure in developing countries." (Heeks: 2002b)

A more concrete example of ICT4D failure is given by Wade, detailing the example of the failure rate in multi-purpose community telecenters in Mexico:

"Buried at the end of the thirty-page World Bank paper is an account of multipurpose community telecenters (MCTs) in rural Mexico. (MCTs are facilities that provide public access to a variety of information and communication services.) It turns out that of twenty-three MCTs built recently in rural Mexico, only five were working two years later. This is a failure rate of 80 percent." (Wade: 2002)

A broader summary of ICTs and failure, by Beynon-Davies, suggests the following:

"Available literature suggests that failure is a ubiquitous feature of both the UK and International experience of IS engineering." (Beynon Davies: 2002)

While Davies' summary relates to IS (Information Systems) development as a whole, it supports the overall picture that there is a tendency for IS and ICT projects to fail, and ICT systems for development, as a subset of ICT systems, are prone to this tendency as well.

This is even more applicable/relevant to ICT systems for development, as a host of cultural and social issues, which are generally not present or not as prominent in commercial development, become increasingly critical to the success of the ICT system. In a commercial system it is easy (or easier) to force user acceptance of a large, company-wide information system – accept or leave (!). This user 'acceptance' is less easy to obtain in a rural African village that has few or no IT skills, as well as a significantly different culture to that of the development agency. Also because of these factors there is no obligation for the community to use the system as well as there being no desire for the community to 'upset' the developers by not using the system. This can often result in perceived acceptance and success of the system where the actual truth is that the system is a significant failure.

Heeks offers the ITPOSMO framework to classify the failure of ICT systems according to seven dimensions:

"Combined with the more descriptive material on information systems, these theoretical ideas build to create seven dimensions of relevance to design-actuality gaps: information (data stores, data flows, etc.); technology (both hardware and software); processes (the activities of the users and others); objectives and values (the key dimension, through which factors such as culture and politics are manifest); staffing and skills (both the quantitative and qualitative aspects of competencies); management systems and structures; and other resources (particularly time and money)." (Heeks: 2002)

This framework encapsulates the idea that the failure of an ICT system is a multi-dimensional problem, which requires success in many different areas and with different aspects to achieve overall success.

The purpose of this research is to show that while each of these seven dimensions are important to the success of an ICT4D project, there are certain basic technical requirements that are non-negotiable. It is the author's contention that it is just as important to have an "adequately" working ICT system that does not achieve cultural or social acceptance, than to have an ICT system that is accepted by the community in question, but is a technical failure. Of course a socially acceptable or adequately working system could still be classified as a failure and a better solution would be to have a system that is successful both technically and socially.

The objective of this research is to gauge the importance of Technical Issues within the context of an ICT4D project. Furthermore it is to "unbox" the concept of Technical Issues in such a way as to obtain a better understanding of what precisely is meant by Technical Issues. This was achieved through the development of a technical maturity model of an ICT4D project using an interpretive research approach.

Initially the current understanding of the Technical Issues in ICT4D was obtained through a literature survey.
Using this information, as well as the author's personal experiences, a process was followed to attempt to create a model, that can be used to gauge the level of technical maturity of an ICT4D project, and which can also be used to assist in the development of the ICT4D project itself.
The created model was then refined using data gathered from a series of interviews with a number of participants from various ICT4D projects.

In summary, the purpose of the research is to attempt to define how important technical maturity is for the sustainability of an ICT4D project, and to attempt to define a model to guide the process of improving technical maturity in an ICT4D project.

1.2. Ethics

Development and especially ICT4D is a culturally and politically sensitive process as
the communities and development agencies involved in ICT4D projects often have experienced a great emotional connection with the project. Discussing issues such as success and failure, as well as the reasons for this, can result in emotional responses from the participants. This, coupled with possibly sensitive political issues requires that a researcher takes care in how to approach the communities involved.
For this reason the strategy of using confidential, one-on-one, interviews was used. These interviews were performed after obtaining the express permission of the participants.

The author has personally also been involved with similar ICT4D projects and thus has, hopefully, developed a certain empathy for these kind of situations

Ethical clearance from the University of Pretoria's ethics committee has also been obtained.

1.3. Role of researcher

The role of the author in this specific mini-dissertation was a mixture of positions. The initial inspiration for the research topic came form the author's involvement in the type of ICT4D projects that the mini-dissertation covers. This was initially a form of Action Research.

It was this close involvement with projects of this nature, as well as their subsequent failure or success that inspired the author to start asking questions about the process and models being followed during an ICT4D project.

This led the author to start considering alternative frameworks or models to current models used in ICT4D projects. The author was especially interested in looking at the question of whether the technical aspects of such projects are neglected or given sufficient attention in current models or thinking. This question led to the idea of creating a model which explicitly focuses on the need for technical maturity and then using this model to test the author's hypothesis that technical aspects are often neglected.

1.4. Structure of mini-dissertation

The mini-dissertation is structured in such a way as to emphasize the creation and revision of the model as the artefact for the research process. Thus the mini-dissertation starts with a literature survey focusing on issues of ICT4D, as well as sustainability and maturity models. The reason for this focus on sustainability and maturity, is the assumption that sustainability and maturity are the key aspects of success in an ICT4D project.

Chapter 3 focuses on the research philosophy, methodology and data collection and analysis methods. This chapter provides the background on the different projects that were the focus of this research.

This leads to Chapter 4, which describes the initial model of Technical Maturity in ICT4D projects. This model was created based on the literature review and personal experience and reflection.

Chapter 5 revises this model based on a further literature study, comments from conference presentations and, most importantly, from a thorough review of the data collected from the interviews.

Finally, in Chapter 6, the salient points of the mini-dissertation are summarised, the research questions addressed and possible areas for future research recommended.

2. Literature review

This literature review lays the ground work for the research in this paper by exploring the pertinent themes, as outlined in the next paragraph, as well as attempting to fix a number of working definitions for the concepts that will be used within the paper.

The literature review is divided into three separate focus areas, each focusing on an important aspect of the research. These areas are: ICT for Development, Sustainability and Maturity Models.

2.1. ICT for Development

Understanding what an ICT4D project is and having a fixed definition for use is vital to provide a solid basis for this mini-dissertation. Different researchers and practitioners have different definitions of ICT4D projects, their scope, their typical goals and their typical environments. ICT4D and IT4D are used interchangeably in this section.

2.1.1. Definition of ICT

Tiglao and Alampay (2004) provide a detailed definition of both ICT and Development and then combine these two definitions to give a more comprehensive view of what they feel ICT4D is. Firstly, they define ICT in the following manner:

"In our study we have adopted a broad definition of ICT, to refer to technologies that facilitate by electronic means the creation, storage management and dissemination of information." (Tiglao et al : 2004)

Cecchini and Raina provide a similar definition of what ICT is based on the Organization for Economic Co-operation and Development's (OECD) definition of ICT.

"The Organization for Economic Co-operation and Development (OECD) defines ICT as the set of activities that facilitates, by electronic means, the capturing, storage, processing, transmission and display of information." (Cecchini: 2002)

Cecchini and Raina further claim that ICT can be an effective tool for rural development (Cecchini et al: 2002). However, no mention is given of exactly what they mean by rural development.

Tiglao and the OECD's definition refer to the *electronic means* by which information is stored, created, and disseminated. Whilst ICTs in general literature and in use usually refer only to the use of electronic technologies, the partial use of non-electronic means should not be excluded from the definition. Focusing purely on the electronic nature of an ICT project or

development creates the danger of ignoring the vitally important human and organizational components of an ICT project or development.
For this reason the author chooses to focus on information in itself as the key factor of an ICT project. The use of electronic technologies, while implied, is not a necessity nor should it be the only possible solution.

2.1.2. Definition of Development

Tiglao et al offer a more specific definition of Development, based on what it attempts to achieve rather than what it is:

"A critical factor that has to be considered when one considers the application of ICTs for development is whether it serves the needs of the poor especially with respect to dimensions of poverty such as poor health, lack of voice and lack of information." (Tiglao et al : 2004)

Todara echoes the sentiment of Development being a process that needs to encompass all aspects of the life of the affected communities in the following quote:

"Development must, therefore, be conceived as a multidimensional process involving major changes in social structures, popular attitudes, and national institutions, as well as the acceleration of economic growth, the reduction of inequality and the eradication of absolute poverty." (Todaro: 1989)

Another similar view of Development, referred to as Human Scale Development is suggested by Max Neef:

"Such Development (Human Scale Development) is focused and based on the satisfaction of fundamental human needs, on the generation of growing levels of self-reliance, and on the construction of organic articulations of people with nature and technology, of global processes with local activity, of the personal with the social, of planning with autonomy, and of civil society with the state." (Max-Neef: 1989)

This conceptualisation is in sharp contrast to traditional forms and thinking of development, such as development for economic growth. Sen talks about the *focus on wealth maximization* instead of economic growth but his criticism of where this concept of development fails, as stated below, suggests a more holistic approach to Development is required:

"The focus on wealth maximization can be taken at different levels, and at the common aggregative level, the spotlight is put entirely on making the community as a whole as opulent as possible, irrespective of distribution and irrespective of what

that wealth does to human lives. It is, of course, true that being rich, wealthy and affluent can be among the most important contributory factors in generating well-being, and the opulence-oriented approach to economic progress certainly cannot be criticized for being irrelevant to the success of human living. On the other hand, insofar as it neglects other crucial factors, such as public care and social organization, which also contribute to the well-being and freedom of individuals, the approach is deeply limited and defective." (Sen: 2000)

These definitions of Development all focus on a process of providing improvement in living and economic conditions for poor communities and peoples, as well as, creating an environment that will ensure the sustainability of this improvement. This issue of sustainability is discussed in further detail in Section 2.2

Using these definitions of ICT and Development Tiglao et al. consider ICT4D in the following way:

"As such, given the above definitions of ICTs and Development, what we would like to highlight are the ICT projects that have a direct impact on empowering people in poor communities as well as impact on alleviating poverty and addressing the MDGs[1]." (Tiglao et al : 2004)

Various projects that the author was involved in took place in a university context. Similarly many of the interview participants were involved in ICT4D projects via a university program. For this reason the following definition by Colle, focusing specifically on ICT4D within a university context is of particular interest to this mini-dissertation:
"ICT for Development refers to the university applying ICT in programs outside its walls in the service of communities and the nation." (Colle: 2005)
The issues of information, its use, and the needs of the community come through as the main themes in defining what ICT4D is. The definitions used so far refer to servicing the needs of the community, often specified as a poor or rural community as well as alleviating poverty and addressing MDGs. The latter part, i.e. the alleviation of poverty and addressing the MDGs appears to see ICT4D as a panacea for solving all the development problems in one go. The author prefers to see ICT4D as one aspect of the overall development process and thus feels the definition of servicing the needs of a poor, rural or underprivileged community as being sufficient for the purposes of this research.

Combining these themes the author uses the following working definition throughout this mini-dissertation:

ICT4D is the use of information and communication systems and technologies to address the needs of poor, rural and/or underprivileged communities.

ICT4D can only achieve this objective if the projects are sustainable. What is viewed as sustainability is discussed next in section 2.2.

2.2. Sustainability

The issues of sustainability are perhaps one of the key talking points in the ICT4D discourse because of the very nature of ICT4D projects. In general, some outside agency provides ICT hardware or software to a community for the purpose of improving some aspect of the people's life within that community. Naturally there is the question of what happens once the development agency withdraws from the project (and withdrawal is pretty much a certainty due to issues of funding and time). Can the project now carry on, still achieving its original goals, without the continued input of the original development agency?

It is this question which many researchers are seeing as the key metric to determining the success or failure of an ICT4D project. As Kanungo states:

"Sustainability emerges as the critical success factor that will influence how information and information technology resources are managed in the post-experimental phase." (Kanungo: 2004)

The post-experimental phase Kanungo talks about is similar to the phase in an ICT4D project that occurs after the development agency have withdrawn from the project.

