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Chapter 1   Introduction

1.1 Motivation

As a developing country, South Africa faces severe challenges. On the Human Development Index, it ranks 110 out of 169 countries, a rank that has been dropping during the last five years (UNDP, 2010). Its inequality rate is the second highest in the world, according to the CIA (2011). While urban environments grow and develop, their rural counterparts battle with delivery of the most basic services, such as water, sanitation and access to education (Statistics South Africa, 2001). The official unemployment rate is 25.7% (Statistics South Africa, 2011) while the number that includes people who have given up looking for work is 36.5% (Roos, 2011).

As an Information Systems (IS) professional in South Africa, how does one respond to these challenges? An option that was available to the researcher was to become involved in the area of Information and Communications Technology for socio-economic development (ICT4D). At the Department of Informatics at the University of Pretoria, the ICT4D research stream is concerned with the "ongoing development and scrutiny of various frameworks for facilitating the introduction of ICT to different developing communities for sustainable socio-economic development" (Department of Informatics, 2011). This study is directly concerned with the contribution of ICT to socio-economic development.

1.2 Concise overview of problem

One of the challenges faced by ICT4D is that the contribution of ICT to socio-economic development is difficult to describe and assess. ICT's contribution to less developed countries is often unclear, according to Bollou (2010: 6): "After over a decade of heavy investment in ICT infrastructure expansion in Africa, little empirical research on the contribution of ICT to development has been conducted to assess the impact of these investments on the development of these countries". "We do not know exactly how ICT affects national development" (Sein and Harindranath, 2004: 15). Heeks (2010) indicates that ICT4D impact assessment has to date predominantly focused on ICT4D's immediate impact, such as providing infrastructure, as opposed to the downstream impact on the socio-economic development of the community at large.

A related problematic notion in ICT4D is that of sustainability. The sustainability that is usually aimed for, is the sustainability of the information system implemented (Jacucci et al., 2006), while the researcher regards this as necessary but not sufficient for the increased sustainability or development of the larger social system.

If one could find a way to describe the larger social system in which ICT is introduced, including its mechanisms and dynamics, then one can start to investigate the impact of a new entrant into the system, namely ICT, on the existing mechanisms. This may be possible through a systems approach, which according to Ackoff (1999) is characterised by its concern for the performance of the total system, even where changes are only made to a part of the system. Systems thinking recognises that the performance of a subsystem relative to its own goals does not necessarily lead to increased performance of the larger system. In ICT4D, there is a need to indicate the effect of a technology intervention on the whole, or containing social system.

A literature search of the use of systems thinking in ICT4D returned very few results, with no results from some of the key ICT4D journals. This is despite Walsham et al.'s (1988) early call for dealing with the social context of ICT4D as social systems. In the current ICT4D impact assessment frameworks (Heeks and Molla, 2009) there is no explicit use of systems thinking. These findings are perhaps not surprising in the light of the "surprisingly little systems thinking in the IS discipline" overall (Alter, 2004) and since "the IS community has not come to realise the significance" of systems thinking (Lee, 2004). The literature search on systems thinking in ICT4D indicates that systems work in this field is not only limited but also fragmented, not providing a good base from which to conduct further research.

In the discussion above a need is identified for the use of systems thinking in ICT4D, in particular to describe and assess the impact of an ICT4D project on the sustainability and socio-economic development of its containing social system.

1.3   Research undertaken

1.3.1   Research aims

This research aims at contributing to the systems-related knowledge base of ICT4D, and in particular to contribute a systems approach which can be used to assess ICT4D's contribution to socio-economic development. In the light of the limited and fragmented literature on

systems thinking in ICT4D, this thesis firstly aims to do a broad investigation of social systems approaches that could be used in an ICT4D context to describe the wider social system that affects and is affected by an IS intervention. From the investigation into possible social systems methods, theories or approaches, a particular approach is selected, against criteria specified for the appropriateness of such an approach. The social systems approach is further developed into a systems framework and applied to a case study, in order to assess the usefulness of the systems approach as well as to contribute to the concern stated above, namely to assess the impact of the ICT4D project on the larger social system.