The question now arises as to what this "critical success factor" is in the context of an ICT4D project. Braa et al (2004) provides a board definition of sustainability, as well as a more precise definition which will be discussed further:

"While sustainability can have different meaning, it broadly refers to the condition of things enduring over time and space. In the context of action research, sustainability can have multiple interpretations from the life of the systems and processes developed as interventions, to the generality and longevity of the research insights generated, *and to the question of how do the research and practical efforts co-exist over time – at what time does the research efforts "pull-out" and the developed systems live on (or not) within the structures that may have been created as a result of the research*." (Braa et al., 2004 own italics)

Of special importance is the final italicised part of the Braa et als (2004) definition of sustainability. This issue is especially pertinent to

this paper as most of the projects that will be discussed involved some form of action research.

From this the author suggests the following working definition for sustainability in a Development and Action Research Context:

The sustainability of an ICT4D system or project is a measurement of when no further intervention is required by the donor agency or agencies to keep the system or project running.

With sustainability defined is now necessary to look at how this sustainability can be achieved and what metrics could possibly be used to gauge the sustainability of an ICT4D project. The metric of maturity has been used to determine the possible success of a system in the realm of commercial ICT projects, and the author believes that using similar techniques of modelling the maturity of an ICT4D project can help to improve its sustainability.

2.3. Maturity Models

The focus of this mini-dissertation will be the adaptation of Maturity Models to ICT4D projects. Thus a through understanding of what Maturity Models are and how they can be applied to different types of ICT projects and organisations is required for the rest of the mini-dissertation.

Sonnekus provides a very broad overview of what the general purpose of a maturity model, as well as what they are:

“Maturity models are frameworks for helping organisations improve their processes and systems.” (Sonnekus: 2004)

The important key here is the concept of improvement, of an organisation, through the use of the model. Models such as these usually have some kind of measurement rubric in terms of levels of stages, where an organisation is placed in one of these stages or on one of these levels depending on the metrics that model employs.

While models or frameworks are traditionally designed to measure some aspect of some phenomenon, maturity models and especially the model that will be posited within this mini-dissertation, focuses on helping with the improvement of this aspect. As also mentioned by Sonnekus in the following quote, the process of moving from level to level is also a process of improvement of the maturity of the organisation in question.

“The principle is that as the organisation progresses through the maturity levels, it becomes better at what it does, and also better equipped to deal with changes in procedures and practices, thereby enabling an organisation to complete projects at a higher rate of success.” (Sonnekus: 2004)

It is this aspect of Maturity Models that will be the focus in this mini-dissertation. The creation of elaborate metrics to precisely measure the Maturity of an organisation, is not the desired result of this mini-dissertation. (Nor, can it be argued, is it entirely feasible to do this with any great degree of accuracy). Instead the created model will focus on giving guidance and direction to the process of maturity within an ICT4D organisation or project.

A specific example of a Maturity Model, and specifically the Maturity Model on which the conceptual model developed later in the mini-dissertation will be based on, is the Capability Maturity Model (CMM).

The CMM is a model or scale on which the maturity of an organisation, in terms of its use and application of ICT and ICT systems, can be measured. It defines certain levels at which an organisation can be, as well as defining the criteria (and characteristics) of a typical organisation at that level. Table 1, adapted from Herbsleb et. al (Hersleb et. al : 1997), describes the different levels of the CMM and their characteristics.

CMM Level	Characteristics
1) Initial	The software process is characterised as ad hoc, and occasionally even chaotic. Few processes are defined and success depends on individual effort and heroics.
2) Repeatable	Basic project management processes are established to track costs, schedule and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.
3) Defined	The software process for both management and engineering actives is documented, standardised and integrated into a standard software process for the organisation. Projects use an approved, tailored version of the organisations standard software process(es) for developing and maintaining software.
4) Managed	Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.
5) Optimized	Continuous process improvement is facilitated by quantitative feedback from the process and from piloting innovative ideas and technologies.

Table 2: The CMM, adapted from Hersleb et. al. (1997)

This model is designed to be used primarily to assess commercial organisations that perform ICT development projects on a regular basis and that have a certain amount of resources to spend on managing these projects. For this reason the CMM cannot be used ‘as-is’ to determine the maturity level of an ICT4D team or an ICT for development system and requires a certain amount of adaptation.

Even though the CMM requires some adaptation to be used in the context of ICT4D it focuses on the idea of generic IT maturity in an organisation. While the domain of an ICT4D project might differ largely from the types of domains that the CMM was originally designed for, the basics of information systems and processes between the two types of projects remains the same.

For this reason as well as its adaptability the CMM is ideal as a starting point model for the design research phase of this paper.

2.4. Meaning of technical

This mini-dissertation focuses in particular on the technical aspects of ICT4D projects. Thus it is the technical maturity of a project that will be the focus of the model. It is important to note that defining a maturity model as a *Technical* Maturity Model does not refer to the technicality of the model but rather that such a model focuses only on the technical aspects of the project. The question arises as to what the exact definition of *Technical*, especially in terms of ICT4D, is. This question is one of the main questions of the mini-dissertation as a whole so only a preliminary answer will be given here based on existing literature. The field work will provide greater insight and this question will be elaborated on later in the mini-dissertation.

It is important to note that the issue of something being *Technical* in nature can only be fully discussed if we define the issue of something *not* being *Technical* in nature. One way of describing this difference is to differentiate between issues that are *Social* in nature and issues that are *Technical* in nature. Bloomfield and Vurdubakis describe this differentiation as follows:

"Namely, they tend to draw a boundary between those aspects that are technical (i.e. inherent to the "technology itself") and those that are not and hence open to social influence." (Bloomfield: 1994)

It is this definition of technical which is adopted in this mini-dissertation. Moreover, Bloomfield and Vurdubakis go on to further cast doubt on the validity of this sheer distinction between social and technological and instead claim "that technical
issues and considerations cannot be disengaged from the (social) sense making
practices in which they figure." (Bloomfield: 1994)

This debate is further elaborated on using responses and observations obtained from the field work.

2.5. Conclusion to Literature Review

In summary the literature review defines ICT4Ds as projects that generally use some electronic means to manage information for some kind of development purpose where development is seen as the general uplifting of a community or person in, but not limited to, life standards.

Furthermore the issue of sustainability, as it relates to ICT4Ds is defined as the ability of an ICT4D to continue functioning without the need for outside assistance.

Finally the issue of sustainability was linked, in part to the issue of technical maturity. The adoption of a technical maturity model, i.e. some kind of model that helps an organisation to improve their processes and systems, is suggested as one possible solution to this issue of sustainability and technical maturity in an ICT4D project.

The primary gap in the literature seems to be that there is not a lot of focus on the technical aspects of an ICT4D project. This is also evidenced in the fact that the author could not find a technical maturity model that was specifically aimed at ICT4D projects, as the secondary gap in the literature.

The literature review has given some guidance to the rest of this mini-dissertation. Firstly it defined the scope of the mini-dissertation in terms of what kinds of ICT4D projects the mini-dissertation should focus on. Secondly it described a capability maturity model as a possible starting point for the creation of a technical maturity model. And finally it gives credence to the idea for the need of such a model.

3. Research Questions and Methodology

The failure of ICT4D projects and systems has been noted in the literature as well as within the experiences of the author. Furthermore, the author has identified an area of possible failure, namely the lack of technical expertise or skills, that the author feels has not been sufficiently addressed in the literature and can thus be summed up as a the main research question:

Can a technical maturity model be used to provide guidance or focus, to an ICT4D project, especially in terms of sustainability?

This chapter outlines the research questions which were addressed to answer this overall question and also describes the process that was used to answer these questions.

This main research questions is addressed through a number of sub-questions. These questions are:

What is ICT4D?
What is sustainability, especially in terms of an ICT4D project?
What is a technical maturity model and can it support sustainability in general and for ICT4D in particular?
What is required to implement or use a technical maturity model for an ICT4D project?

3.1.2. What is ICT4D?

This research question's purpose is to determine what exactly the scope is within which the research will focus. ICT4D is a specific sub-field within the domain of IS (Information Systems) research, and needs to be well defined to limit the scope of the type of projects and literature that will be studied.

It is also important to differentiate between a normal or commercial ICT project and an ICT4D project. The way different aspects of these projects are defined do differ and can have an impact on the other issues being discussed such as sustainability and technical maturity.

3.1.3. What is sustainability, especially in terms of ICT4D.

The issue of success or failure of projects has been and still is one of the main issues within IS research. Attempting to further define what success or failure is in terms of sustainability will give a clear guide to measuring the success or failure of an ICT4D project. ICT4D projects have certain unique aspects that determine success or failure differently to normal or commercial projects and it is also important to define what these aspects are.

3.1.4. What is a technical maturity model and why is it needed in general and for ICT4D?

This question defines exactly what a technical maturity model is as well as gives an example of such a model. Not only will the technical maturity model be defined, it's application and use will also be discussed. This question will also lead into the main research question of using a maturity model for an ICT4D project.

3.1.5. What is required to implement or use a technical maturity model for an ICT4D project?

This question asks what is required for using technical maturity models in an ICT4D project. It presuppose a use or application for technical maturity models in ICT4D projects and attempts to define what other factors need to be in place for the successful use of such technical maturity models.

These questions are addressed using an interpretive research approach. The rationale for this decision is discussed in the next sections.

3.2. Philosophy: Interpretive

ICT4D projects and any discussions concerning them are truly multi-dimensional issues, which cover a range of topics that are both subjective and objective in nature.

Any discussions that pertain specifically to success, failure, sustainability or maturity are by nature subjective as the issues of success, failure, sustainability and maturity are by themselves subjective. Different people, based on their view on the subject matter, their backgrounds, their purposes can have different opinions on whether a project was successful or not, or whether a project is sustainable.

This subjectivity in the opinions of the research subjects, as well as the subjectivity in the researchers themselves, leads to the use of a subjective research philosophy.
Oates gives this subjectivity as one of the characteristics of interpretive research and thus an interpretive research style fits the necessary requirements for this philosophy:

"… there is no single version of the 'truth'. What we take to be 'real' or 'knowledge' is a construction of our minds, either individually or in a group. Different groups or cultures perceive the world differently." (Oates : 2006)

Adopting an Interpretive Research Philosophy leads to a choice of different research strategies, such as case studies, action research and design research. The strategy used in this mini-dissertation is described further in the following section.

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3.3. Strategy:
Thematic Analysis and a Dialectical Process

The research strategy was a two phased strategy, both phases having a model as their end result. These models are not the end goal of the research, but rather the mechanism by which the main research questions will be answered.

The initial model was created through a process of Thematic Analysis loosely based on the principles of grounded theory. Grounded theory is a research technique designed to elicit meaning from data without a preconceived notion or theory about that data. Daengbuppha et. al. provide the following expansive definition of grounded theory:

"The grounded theory approach is based on a range of qualitative research methods that use a systematic set of procedures, and simultaneous processes (as opposed to sequential) of data collection and analysis, to develop an inductive derived grounded theory about a phenomenon (Strauss and Corbin, 1998). This approach is designed to assist researchers to produce "conceptually dense" theories that consist of relationships among concepts representing "patterns of action and interaction between and among various types of social units" (Strauss and Corbin, 1998, p. 278). Grounded theory is often used as a form of comparative case-oriented explanation-building; it has been popular in sociological research and is related to ethnography. " (Daengbuppha et al: 2006)

For the purpose of this mini-dissertation the important facets of grounded theory that were used in the research process were those of determining *patterns of action and interaction between various types of social units* and using Grounded Theory *as a form of comparative case-oriented explanation-building*.

The author defined themes from the literature concerning the failure of ICT4D projects, with specific focus on the technical themes. Based on this thematic analysis the author created a maturity model that assisted in determining the technical maturity of an ICT4D project.

The second phase of the research approach was using the created model with the literature and the information obtained through Interviews, Observations and Document Analysis of ICT4D projects. This phase could be described as the dialectical process through which the proposed model (the thesis) and actual experience (the anti-thesis) lead to the development of a revised and refined model (the synthesis). This revised model purports to provide an understanding of the

phenomenon of 'the technical' in ICT4D projects that is better than the previous theories or models.

3.2. Data Collection

As stated the data for the first phase was obtained through an analysis of existing literature on the issue of the technical themes in ICT4D projects.

The data for the second phase included a series of interviews which where conducted to elicit the information and opinions about ICT4D projects from participants in such projects. The interview questions where of an open nature and thus the interviews as a whole were semi-structured.

The interviews were all conducted face-to-face and were recorded and later transcribed to ensure that the maximum amount of data was collected as well as to ensure the quality and accuracy of the data recorded.

As the Interviews were semi-structured and thus contained open-ended questions, the questions asked varied, but loosely followed the questions listed in the general guidelines. The list of interview questions and a brief explanation of each question is given in Annexure B.
The author often changed the focus of questions or re-asked certain questions in new ways or even left out questions depending on the type of responses received. Often the respondents would volunteer new and interesting data which the interviewer would then explore further with extra questions.

The author also performed other methods of data collection, namely observation and document analysis. The observation was performed at two of the ICT4D project sites. The document analysis consisted of analysing various published materials that were focused on the ICT4D projects mentioned by the interviewees.

The table on the following page summaries the various types of data collection and their sources used in this second phase of the research.

Data Collection Method	Source	Reason
Semi-structured interviews	Participants in the following projects: SEIDET, GSS, UThukela District Child Survival Project, The MPCC evaluation, Computer Literacy Training[2]	To obtain data of first hand experiences with ICT4D projects.
Document analysis	Articles about the following projects: SEIDET, GSS, UThukela District Child Survival Project	To obtain background data on some of the projects.
Observation	Participation in the following projects: SEIDET, GSS	To observe the projects first hand.

Table **2**: Summary of **Data Collection Methods**

3.3. Summary of projects

The author performed six different interviews with selected participants within the field of ICT4D. The participants were mostly involved in the ICT4D projects primarily as researchers, generally involved with and in action research. There was some overlap where the same participants were involved with different aspects of the same project, but there were also situations where participants were individually involved in more than one project.

The table on the following summarises the projects:

Project Name	Project Location	Institutions involved	Participant
SEIDET project.	Siyabuswa, Mpumalanaga	University of Pretoria	HT(1), MM(2), LW(3), HL(4),
GSS project	➢ Siyabuswa, Mpumalanga ➢ Lebotlane, North West ➢ University of Pretoria, Gauteng	University of Pretoria SEIDET	HT(1), The author
MPCC evaluation	Various locations in SA	University of Pretoria	JP(5)
ChildSurvival	UThukela District Child Survival Project, KwaZulu Natal	University of Western Cape, WorldVision, UNICEF, DoH, University of Natal	EB(6)
Computer Literacy Training	Mamelodi Campus, UP	University of Pretoria	HT(1)

Table 3: Summary of Research Projects

The following is a brief overview of the projects. A further in-depth discussion is done in section 5.1:

SEIDET: The project that most of the participants were involved with was the Siyabuswa Educational Improvement and Development Trust (SEIDET) centre in Siyabuswa in Mpumalanga, South Africa. LW (3) was involved with computer literacy training, while MM (2) was involved with research on computer based maths teaching. HL (4) was involved in the initial setup of the centre, while HT (1) used the centre as a site for the GSS research project mentioned below.

GSS: An e-collaboration and e-government project was hosted at a site in North West Province, namely the Lebotlane MPCC as well as on the premises of the University of Pretoria itself and on the SEIDET premises mentioned previously. HT (1) used the facilities to host the initial stages of an e-collaboration and e-government initiative. The author participated in this research, to find ways of using Group Support Systems for e-collaboration and e-government, as well.

MPCC Evaluation: There was also an interesting project were JP (5) was involved in a project to evaluate a large number of Multi-Purpose Community Centres (MPCCs) in South Africa and to do some comparison with similar projects in Hungary.

Computer Literacy Training: HT (1) was also involved with computer literacy training on one of the satellite campuses of the University of Pretoria.

UThukela Child Survival Project: Finally EB (6) was involved with a child survival, maternal health and HIV/AIDs project in the UThukela region of KwaZulu Natal, South Africa.

The author was also involved in similar development projects, as mentioned earlier,. In fact, while the focus of the author's project was rather different from the focus of the projects mentioned in the interviews, two of the actual locations were shared, namely the SEIDIT Community Centre in Siyabuswa and the MPCC in Lebotlane.
While the interviews were conducted after both the author's and the interviewees experiences at Siyabuswa, the experiences of the interviewees occurred before the visits to Siyabuswa by the author. This gave the author the unique opportunity to experience a form of "time-lapse" and to see how the projects mentioned in the interviews were carrying on some years down the line.
The author was also involved at the Lebotlane MPCC as a part of the GSS project. This gave the author an excellent opportunity not only to view the GSS project from the inside but also to observe an MPCC up close.

3.4. Modes of analysis

The analysis consisted of two stages: firstly, the use of a literature survey to create a preliminary conceptual model; and secondly, the use of semi-structured interviews backed up with literature to refine the conceptual model.

The initial stage, namely the creation of a preliminary model, was done through the juxtaposition of the literature regarding ICT4D, the literature regarding maturity models and the authors own experiences with ICT4D projects.

The second stage, i.e. the creation of a revised model was threefold in itself. The author searched for certain themes or aspects that are regarded as important for such a model to have, through the following mechanism: analysis of the shortcomings of the original model, literature survey and semi-structured interviews.

The analysis of the shortcomings of the model came from comments the author received about the model when it was presented at a conference[3], the arguments and themes in the literature and the authors own experience with the model.

The analysis of the literature survey and especially the semi-structured interviews was done using textual analysis. The nature and size of the interviews, as well as the process of design research, lent themselves better to a more thematic form of textual analysis than another type of perhaps stricter coding.

3.5. Conclusion

The mini-dissertation used an interpretive philosophical basis for the research methodology. A form of Thematic Analysis, loosely based on

a Grounded Theory approach, was used to elicit the general themes from the literature concerning ICT4D projects.

These themes were then compared to themes that appeared out of observations by the author of ICT4D projects, as well as themes that emerged out of a series of interviews with participants in ICT4D projects.

These themes were used to develop a model for guiding the process of technical maturity within an ICT4D project. This model was also used to summarise the themes elicited during the research.

4. Initial Technical Maturity Model.

4.1. Introduction

As mentioned in Section 2.3 the Capability Maturity model is designed to be used primarily to assess commercial organisations that perform ICT development projects on a regular basis and that have a certain amount of resources to spend on managing these projects. For this reason the CMM cannot be used 'as-is' to determine the maturity level of an e-development team or an ICT 4D system and requires a certain amount of adaptation.

The following is a list of the general type of differences that one finds between ICT 4D and commercial development projects. These serve as indicators of a trend and thus reveal more of the tenor of the differences instead of being specific examples that will be addressed by the adapted model:

The technical side of ICT4D projects are generally once-off affairs
The CMM is designed to measure the maturity of an organisation and how well they can handle development projects over a protracted period of the organisation's life time. For this reason mention is made of previous projects that the organisation has performed in different levels of the CMM. On the other hand the development of an ICT4D project is usually a once-off affair, with the various parties consisting of different individuals and agencies that have come together to work on this specific project. It is unlikely that exactly the same individuals and agencies will work on a new project in the future or have worked together in the past and it is thus difficult to measure the protracted maturity of an ICT4D project.

ICT4D projects tend to have diverse budgets and project scopes
ICT4D projects range from small pilot projects running on a single computer in a single community, to massive country-spanning networks. For this reason it is difficult to pigeonhole e-development projects as having specific criteria in terms of budget or scope. While this facet does not uniquely differentiate ICT4D projects from commercial ICT projects, the nature of the funding, i.e. generally government or donor based-funding, differs from commercial projects. The fact that the funding comes from donor agencies or government, in turn means that the goals and targets for an ICT4D project are often more complex as the agendas and cultures of the funding organisations can and do have an impact on the project as a whole.

Skill sets are often disparate to the problem in question ICT4D projects
A commercial organisation hires people who can perform a certain task in the organisation. In an organisation that is producing ICT systems the skills of those people hired often relate directly to the system that is being developed, especially in terms of technical competence.

In ICT4D projects, the members of the team are often chosen not for their technical competence but for their knowledge of the domain in

which the project resides or their socio-political standings that can influence the project.
Similarly members of ICT4D project teams are often researchers and domain specialist first and technical practitioners second. This makes, as Walsham and Sahay report, research in the field of ICT4-D a complicated process with many different parts and connections:

"The use of the term *information infrastructure*, rather than information system, reflects the authors' view that such highly complex networks of actors, including technologies, need different methods of development and management." (Walsham: 2006)

4.2 ICT4D Technical Maturity model
Taking the abovementioned factors into consideration and combining it with the CMM, it becomes apparent that defining the technical maturity of an ICT4D project cannot be done merely on one dimension. Technical maturity for a project is not just the skills of the project members or the level of project management that the project has, but a combination of both. This echoes Heeks levels of staffing and skillls in his ITPOSMO framework described in Chapter 1. For this reason the model in Figure 1. defines technical maturity, for an ICT4D project, according to these two criteria of the technical skill set of the project members (horizontal axis) as well as systems development project management (vertical axis).

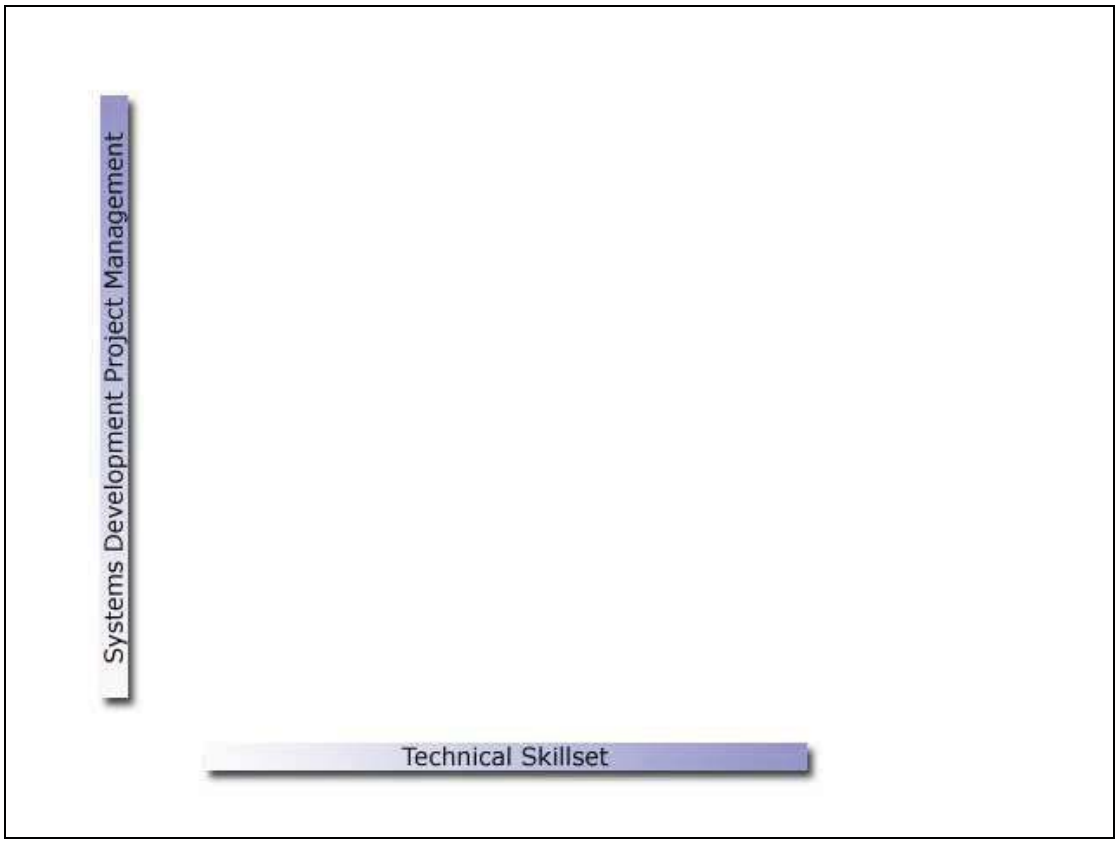

Figure 6: Dimensions of the Technical Maturity Model

As mentioned the CMM is designed to be used with organisations that are involved in many systems development projects and it makes sense to have the 5th level, Optimized included in the CMM. However, in general, ICT4D project teams are often only together for the duration of the project and thus have little opportunity or inclination to enter this 5th level. Therefore the model presented here adapts the CMM in terms of the broad outline of levels of maturity, but simplifies the number of levels into four stages for each of the two dimensions given in Figure 1.
Each of the different stages of the two dimensions are now described.