1.3.2 Research strategy

Empirical work conducted in the study constitutes a single, longitudinal case study, performed in an interpretive fashion in a rural village in KwaZulu Natal, South Africa. The Department of Informatics has undertaken an IT literacy training project there since 2009. The community that is involved with and affected by the IT training is described, for purposes of analysis, as two social systems served. The theoretical framework, incorporating Giddens' structuration theory and autopoiesis concepts, is used to describe the two social systems served as well as the ICT4D project, as the serving system. In the process, an in-depth understanding of the social systems as well as their mutual interfaces and influences are developed. This is done to see whether and how the serving system(s) can influence the self-producing ability and sustainability of the systems served. In this manner, the contribution of the ICT4D project to the socio-economic development of the systems served is assessed.

1.3.3 Research contribution

The study makes a theoretical contribution in the area of social systems theory. A search for social systems approaches and theories to apply in an ICT4D setting is documented, resulting in a set of criteria for selecting a social systems theory for the study. The candidate theory, namely social autopoiesis, is further assessed for its feasibility. Following this, the candidate theory is developed into a social systems framework to guide data collection and analysis. The theoretical contribution is presented in Chapters 4 to 7.

The empirical contribution of the study takes the form of a case study in a rural South African village. Using the social systems framework, the social systems involved in an ICT4D project are described, as well as their mutual influences. The result of the empirical study is a description of the contribution of the ICT4D project to the socio-economic development of

the systems served. The empirical study shows that with the help of the theoretical framework, certain claims can be made concerning the value of the ICT4D project to the larger community. The empirical contribution is presented in Chapters 8 and 9.

1.3.4   Research questions

The main research question of this study is as follows:

- How can social systems theory help us to describe and assess the contribution of an IT intervention to the social system it serves, in a remote, rural African community?

The derived research questions are as follows, with the chapters that deal with each in brackets:

- What is an appropriate social systems framework with which to study the impact of an IT intervention in a remote, rural African community? (Chapter 7)
    - How does the literature approach social systems, from systems thinking and from social theory perspectives? (Chapters 4 and 5)
    - What is the value of the theory of autopoiesis when applied socially? (Chapter 6)
- How can a systems framework based on social autopoiesis be practically applied in a deeply rural community in a developing country? (Chapters 8 and 9)

1.4   Chapter outline

The rest of the study is organised as follows:

In Chapter 2, the ICT4D literature of relevance to the research project is discussed. The research problem is described and motivated, followed by a motivation for using systems thinking to address this problem. A literature review of existing systems thinking research in ICT4D is presented and discussed.

Chapter 3 contains the research methodology and planning. The research project entails a theoretical component, namely the search of a social systems theory and the subsequent development of the theory into a framework for practical application. The empirical component entails the application of the systems framework to a case study. The planning of the case study research is presented, along with a concise description of the case study setting,

which is later described in more detail as part of the systems description. In Chapter 3, the research ethics of the study is discussed, as well as the study's limitations.

Chapter 4, the first in the series of theoretical chapters, deals with systems thinking. It provides a historical context and overview of systems thinking, along with key definitions. Following this, a journey through the systems literature and streams of thinking is presented, as part of a search for a systems approach to describe the social context of an ICT4D project.

In Chapter 5, the search for a social systems approach or theory continues, this time traversing through the social theory literature, in particular where systems concepts are applied. Having concluded the journey, the question of selecting a social systems approach or theory is addressed. A set of criteria to aid the selection is presented. Following this, the researcher's preferred theory of social autopoiesis is motivated for by means of the criteria.

Chapter 6 deals with autopoiesis and its social application. Being the suggested social systems theory, the researcher first needs to master its underlying principles and confirm its social applicability before proceeding with its use.

Chapter 7 concludes the series of theoretical chapters. From the suggested theory of social autopoiesis, a systems framework is developed for practical application. This is an important exercise since the literature on the particular conceptualisation of social autopoiesis, that involves the use of structuration theory, provides little guidance as to its practical application.

Chapter 8 is the first of two chapters where the systems framework is practically applied in the ICT4D case study. It contains the preparatory work that, according to the framework, precedes the systems description. The preparatory work consists of a general background description of the rural community, followed by a contextual description of each of the social systems of interest: the systems served as well as the serving system. Also included in the pre-work is the stating of modelling assumptions and simplifications.