4.2. The Technical Skillset Dimension

The Technical Skillset Dimension focuses primarily on what skills the individuals involved in the ICT4D project have and what level these skills are.

Technical Skillset: Limited
This level of maturity in an ICT4D project refers to projects that are small in size and focused primarily on the development aspect of the project not the technical side. The members of the project often believe that they will be able to obtain the necessary skills themselves or recruit the skills during the evolution of the project, but there are practically no technical skills in the project group at the start of the project.

Technical Skillset: Individual
At this level the project members are aware for the need for technical expertise in the completion of the project, but feel that the skills that are available within the project group, however diverse, would be appropriate for completing the project. It is at this stage of maturity that one often finds project members with development skills and expertise that overshadow their technical skills or abilities.

Technical Skillset: Organised
At this maturity level there is a concerted effort by the project members to include technically skilled people in the project group, often from the initiation of the project. There is a clear focus on providing a project that is technically sound.

Technical Skillset: Integrated
The final level of maturity is one where the technical skills of the project members are synchronised with the development skills of the project team, thus resulting in the technical aspect of the project being well aligned with the development aspect. These kinds of ICT4D projects are characterised by a high level of cohesion between the technical and development sections of the project team.

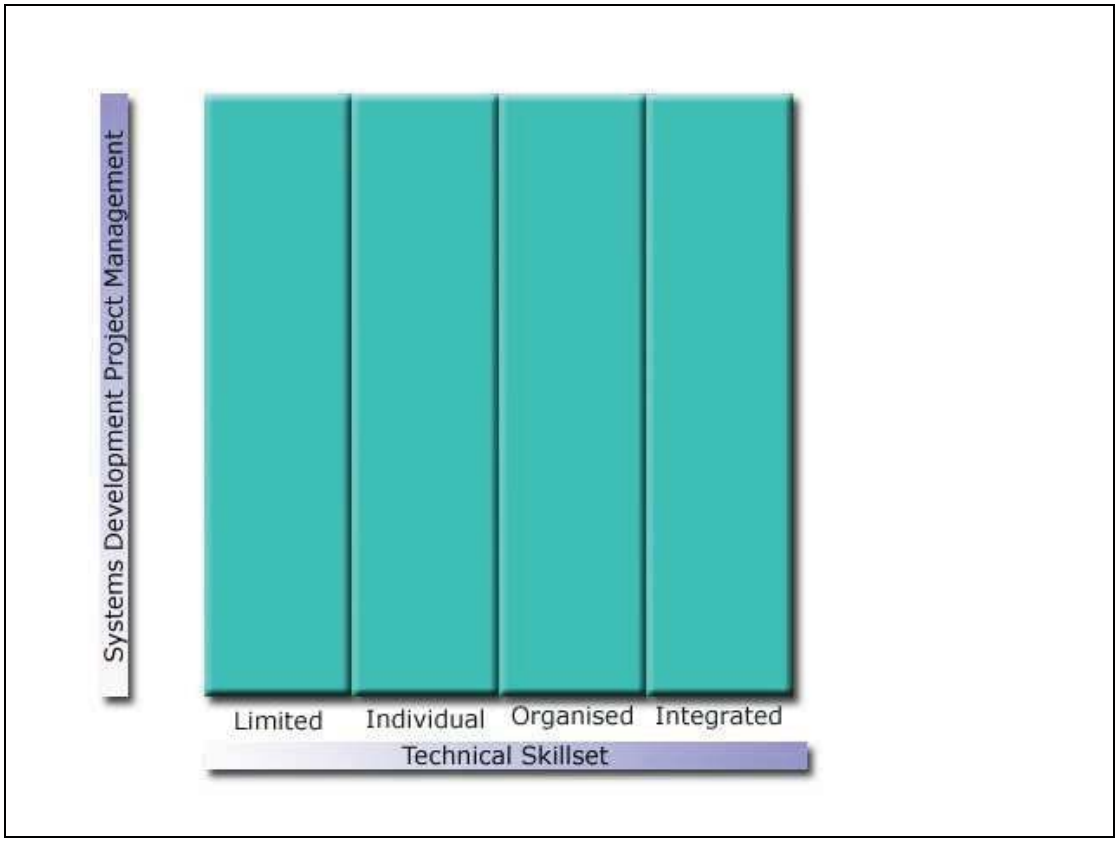

Figure 7: Technical Skillset Stages

4.3. The Systems Development Project Management Maturity Dimension

The Systems Development Project Management Maturity Dimension focuses on the ability of the project team as a whole to manage an ICT4D project. There is also an element of the need for individual skills to be able to perform the project management but in general this dimension focuses on the ability of the project team as a whole.

Systems Development Project Management: Limited
At this level of maturity the Project Management of the Technical side of the development project is generally completely absent or extremely limited. The focus of the entire project at this level of maturity is on the development issues without regarding the systems development project management at all.

Systems Development Project Management: Individual
At this level of maturity, project management process and standards are implemented on an individual basis, each person involved with the technical aspect of the project using their best knowledge of design and architecture without an overriding view or cohesion.

Systems Development Project Management: Organised
A well documented, well understood process of Technical Project Management is in place, guiding the technical aspect of the project, but without fully integrating with the development side of the project.

Systems Development Project Management: Integrated

At this final level of maturity the Management of the Technical aspects of the project are fully integrated with the Management of the development aspects of the project. Standards and documented procedures are not only used to ensure technical success but also to underpin the success from a development aspect.

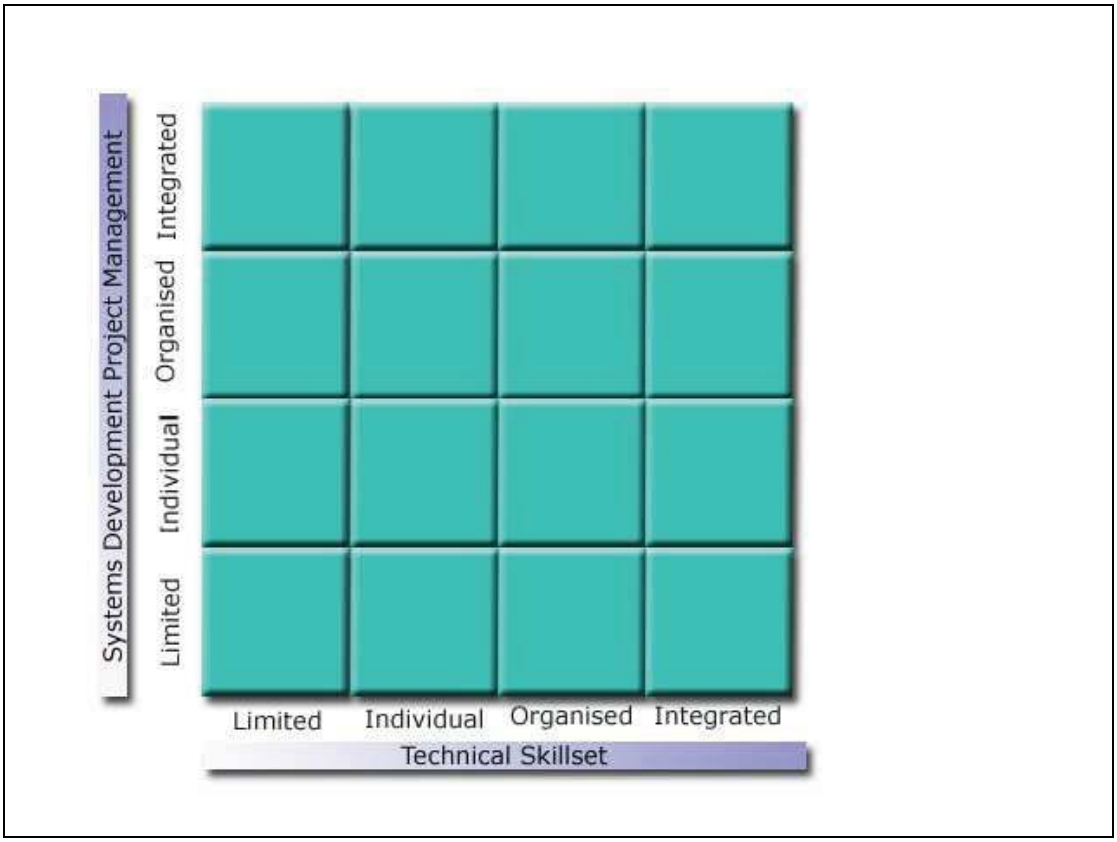

Figure 8: Combined Technical Maturity Model

Obviously, this model gauges the maturity of a project based on two dimensions so the possibility to having a project with a high level of technical skill but low systems development project management is highly possibly. Similarly it is important to note that while each dimension has been divided into four separate sections, each dimension is still a continuum. A project can fall on the border of two sections and two projects that fall within the same section can be at different levels of maturity within that section.

It is also important to note that the levels of Limited and Individual and also Organised and Integrated can be combined into a super-set. This in turn simplifies the model into the four quadrants that can be seen superimposed over the framework: the Limited quadrant, the Individual-Led quadrant, the Organisation-Led quadrant and the combined quadrant, as illustrated in Figure 4. These quadrants are useful when determining what the broad maturity of an ICT4D project is and what factors are important for the sustainability of the project.

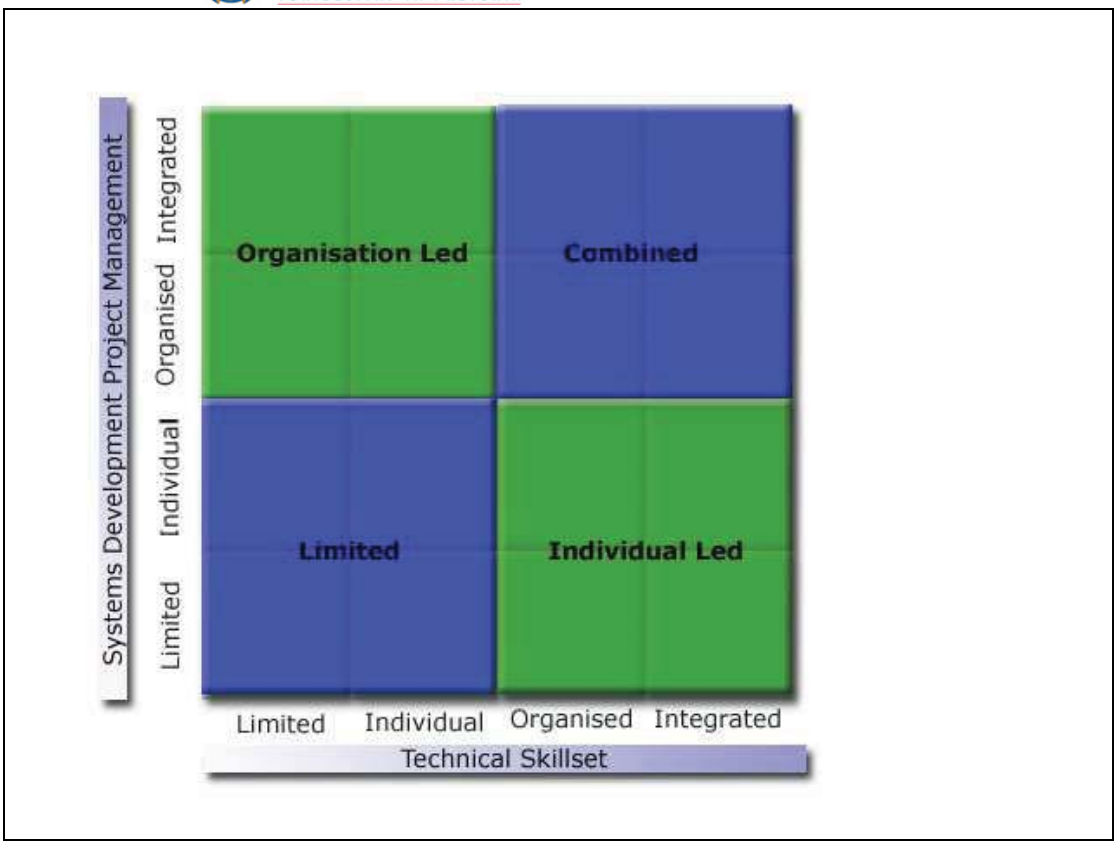

Figure 9: Technical Maturity Model Superset

4.4. Shortcomings of the model

The author has realised that there are several shortcomings with this model. Some of these were pointed out to the author at the conference were the model was presented, while other shortcomings became apparent during the interviews with the participants.