Chapter 9 contains the data analysis of the study, in the form of social systems descriptions. The systems are described making use of the derived systems framework. Descriptions are provided of the two social systems served by the ICT4D project, as well as a description of the ICT4D project, being the serving system. Subsequently, the mutual influences of the systems on each other are described. The description of the influences of the systems on each other, in particular of the ICT4D project on its systems served, is used to indicate the

contribution of the ICT4D project to the socio-economic development of the two systems served.

Chapter 10 concludes the study. It contains an assessment of the research process using Klein and Myers' (1999) principles of field research and an assessment of the theoretical contribution using Whetten's (1989) guidelines. It revisits the overall purpose of the study to see if it has been achieved, and suggests opportunities for further research.

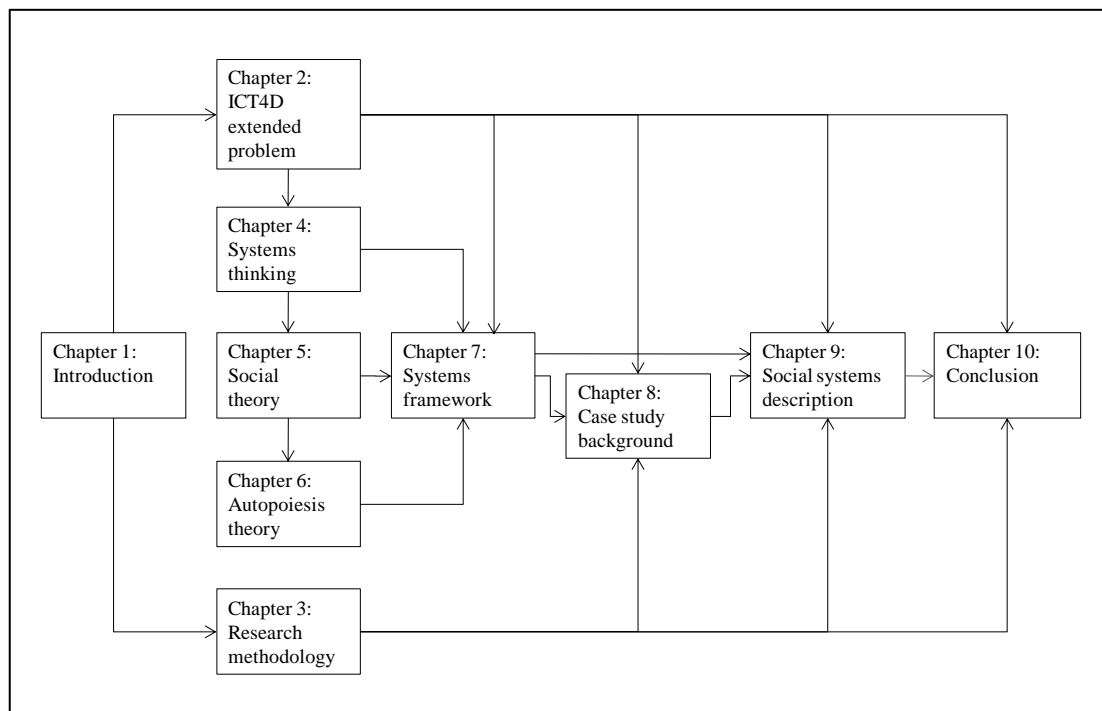Figure 1.1 below provides an overview of the chapter planning, and indicates how the chapters are interrelated.

Figure 1.1: Chapter outline

1.5 Conclusion

This study aims to apply systems thinking to study the social context of ICT4D, in order to find a way to describe and assess the contribution of ICT to socio-economic development. The case setting for the empirical study is a remote, rural community in South Africa. The main research question of the study is the following:

- How can social systems theory help us to describe and assess the contribution of an IT intervention to the social system it serves, in a remote, rural African community?

The contribution of the study is twofold. A theoretical contribution is made in the area of social systems methodology. The empirical contribution is in the ICT4D domain, addressing a broader problem in ICT4D while studying a rural South African community. The theoretical framework is applied in the case study.

In Chapter 2 that follows, the ICT4D research context of the study is given, including a more detailed discussion of the problem statement.