One of the main shortcomings that became apparent during both the model's presentation and the interviews was the complexity of the model. The change from a 5 level Capability Maturity Model to a 16 quadrant or level model appears to add unnecessary complexity to the model. This additional complexity does not necessarily add more useful information to the model but instead increases the complexity of using the model.

Another shortcoming mentioned during the presentation of the model, was that the model did not do justice to the complexity of an ICT4D project! This shortcoming appears at odds with the shortcoming previously mentioned but instead points to a deeper issue.
This issue is twofold: firstly the model only looks at the technical factors in an ICT4D project, and even though this is explicitly stated as the constraints of the model a lack of the context within which one must view the technical issues creates a shallow view of the problem space. Secondly the division between the *Systems Development Project Management* axis and the *Technical Skillset* axis, especially in the

context of an ICT4D project as a whole, appears to be rather artificial and to be creating a distinction that in practice is often not present.

A final short coming is the issue of a static model versus a process based model. The current model, as is, represents a frozen snapshot of the maturity of an ICT4D project. This leads to some possible problems, namely the danger of pigeonholing an ICT4D project and secondly not providing a process for changing the maturity of an ICT4D project.
The danger of pigeonholing an ICT4D project essentially refers to that fact that the model forces an ICT4D project to fall within one of the 4 quadrants and disregards the possibility that different parts of the project could be at different maturity levels and that maturity levels are dynamic and can and will change.
Secondly, the model only elucidates which level of maturity an ICT4D project is currently at. No mention is given to how or why an ICT4D project should attempt to move to different levels of maturity. As a tool for measuring the technical maturity the current model might be sufficient, but the basic research question focuses on using a technical maturity model to assist in the process of creating an ICT4D project. The current model does not provide much assistance in this regard.

The author used these shortcomings as a guideline to the semi-structured interviews and the literature review which were used in creating the Revised Model. This process is described in the next chapter.

5. Selected ICT4D projects

5.1. Introduction

This chapter takes the themes elicited from the literature review, combined with the themes discovered through the interviews and observations and incorporates them in the form of a revised model.

Firstly, a brief background to the different ICT4D projects which the interviewees and researcher were involved with is given. This is based on the documentation of the ICT4D project, the interviews and on occasions the author's observations. A textual analysis was then performed on the interviews and combined with the author's observations a new set of themes or aspects were elicited.

The revised model was then constructed based on the themes elicited from the interviews and observations as well as the shortcomings of the initial model.

This section provides some background on the various ICT4D projects that the interviewees and author were involved with. These descriptions are based on data from the documentation that has been written on these projects, as well as the information from the interviews.

This background information is provided to ensure that the projects and the themes elicited from them in the analysis, are seen within their correct context. Another, perhaps more pertinent, reason for providing the background is to compare the initial goals of the project with its current status. Hopefully this comparison will provide some insight into the maturity and sustainability of the specific project.

5.2. SEIDET project.

Participants:

HT (1) was involved in the SEIDET project as a site for hosting research meetings of the GSS project. MM (2) was involved with research on computer based mathematics training at SEIDET. LW (3) was involved in teaching computer literacy to students at the SEIDET centre, while HL (4) was involved in the initial setup of the SEIDET centre.

Background:

The SEIDET project has been the focus of research for various institutions, amongst which is the University of Pretoria, for a number of years. Thus there is a significant amount of research available, from the University of Pretoria, which has used the SEIDET site as a basis for their activities. The author has used some of the information from this research to give some background on the project itself. One

example of this is the basic description of the activities of the SEIDET project, given by Phahlamohlaka and Friend:

"The Siyabuswa Educational Improvement and Development Trust (SEIDET) was founded in 1992 in Mpumalanga Province, South Africa, as a non-governmental, community-based initiative to provide supplementary education for young people in three rural towns with a legacy of substantial educational disadvantage." (Phahlamohlaka et. al.: 2002)

The author had numerous visits to the primary centre located in Siyabuswa (one of the three rural towns mentioned). The centre consisted of various classrooms, an office with printing and photocopying facilities and a computer lab.

The important thing to note about the SEIDET project is the "community-based" aspect of it. During each of the author's own visit to the project the community was heavily involved in the projects and research that occurred. The project had the support of local traditional leaders as well as the local representative of the government and the current ruling party (of South Africa).

Because the centre was community-based and funded and assisted primarily by the community and the NGOs its facilities were often not as advanced as other similar centres, for example, those mentioned in the MPCC evaluation project or even the Lebotloane MPCC. This is an interesting fact to note when comparing the success of the SEIDET project to other projects that had, to some extent, better and more advanced technologies.

Initial Goals:

As mentioned in the quote from Phahlamohlaka the SEIDET initiative's main purpose was to provide supplementary teaching to the school going youth of the surrounding areas.

Use of ICT in the project:

The primary use of ICT in the project was firstly as a teaching tool, for example Participant 2's (MM) research on computer based mathematics training, and secondly as a focus for computer literacy training, for example Participant 3's (LW) computer literacy courses.

ICT was also used in terms of communication between the research sponsors and the community, e.g. LW (3) used a satellite link to give distance based classes to some of the students at the SEIDET site itself, as well as being used in day to day administrative tasks, e.g. sending faxes, printing and making photocopies.

Current Status:

As of the author's last visits to the centre, in 2006, the SEIDET Project was still running with various degrees of success depending on the

specific project. The supplementary education programs had been highly successful with some of the students of those programs managing to reach postgraduate levels at the University of Pretoria. The computer literacy classes where also still continuing even though there were various setbacks which will be discussed in more detail in the analysis.

5.3. GSS project

Participants:

HT (1) was involved with the GSS project as the chief researcher. The author was also involved as a member of the research group for this project.

Background:

The GSS or Group Support Systems project was a project aimed at using theories of collaboration and e-collaboration to inform members of affected communities in South Africa about their rights concerning Administrative Justice. The research focused on using workshops to both inform communities about their rights concerning Administrative Justice, in the form of case studies and simulations, as well as experimenting with the concept of using e-collaboration tools for e-government in especially poor and rural communities.

Of special interest to the author concerning this project is that it was held at three different sites, as reported below:

“Three field locations in three different Provinces were selected to carry out the simulation exercises; Siyabuswa in the Mpumalanga Province (hosted by SEIDET), Lebotloane in the North West Province (hosted by Leretlabetse Multi Purpose Community Center) and several Civil Society organizations (hosted by the University of Pretoria) in Gauteng.” (Twinomurinzi: 2006)

The point of interest for the author was the fact that two of these centres involved in this research overlap with other projects that formed part of the interviews conducted by the author, namely the SEDIET Centre in Siyabuswa, which formed part of another two of the interviews, and the Leotloane Centre, which, as an MPCC could be used as a concrete example of what was generalized in the interview concerning MPCCs.

This meant that the author was able to gain multiple perspectives and interpretations of the same sites and similar projects, leading to a deeper understanding of ICT4D projects in general.

The research project consisted of workshops held at the above mentioned sites, as well as other research. The author will focus more on the workshops seeing as these involved a direct interaction with the communities involved and were held within the geographical areas of the communities as well.

Initial Goals:

The overall focus of the project was to find oppurtunities to implement and research ICT-based (in specific web-based) GSS tools for use within e-government contexts in South Africa. The focus would be especially on rural and poorer communities, similar to the communities found at places like the SEIDET centre mentioned previously.

Use of ICT in the project:

As mentioned earlier the collaboration and interaction of the communities with the government, would be facilitated via electronic means, e.g. web-based GSS tools, specialised Group Support Software or even something as basic as email. To test these types of technologies, during the workshops mentioned earlier, a computer lab, with networked computers was used.

The specialised Group Support Software was installed on these computers and was used to test a hypothetical example of an e-government scenario.

Current Status:

The project, as of the writing of this dissertation, is approximately two thirds through its initial life cycle. The project is advancing through its various phases and, being incomplete currently, is difficult to evaluate in terms of maturity and sustainability.

5.4. MPCC evaluation

Participants:

JP (5), was involved in the MPCC evaluation project as a researcher, working with the data produced from the project.

Background:

The MPCC evaluation project was more of a meta-study than a focus on any single site or initiative and thus covers more broad themes and generalisations. The actual scope of what falls under an MPCC or telecentre is pretty wide, as there are a number of possible areas of distinction between the different types of centres. For example some are government funded and others are purely donor funded, some have a focus on providing ICT facilites and others have ICT facilities only as one component of a larger whole. Some centres are urban and others are rural with their various inherent differences. The following is a list of the different types of telecenters and ICT projects that has been initiated in South Africa in the recent past and gives an idea of the range and scope of the different centres:

"• Telecentre launching actions by the Universal Service Agency (US) (Universal Service Agency 1997).
• The Department of Education's support of the Schoolnet SA project (Riordon 2002 Schoolnet SA 2001 and 2003) that is aimed at providing schools with Internet access.
• The Department of Communication's Web Internet Laboratories (DoC-WIL) project at previously disadvantaged tertiary education institutions (Department of Communication 1999).
• The Department of Communication's Info.com series of projects, for example the "Public Information Terminal" initiative (Mahlangu 2001).
• The Multi-purpose Community Centres (MPCCs) of the Government Communication and Information System (GCIS) (Government Communication and Information System 2002)." (Conradie: 2003)

Another issue is that in some cases the terms telecentre, MPCC and others are used interchangeably and each has different meanings for different people.

Because of these problems of scope and differentiation the author will focus on specific examples of MPCCs obtained from the data collected in the interview and attempt to correlate that with the author's own experience and the experience of the other interviewees in similar situations.

Initial Goals:

As mentioned earlier, the author will focus more on individual examples of MPCCs, and thus the initial goals mentioned here are those of MPCCs in general and not of the evaluation project.

MPCCs in general are an attempt to provide a community centre, generally for rural and poorer communities, where various services, governmental or private, can be provided to the members of the community. For example, the Department of Home Affairs would use the community centre on certain days of the week to provide basic administrative services to the community, like handing out new Identification Documents etc.

Another service which a lot of these MPCCs provided was the use of a computer lab, often with an internet connection as well.

Use of ICT in the project:

As mentioned earlier the focus of many of the MPCCs was the installation of a computer lab. Usually these computer labs consists of a number of networked computers, with an internet connection as well as printing and copying facilities. Various labs will have different

software sets loaded, some going for proprietary software and others for open source software.

Current Status:

The actual evaluation project has been completed but the debate on the use of telecenters and MPCC as well as their implementation is still continuing in South Africa. The author visited two examples of MPCC and telecenters working on the GSS project which can be used as examples of the current status of MPCC and telecenters in South Africa.

In the one example the telecenter, namely at Siyabuswa, even after having a serious of setbacks, has been able to continue functioning and provides a service to the community. This shows an example of sustainability in a telecenter. The other example is of an MPCC, namely the Lebotloane MPCC, in which the computer lab is not being used for its intended purpose because of technical difficulties. This shows the opposite picture to the Siyabuswa centre where a lack of technical maturity has led to a failure in sustainability.

5.5. UThukela District Child Survival Project

Participants:

EB (6) was involved in this project as a funder and as an evaluator of the project.

Background:

The UThukela District Child Survival Project (TDCSP) was a project with various facets, focusing primarily on maternal care, child survival and HIV/AIDs. Further background is given below:

“
The UThukela District Child Survival Project (TDCSP) was selected by the National Department of Health as one of three learning sites for the development of a community component of child health in 1999. The design of the community based child health IS was part of this larger child health project. The community-based child health IS was implemented in OKhahlamba, which is one of five municipalities in the UThukela District of KwaZulu-Natal on the eastern coast of South Africa. The population of OKhahlamba Municipality is mainly rural, poor and relatively under resourced.” (Byrne, Sahay : 2007)

Initial Goals:
The initial goals of the project was to enhance the maternal health and child health care as well as the treatment of HIV and AIDS in the UThukela region as summarised by Byrne:

“The premise behind developing a community-based child HIS within this larger child health project was that the vulnerability of children can be tackled by employing two interconnected

strategies. The first is through the creation of awareness of the situation of children and the second is by mobilising the commitment and action of government and society to address this situation." (Byrne, Gregory: 2006)

Both of the above mentioned strategies would be attempted through the use of an HIS (Health Information System) that would be interconnected with the local and national Health Information Systems.

Use of ICT in the project:

Part of the TDCSP 's activities was an Information System, or HIS (Health Information System), to monitor the health of the children within the community, known as the child health community-based information system (CBIS) (Byrne: 2004). While this information system did not necessarily contain technological artefacts in its initial stages, it included much work with the implementation of data flows and paper based systems within the community.
Another aspect of the child survival project was its connection with the District Health systems, which involved the training of medical workers to use the HISP software and combine it with the information from the community level.

Current Status:

The UThukela District Child Survival project is definitely a successful project, seeing as it has been in place for 13 years up to this point. The project also had a definite impact in terms of providing employment and improving the ability of the people in the community to obtain employment. The longevity of the project and its continued survival points to a high level of sustainability.

5.6. Computer Literacy Training

Participants:

HT (1) was also involved in the computer literacy training project.

Background:

The computer literacy training program is a program that is run as part of the Continuing Education initiative at the University of Pretoria (CE@UP). CE@UP is a 'for-profit' arm of the University of Pretoria designed to provide training services to people outside of the regular structures of the University, e.g. business people, large corporations etc.

The computer literacy training program was held at the Mamelodi Campus of the University of Pretoria, which is in the Mamelodi township, a previously disadvantaged part of the greater Pretoria area.

Initial Goals:

The Computer Literacy program focused on teaching people from rural areas basic computer skills which included everything from switching the computer on to basic internet usage.

Use of ICT in the project:

The use of ICT in the Computer Literacy Training project was in the computer laboratories that were used to give the classes in and that the students used for practice.

Furthermore there is the implication that ICT usage is the eventual goal of the project, i.e. enabling the students to use and operate various types of hardware and software which they might encounter.

Current Status

While the actual training courses have been completed at the time of writing this dissertation, and as such there is no current status, there is still the feedback from the participants as a possible measure of the success or sustainability of the project. While it is difficult to measure the overall effects of the project, the responses of the participants coming back and saying that the course has improved their lives, allowed them to obtain better playing jobs etc. appears to point to a degree of sustainability in the effects of the project.

5.7. Conclusion

The five different projects, even though all had different scopes in terms of duration, funding, focus and geographic, have the common element of ICT4D, either centrally or peripherally as a focus. Most of the projects focused on small rural communities with a localised ICT4D centre or service, servicing the needs of that community.

A number of the projects also involved researchers from academic institutions and provided some valuable insight into ICT4D in an action research context.

The varying degree of success and sustainability also provides a useful comparison in terms of technical maturity and its effect on these issues of success and sustainability.

6. Themes elicited from the analysis of interviews

This section discusses the major themes elicited from the textual analysis of the interviews. The themes elicited are compared to themes discussed in the literature and are used to provide guidelines for constructing the revised model. In general themes were elicited that either hinder or encourage sustainability. If the theme hinders sustainability then a counter action was suggested for the model. If, on the other hand, the theme encourages sustainability, then the implementation of that theme was suggested for the model.

Additionally, one overall research question that this dissertation is addressing is whether a technical maturity model can assist the development of an ICT4D project, which in effect implies that technical maturity is important in an ICT4D project, especially in terms of sustainability. This statement is not necessarily obvious and requires some more investigation. For this reason the theme of technical failure, and its effect on the success and sustainability of a project, was one which the author tried to elicit in the response of the interviewees.

6.1. Process of eliciting themes

In general the process of discovering themes was to use a basic form of textual analysis whereby the author looked for themes, concepts or similar events that repeated themselves through the texts (i.e. the interviews). The most common and the most prominent of these was then selected and grouped into a selection of major themes. Each theme is discussed in more detail, based on the interviews, the author's observations and the literature.

The following is a list of the themes elicited from the textual analysis.

- Existence of technical skills (as related to sustainability)
- Assumptions made about the project and its members
- Socio-technical issues
- Importance of community involvement
- Political and cultural factors as linked to success
- Examples of technical failures leading to overall failure

Some of these themes are further described, but others are not elaborated on as they do not fit the focus of the dissertation. These are still themes or concepts that are worth mentioning in the context of an ICT4D project.
The two themes, 'importance of community involvement' and 'political and cultural factors', while important for ICT4D projects are not part of the focus of this dissertation, because they do not directly impact on the socio-technical side of an ICT4D project. While they can have an effect on the technical aspects ICT4D project (and they do!) they are not the primary forces acting on these technical aspects and for this reason the other four themes where expanded on in more detail rather than these two themes.

6.2. Theme 1: The existence and absence of technical skills

The overall hypothesis of this dissertation is that technical maturity is required for a successful and sustainable ICT4D project and thus in

this section examples and themes are discussed from the interviews where technical maturity led to the success and sustainability of the project. It is more difficult to clearly say that this specific example of technical maturity definitely lead to the success of a project but it is possible to see some kind of correlation between the level of technical maturity and the existence of technical skills and the success and sustainability of a project.

In the GSS project, as above, the HT (1) also doubled as the technical expertise in the project. In answer to a question about the critical factors for the success or perceived success of the project, he mentioned that the technical support that was given paved the way for the social success of the project.

The MPCC evaluation project also provides examples where the existence of technical skills within the project or "within reach" of the project (i.e. the project members could easily obtain those skills) resulted in a higher likelihood of success. The fact that one of the researcher's husband was involved in the project as technical support, and that he was called out often to go along with her and assist, provides an example of the need for technical skills and technical support in an ICT4D project.

In the interviews
some examples from the cases indicated that a lack of technical maturity or a technical failure led to some degree of failure or lack of sustainability in the particular project.

The first example comes from the Lebotlane MPCC that was a part of the GSS research project. The interviewee mentioned that the technology that was available at the MPCC was of a very high quality, and even went so far as to say it was probably even more superior than the technology used as a part of the project at the University of Pretoria. The problem was that even with this kind of superior technology the computer lab at the MPCC was not in a working state because of technical problems, such as viruses and software problems. Because the users of the labs had downloaded inappropriate material for such a lab the computers had become infected with viruses and were slowed down with the number of unnecessary programs and software which were running. Furthermore, because of the viruses and unnecessary software on the computers the network in the lab was not performing optimally.
This led to a decision by the technical staff of the lab to replace the current wired network with a wireless one to alleviate the networking problems. Unfortunately this was fixing the wrong problem.

This is an example were there was a lack of technical skills in terms of correctly protecting the computers against viruses and malware and a further lack of skills in correctly diagnosing the problems with the network. Interestingly there was also an element of social skills required. A correct policy and its enforcement regarding viruses and downloads in the lab would have prevented much of the problems that occurred.

The idea that these types of centres' success and sustainability are vulnerable to a technical failure is borne out by similar examples from the MPCC evaluation project. The interviewee involved in this project mentioned an example he saw of the computer lab in an MPCC being used by teenagers form the community to play computer games and not being used for the purposes it was initially designed for.

Another instance of a technical problem causing the possible failure of such an MPCC initiative comes from the same interview. The interviewee mentioned how one MPCC centre did not have its internet connection for several months due to a lack of delivery on the side of the telecommunications provider. While one can argue that this example also has a social aspect in terms of an entity beyond the control of the project not delivering as planned, it gives an example of how critical the technical aspects of an ICT4D project can be. Here one, relatively simple (in terms of how easy it should be to get the telecommunications provider to provide it) technical component of the project is not present and the projects success and sustainability is in danger.

6.3. Theme 2: Assumptions made of inherent technical expertise of project members

The theme of assumptions made about the project, its scope, the project team and their skills etc. is an interesting one because the author did not expect it to appear as a theme. The interview questions were designed to elicit information about Technical Maturity in an ICT4D project and focused on technical skills in the project group.

What was also interesting about this theme of assumptions was not only that it was unexpected but also that it provided a possible new angle unto the issue of Technical Maturity. In many cases the assumptions that were made about a project or its team members were about the technical skills of the members or the technical needs of a project. While cultural and social issues were also the targets of assumptions in the projects under discussion it was interesting to see how many times Technical Issues and especially technical skills were the focus of an assumption.

During the analysis of the interviews the theme of assumptions of technical skills and issues cropped up in every case discussed in the interviews. It seemed to be an especially prevalent theme when it came to cases involving action research.

In the GSS case the interviewee mentioned the fact that even though he was involved in the project as a researcher, to setup and facilitate the Group Support workshops, his technical skills were often called for. What he found interesting was the amount of times he would have to travel to one of the MPCC or telecenters to ensure that the technology was working and even then how few people knew about him doing all this fixing and maintaining. As he mentioned: "No-one asked whether it was working or not. It's IT, it must work!"

In the UThukela District Child Survival project there was also a case of assumptions about the technical skills of project members, though less obvious than in the GSS case. In his case there was also a lack of technical skills in the community the project was focusing on and the researcher interviewed, who was involved in the project in terms of funding and evaluation, was often times required to exercise her technical skills to assist the project. The severe lack of technical skills meant that something like operating a video camera was seen as a technical skill. Mentioned was made about the people from the community being nervous of using the technology and there was a subtle assumption that the outside researcher would have the necessary technical skills to assist them.

In the MPCC evaluation project once again a similar tale is told. The purpose of the project was the evaluation of the sustainability of various MPCC and telecenters. According to the information obtained from the interview one of the researchers in the project group ended up taking her husband along on visits to these centres. Because he had a strong technical background they often ended up fixing software and even hardware issues in these centres and spending more time on this than the actual planned interaction with the people in these communities. This is another example of the subtle assumption made about the technical skills of project members in a non-technical capacity.

In the interview with one of the researchers who assisted in the planning and creation of the SEIDET project the theme of assumptions of technical skills surfaced once again. The researcher stated that the project team felt that any specific skill they would require in setting up the SEIDET project, and especially in setting up the computer labs could be obtained from the researchers in the project team or from the department at the University. For example a colleague of the interviewee provided a demonstration on web design skills to the community. Here the assumption was made that the necessary skills could be found from amongst the project members or colleagues of those members.

This assumption also questions the sustainability of a project, especially in terms of technical skills. One cannot assume that there will always be someone who can provide those necessary technical skills and support.

6.4. Theme 3: Dissemination of information and feedback

The assumptions of technical skills, while the most numerous, where not the only assumptions that were mentioned in the interviews. Further assumptions that revolved around the dissemination of information to the communities involved, and feedback obtained from the communities were also observed through the interviewees

responses. The importance of good communication with stakeholders in any ICT project makes this a significant assumption to look at in terms of the sustainability and success of any ICT project.

In the computer literacy project at the SEIDET labs an assumption was made that the usefulness of the classes given would be spread by word of mouth through the community. In actual fact what happened was that the participants in the classes, who were mainly women, kept the fact that they were going to class a secret. This was done so that their husbands and other men in the community wouldn't see them as trying to place themselves above or better than the existing hierarchy. There was also a question of whether the technology provided in the computer labs was really necessary. An assumption was made about the utility of the technology provided.

In these examples an assumption means that the project was initiated or continued with insufficient information as to what was really required and what resources the project really had. The assumption that someone will be able to handle any technical problems can cause stress on members of a project team as they will now have to perform their research tasks as well as technical support tasks.

This can impact the overall technical maturity of the project by misrepresenting the required technical skills at the beginning of the project, or by misrepresenting the amount of technical support the staff of the project need during the project. These misrepresentations can cause loss of resources in the form of time, money or even people.

6.5. Theme 3: A requirement for Socio-Technical Skill Sets

The theme of socio-technical issues is one that the author was hoping would be clarified in further detail through the interviews. For this reason the question was added to the interview as to what the interviewee sees as defining "technical" and how to differentiate between social and technical as concepts.

What was of interest to the author was that while a number of the interviewees stated it was difficult to differentiate between technical and social, especially in terms of skills, numerous examples where given of socio-technical skills. This theme of combining social and technical aspects, especially in terms of skills is one that is explored in further detail here.

HT (1), who was involved in the GSS project as mentioned earlier, was involved as the technical support as well as the project manager of the research group. What was interesting was that he made mention of the fact that pure technical skills were not sufficient in solving the technical problems. He also mentioned that he wasn't sure that someone with a purely technical background could have fixed those problems that occurred mainly because they were user related problems. He gave the example of a file on a computer being moved to another location without the user's knowledge, and that it was a socio-technical problem that needed fixing

, because it required a social ability to interact with the user and discover their exact problem and need.

Furthermore, what was interesting was that this same interviewee classified the skill required to solve these kinds of socio-technical problems as “A non-studied skill”. In other words these kinds of problems need experience and inter-personal skills to solve and not necessarily just “book knowledge”.
This same Participant also made mention of the fact that he feels that Technical Skills in an ICT4D project must be user driven, and must be beneficial to the user.

LW (3), who was involved in the Computer Literacy Project at SEIDET, made a similar comment about what defines a technical skill. This interviewee defined it as “Social skills in helping the participant use the IT”.

Another interesting aspect of defining technical skills was raised by EB (6), who was involved in the UThukela District Child Survival Project. This interviewee mentioned that technical skills are difficult to define because they refer more to levels of ability. The interviewee feels that, for example, getting a computer to do something for her, especially if it is using a skill she doesn’t yet have, is seen as technical, whereas competent users would not consider this technical at all.
Furthermore, the interviewee stated that the definition of what is a technical or non-technical skill is, is often socially defined.

Participant 6 (JP), who has assisted in the MPCC evaluation project, had experienced a lot of the same problems with socio-technical issues in the centres that had been part of the study. While he did mention that one needs those basic technical skills, e.g. hardware installation and software knowledge, more importantly were, once again the people skills surrounding that technology. As he explained that one “needs patience to deal with people who have no idea how these ‘boxes from the sky’ work.” Also one needs the right “personality to work with someone who tries to explain with insufficient terminology what they want to do with this machine”.
While the participant mentioned that one could be trained in terms of these interpersonal skills it is mostly a personality trait that is required and often needs to be inherent in the project member.

Another interesting example comes from MM (2), the researcher who helped train teachers at the SEIDET facilities in the use of specific educational software. This participant felt that the teachers had sufficient technical knowledge to use the software they were trained on, but their life world had certain obstacles to the integration of the software and its use. For example, trying to use the software in a classroom without PCs can be quite daunting if not down right impossible.

The final view on what can be seen as socio-technical skills and what defines the difference between social and technical is provided from the interview with a researcher that assisted in the setting up of the

SEIDET project. He mentioned that a merely technical skill can be seen as "expertise associated with the manipulation of the artefact", but can also include knowledge associated with the artefact or "machine", e.g. what can be achieved with it, what are the rules governing it, how does it work etc.
This second definition refers more to the socio-technical skills associated with using a piece of technology and hence this interviewee also mentioned that it is very difficult to draw the line between social and technical.

Overall the theme of socio-technical skills and issues here refers to the interviewees own experiences that technical skills on their own were not sufficient and there was a need to use those skills in the correct social context. This leads to the idea of needing "socio-technical" skills that are beyond just the ability to use of technology but also encompass the ability to apply the technology correctly in the context of the problem.

6.6. Summary of themes

From this analysis the following main ideas or themes were elicited, from the interviews, that pertain to the issue of technical maturity and sustainability:

- Firstly, the twin issues of technical failure impacting on the chances of sustainability and technical maturity increasing the likelihood of success of the project was discussed.
- Secondly, the issue of assumptions made about the project and its members, and how this can impact the project and its assessment was discussed. Tangentially the issue of assumptions made about the communication in and around an ICT4D project was discussed.
- Finally the concept that the issues faced by an ICT4D project, and the skills required to deal with these issues do not always neatly fall into the definitions of either social or technical but indeed fall under a third socio-technical heading.

7. The revised model

This chapter assembles all the themes, concepts and issues analysed and discussed so far into the form of a maturity model. The model will be informed by the following categories of issues:

- The short comings of the previous model as discussed in chapter 4.
- The authors own observations on site and reflections over time
- The themes elicited out of the interviews of various ICT4D projects described in the preceding chapter (Chapter 6)

Each of these categories is briefly reviewed to highlight the pertinent issues which arose in terms of its influence in the creation of the revised model.

7.1. Shortcomings of the previous model

In chapter 4 three main shortcomings of the model were outlined and required improvement in the revised model. These are described below along with the addition of possible solutions to these issues.

This first shortcoming was the complexity of the model. A 4x4 matrix of possible maturity levels adds unnecessary complexity to the model, while not necessarily providing any additional information or use. To rectify this in the revised model a simpler format of four or five distinct maturity levels is given.

The second shortcoming of the model is that it is static, i.e. it only shows the maturity of the ICT4D project as a slice of its entire lifecycle. The author feels that for the model to be of use and be applicable it needs to be more process based, showing how a project can move through different levels of maturity. To rectify this the revised model includes brief indications as to how a project can move through the different levels of maturity.

The final shortcoming in the initial model is that it is not holistic enough and focuses on the technical aspect of an ICT4D project sole in a vacuum. While the intent of the model is to focus on the technical maturity of such a project it is important to include an indication of how these technical issues align with the social, cultural and political context of the project.

7.2. The author's own observations and reflection

The author's own observations align well with the themes elicited out of the interviews, especially the need for technical maturity in an ICT4D project as well as the importance of taking both the social and technical issues into account together as a socio-technical whole.

What is interesting in terms of the authors own reflections is how they, and the opinions the author has had on this topic, have changed over the course of this research. Based on this change, certain aspects of the revised model were seen as more important than in the initial model.

The author started this research with a firm belief in the need for stronger technical maturity in ICT4D project. At this time the author acknowledged that cultural and political factors are important, but felt that there was a severe lack of focus on the technical aspects of ICT4D projects.

As the author researched the subject of technical maturity in ICT4D projects, and visited the sites mentioned in this dissertation, the author came to realise that technical maturity on its own would only solve a part of the problem of sustainability. Also, there was a danger of focusing too much merely on the technical aspects of ICT4D projects and not viewing the technical maturity in the whole context of the project.

This observation of the author was confirmed from the various responses in the interviews, and the author realised that for a high level of technical maturity (and thus a high chance of sustainability) any technical skills or aspects within an ICT4D project need to be seen within the social context of the project as well.
This observation eventually lead to the inclusion of the final stage of the revised model as will be shown later on.

7.3 Themes elicited out of the interviews

While a number of different themes or aspects were elicited out of the interviews, not all of them directly impact the creation of the model. Some of the themes support the need for such a technical maturity model while other themes deal with issues that are not pertinent to the model, but are generally applicable to ICT4D projects. Only the following themes were directly considered in the revision of the model.

Firstly, the issue that this cannot be a technical model alone as the social issues often have a marked impact on the technical maturity and visa versa. This ties in with the theme of the need for technical skills in a project, but not in isolation. This means that the model will in fact not be a technical model, but a socio-technical model.

Secondly, the repeated instances of assumptions of technical ability and maturity show in the interviews will need to be taken into account by the model. The model will need to clarify the importance of accurate communication and have the correct assessment of the skills, resources and requirements of such a project.

7.5 The revised model

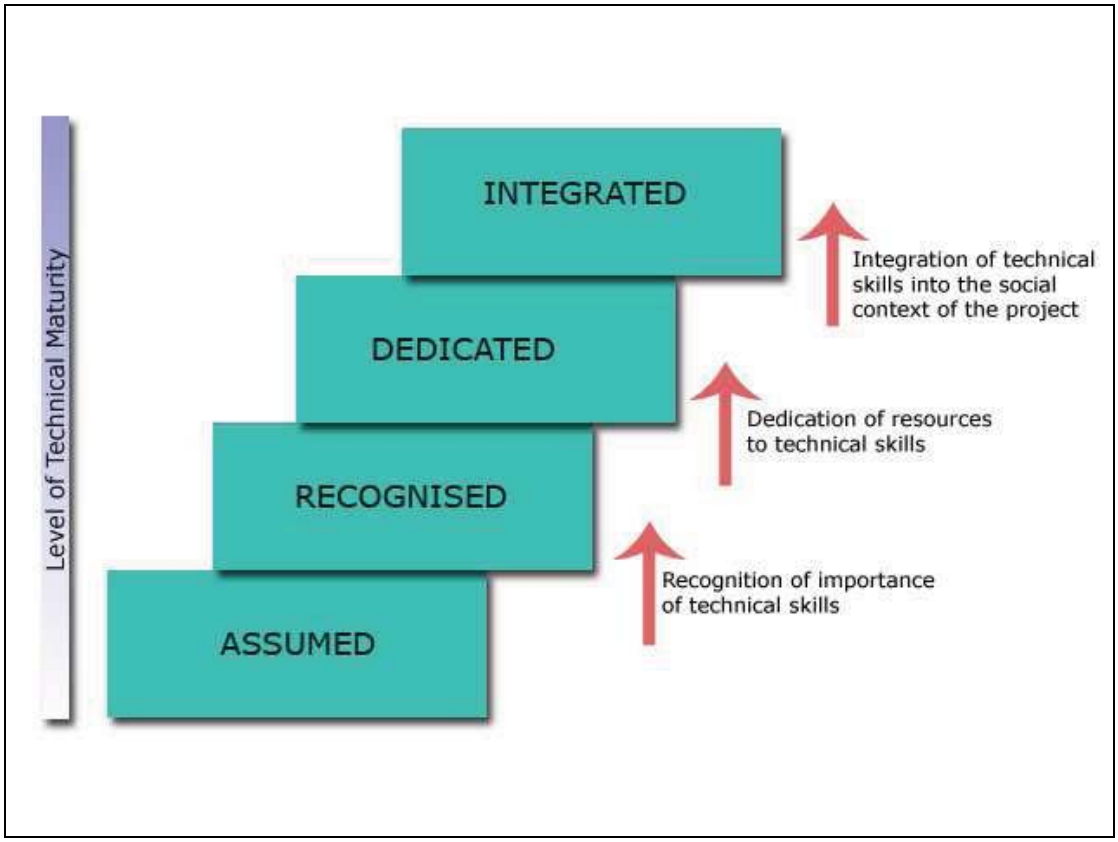

Figure 10: Revised Model

This revised model, as shown above, returns to a more traditional and simplistic maturity model. It contains different levels of maturity and indicates how to transfer from one level to another level.

While it is implied that the model has four different levels the differentiation between the different levels is not explicitly stated, i.e. that "Assumed" is level 1 etc. In other words the model relates more to a technical maturity continuum than specific stages. This was done because it is firstly quite difficult to define precisely what maturity level a project is in, and second, it is not the intention of the model to 'pigeonhole' a project or system in this way.

The model includes three 'transfers' or ways in which a project can move upwards in terms of maturity, in essence moving up to the next level.

7.5.1. The levels of the model

The levels need to be seen as general indications of maturity and it needs to be recognised that it is possible for parts of a project to be at different levels of technical maturity.

The first level is the Assumed level. This level, as the name states is where there is an assumption or assumptions prevalent in the project as to how the technical aspects of a project will be handled. There will be no specific allocation of resources towards the technical aspects of the project either during the planning or the execution stages.

The second level is the Recognised level. This level is more mature than the Assumed level because at this level there will be no more assumptions about the technical aspects or requirements of a project. The project members will know what kind of technical skills are required for which parts of the project, even though they might not have allocated resources to these areas yet.
This stage is made distinct from the next, the Dedicated level, for a very important reason. Sometimes an ICT4D project does not have the resources to fully implement the technical aspects, or perhaps the project goals can be achieved sufficiently with a low technology solution. In this case it is important that this is recognised and a decision can be made as to the level of technical involvement in the project.

The third stage is the Dedicated stage. It follows from the recognition of the importance of technical skills in the previous stage and relies on a decision on the part of the project team to dedicate a sufficient amount of resources to the improvement or collection of the technical skills for the project.

The final level is the Integrated level. This refers to the point when the technical aspects of the project are integrated with the social goals of the project. Often times the introduction of a technology into the lives of a community can cause a significant disruption in the daily lives of that community. At the Integrated level of technical maturity is there not only a dedicated technical resource, but the resource is applied in such a way that it is aligned with the social context of the project.

It was shown from the data gathered that technical maturity has an impact on sustainability and thus there does not need to be an explicit element of sustainability in the model. Even so the Integrated level implies a level of sustainability as it is at this point that the technology is not disruptive to the social activities of the project and they have thus become part of the project. While this inclusion of the technology as part of the project does not guarantee success or sustainability it does improve the chances of it occurring.

7.5.2. The ‘transfers’ between levels in the model

Between each level of the model there is a transfer or process which outlines how one moves from the one level of technical maturity to a higher level of technical maturity.

The first transfer occurs between the Assumed and Recognised levels. To move a project through this transfer there needs to be a clear and official recognition of the technical skills needed in this project. If there is no need or a minor need for technical skills this needs to be recognised as well to ensure that resources aren't wasted on unnecessary requirements.

The second transfer occurs between the Recognised and Dedicated levels. Once the need for technical skills has been recognised within a project it is important to devote sufficient resources to them. Hence to move a project through this transfer there needs to be a dedication of resources (either personnel, time or money) to acquiring the necessary technical skills and implementing them.

The third transfer, and perhaps the most difficult, occurs between the Dedicated and Integrated levels. During this transfer the technology that is being used, and the technical skills that are managing the technology, need to become part of the social context of the project. What this means is that the disruptive nature of the technology that has been introduced in the Dedicated level needs to be minimised as much as possible, while sill providing the utility for which it was implemented in the first place.

There are various ways to achieve this final transfer and the best option depends on the conditions of the project in question, but some general examples can be given. The first method is to transfer the technical skills from the project team to the community for which the project is being developed. This not only adds a degree of sustainability to the project but ensures that the technology and its use are closer aligned with the actual needs of the community.

Another method is train a domain expert, for the project group, to the use of the technology. In this way someone who understands the social context can also use the technology being provided and the socio-technical issues can effectively be integrated in a single person or position. An example of this would be training a medical doctor in using the software installed in a rural clinic.

8. Research questions revisited and future research

Various research questions were stated earlier in the dissertation as the focus points to guide the research. Through looking at the data presented and gathered (from interviews, the literature and observation) and by synthesising the data into the form of a model, some clarity and answers can be given to the research questions. Each of these questions are not addressed.

8.1. What is ICT4D?

This question was asked to define the scope of an ICT4D project for the purposes of this dissertation. Various definitions are given in the literature and the author adopted a version of these definitions for this dissertation, namely: ICT4D is the use of information and communication systems and technologies to address the needs of poor, rural and/or underprivileged communities.

The process of analysis of the data as well as the construction of the model has confirmed this general definition. The projects that the author observed, and that the interviewees were involved in, were identified as ICT4D projects and also conformed to the definition given above.

An interesting side aspect, which came up through the research but which wasn't really a question initially, was that a lot of the research projects that were analysed were in fact Action Research examples, and the interviewees were often involved as researcher first and development workers second. This is perhaps another avenue of research that can be explored in further studies.

8.2. What is sustainability, especially in terms of an ICT4D project?

This research question attempted to define sustainability, as the author suspected that technical maturity can lead to increased sustainability. The initial definitions of sustainability, as garnered from the literature can be summed up as follows: The sustainability of an ICT4D system or project is a measurement of when no further intervention is required by the donor agency or agencies to keep the system of project running.

This was confirmed by examples from the authors' observations and the literature. The two longest running projects examined, i.e. the UThukela Child Survival Project and the SEDIET project, both had ensured some level of community involvement. In the SEIDET project the technology has twice been stolen, but yet the community have been able independently to acquire new technology for the computer labs.

8.3. What is a technical maturity model and why is it needed in general and for ICT4D?

A technical maturity model is merely some model which can be used to measure the technical maturity of a project, system or organisation.

As was shown from the interviewees responses, that while there is not conclusive evidence technical maturity will lead to sustainability, the lack of technical maturity will have marked impact on the sustainability of a project. Because a technical maturity model can help to (a) gauge the technical maturity of a project and (b) advise as to how to improve the technical maturity, the use of a model can improve the technical maturity of a project.

Seeing that technical maturity will improve the chances of sustainability of a project, it can be argued that the application of a technical maturity model to a project will improve the chances of sustainability of the project.

8.4. What is required to implement or use a technical maturity model for an ICT4D project?

The most important factors that would be required to implement a technical maturity model for an ICT4D project are the necessary skills and the necessary levels of communication.
Without the necessary technical skills, or an opportunity to obtain them, the implementation or use of a technical maturity model is without much purpose. A project that cannot employ the necessary technical skills does not need to ascertain at what level these skills are required.

Secondly, to properly implement a technical maturity model, good communication between the project members themselves, as well as with the outside community and agencies is required. Without good communication, it will not only be difficult to ascertain what the technical maturity level is, but the importance of a technical maturity model for the project will not easily be realised.

8.5. Overall research question: Can a technical maturity model be used to provide guidance or focus, to an ICT4D project, especially in terms of sustainability?

It appears, from the research that a technical maturity model can indeed assist in providing guidance or focus to an ICT4D project. Being able to ascertain what the technical maturity level for an ICT4D project is, can assist the project members in making decisions about various issues concerning the project, for example:

- Are more technical skills needed for the project?
- Are there any assumptions made about the technical skills that are present in the project, and how do these affect the activities of the members of the project?
- Do the technical aspects of the project fit into the social context of the project?

Answering these kinds of questions can allow a project team to better determine the necessary allocation of resources in the project. Answering these kinds of questions can also assist the project team in

gauging the impact of the technical aspects of the ICT4D project on the social context of the communities involved.

In closing it is important to note that any model is only a tool, and not a magic wand. The understanding of the reasons for the model, the correct measurement of the necessary variables and the flexibility to interpret the model, are all required to make the tool work. Hopefully this model will be another useful addition to the intellectual toolbox of those interested and involved in development and ICT, and will help, ultimately, to improve the lives and living standards of many people in need of ICT4D services.

8.6. Future research

The primary direction in which future research in this field of ICT4D and technical maturity can go, is to test the model in the field. While the author feels confident that the model has been well researched and is grounded in accurate and worthwhile observations and interviews, the true test of any model is how well it holds up in practice.

The use of this model, in one or more ICT4D projects, would not only validate this research and its importance, but help to refine the model and the research it is built on as well. Further issues and assumptions could also arise from the practical application of the model, from which the model could be further expanded and improved.

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Annexure A: Interview Questions

The questions in the interview were aimed more at answering the research questions focusing on what sustainability is and specifically on how technical skills or maturity impacts this sustainability. Other issues of what an ICT4D project is or what a technical maturity model is, are covered by the literature survey.

Briefly explain the ICT4D project you were involved in. (Specifically if it was a project delivering hardware, software, helping with existing hardware or software, helping with policies, helping with organisation, helping with research or other).

This question was designed to determine the basic background to the specific project in question. Certain interviewees were question on multiple projects so it was important to differentiate between the different projects. This question was also designed to determine the level and type of ICT involvement in the project. The level of funding, either from government or private sources as well as the environment of the project are the pieces of data that this question will try and elicit.

What was your personal role? What was the role of your institution? (If applicable)

This question was designed to place the role of the interviewee and their institution in the context of the project. This was important to determine any biases they might have as well as to define their level of involvement and level of expertise.

How would you describe the technical level of the community involved in the project, especially in terms of the specific IT solution being provided? How much training was required for the community to be able to use the technology?

This question's purpose was to determine the level of technical skill within the community for which the project was developed. The purpose of this question was to determine how much technical training was required and how vital technical skills were to the sustainability of the project. This question was also useful in determining the level of technical skill of the interviewee seeing as they would be involved with the training process.

Can you give a brief breakdown of the responsibilities and areas of expertise of the project members? (e.g. domain experts, technical experts, community leaders, social workers, academics etc.)

This question was designed to elicit data on the different skills of the participants within the project, especially in terms of their technical skills. The importance of this question was to determine the importance of technical skills within an ICT4D project.

Was the project a success or failure? And to what degree? (Being used fully as planned? Being used otherwise as initially intended, i.e. *bricolage*? Is it not being used at all?)

This question was designed to lead to either the question on the critical success factors for success or failure. Besides leading into the next two questions this question also tries to define what success or failure is. In certain interviews the issue of success was replaced with sustainability depending on the project.

If it was a failure what would you say were the critical factors leading to the failure? (e.g. lack of skills (of any type), lack of community involvement, lack of funding? Etc.)

This question is asked if the previous response was that the project was a failure. This question represents the crux of the interview. If the respondent feels technical maturity or skills played an important part in the failure of the project it is during this stage that this will come to fore. This leads directly into an answer to the main research question. Any other possible opinions in terms of critical factors will also be hopefully elicited during this question and provide a broader picture as to what the causes of failure were in this specific project.

If it was a success what would you say were the critical factors leading to the success? (e.g. necessary skills available (of any type), community involvement, funding? Etc.)

This question is asked if the previous response was that the project was a success. This question represents the crux of the interview. If the respondent feels technical maturity or skills played an important part in the success of the project it is during this stage that this will come to fore. This leads directly into an answer to the main research question. Any other possible opinions in terms of critical factors will also be hopefully elicited during this question and provide a broader picture as to what the causes of failure were in this specific project. The issue of sustainability could also come out during this question as the critical factors could imply that success is measured in terms of sustainability.

Do you feel the technical skills of the project group were sufficient? What impact did the technical skills of the project group have on the overall success failure of the project?

This question focuses on the technical skills of the project and project team. While the previous question asks for the respondents opinion on which possible critical factors were important in the outcome of the project this question focuses the respondents reply on one specific topic, namely that of technical skills. This once again leads directly to the research question of technical skills and what impact they have on the sustainability of an ICT4D project.

How would you define what technical skills are in an IT4D project? (Is hardware installation a technical skill? Is software

coding a technical skill? Is a technical domain skill still a technical skill?)

This final question was a broad question designed to determine what the respondents see as a technical skill. The issue of what exactly falls under the scope of a technical skill is an underlying question that the author feels is not sufficiently understood in this field. The issue of technical skills is often black boxed in either the field or the literature and obtaining an idea of what exactly is understood by the respondent to mean technical skills, helps to place the other questions in context as well.