Chapter 2   ICT4D background relevant to problem statement

2.1 Introduction

This chapter discusses literature that is relevant background material to the problem statement presented in Chapter 1. It departs by introducing expanded definitions of ICT4D concepts that are relevant to the study. When introducing the concepts of development and sustainability, problems identified in ICT4D with respect to these two notions are discussed. An argument is made for the use of systems thinking to address the identified challenges. Existing contributions on systems thinking in ICT4D are investigated by means of a literature survey. Common themes, weaknesses and opportunities are highlighted. A way forward is suggested for the use of systems thinking to describe the social context of an ICT4D project, with the aim of assessing ICT's contribution to the socio-economic development of the larger social system it serves.

2.2 Key definitions

The following items represent some of the key terminology of the thesis: system, information system, ICT4D, development and sustainability. For each term, a definition and short discussion is provided. The definitions serve as a departure point and also indicate some of the assumptions being made.

2.2.1 System

In this study, a system is regarded as a subjective mental construct, defined according to the purpose of a study or project (based on Checkland, 1999; Olsson and Sjöstedt, 2004; and Daellenbach and McNickle, 2005). Concisely put, a system is "a complex whole the functioning of which depends on its parts and the interactions of those parts." (Jackson, 2003: 3). Systems thinking is characterised by a holistic approach, suited to deal with complex problem environments where an understanding of the relationships between the parts and the whole is important. It is further characterised by its transdisciplinary nature, drawing concepts from one discipline and applying it in another, which can lead to new insights into existing problems (Jackson, 2003: 13).

Supplementary definitions and a broader discussion of the concept of 'system' are provided in Chapter 4, which deals with systems thinking.

2.2.2   Information system

An information system consists of two systems. The first is the system being served, consisting of people that take purposeful action and have information needs. The second is the serving system, which provides support by processing information that assist in the purposeful action of the people in the system served. The nature of the system served, and how this system is understood, must inform what the serving system will look like (Checkland and Holwell, 1998: 111).

Checkland and Holwell's definition is broader than that of Stair and Reynolds (1998: 13), namely "a set of interrelated elements or components that collect (input), manipulate and store (process), and disseminate (output) data and information and provide a feedback mechanism to meet an objective". While Stair and Reynolds (ibid.) focus on the function of information processing only, Checkland and Holwell (1998) add a systems notion, in particular that of the 'system served' and its associated needs. It is further clear that people form the basis of Checkland and Holwell's two systems.

In the above definitions, no mention is made of 'technology' or 'computers'. While it is assumed that computers are usually involved with the information processing function mentioned above, IS professionals distinguish themselves from computer scientists in this respect. "Information systems is 'different' to computing in that the IS professional is concerned not just with the exploitation of technology but with the effects of IT and organisational ramifications that IT will bring" (Stowell and Mingers, 1997: 11). Hirschheim goes as far as stating that "information systems are not technical systems which have behavioural and social consequences, but are social systems which rely to an increasing extent on information technology for their function" (Hirschheim, 1985, cited in Walsham et al., 1988: 191). In this study, the focus will be on the social systems more so than the technology itself. This is because the challenges of an ICT4D project lie with the overall social systems rather than the technology (e.g. Walsham et al., 1988).

2.2.3   Information and communications technology for development (ICT4D)

Information systems in developing countries (ISDC) research is based on the potential contribution of ICT to "the improvement of socio-economic conditions in developing countries" (Avgerou, 2009: 2).

There are two dominant acronyms in the literature: ISDC and ICT4D. Read literally, they differ on two accounts: IS vs. ICT, and developing countries vs. development. According to Brown and Grant (2010), the ICT "for development" and "in developing countries" are in fact two different research streams. However, ISDC and ICT4D are often used in a less strict sense to refer to the same thing. Avgerou's definition above could apply to both. The key concerns of socio-economic development are usually located in developing countries, while IS work in developing countries is not always concerned with socio-economic development. Of the two acronyms, ICT4D appears to be gaining ground. For example, the focus of the International Federation for Information Processing's Work Group 9.4 (IFIP WG 9.4) is on "social implications of computers in developing countries" that bears close relation to ISDC. However, the current IFIP WG 9.4's official web site contains many references to ICT4D in the names of papers, panel discussions and viewpoints of members (IFIP WG 9.4, 2011). This study is primarily concerned with "for development", while simultaneously taking into account the "in a developing country" context. In this study, the term ICT4D will be used, while adhering to the definition of Avgerou (2009) stated above.

The debate on the link between ICT and socio-economic development in ICT4D is discussed under the term 'Development' in Section 2.2.4.

2.2.3.1   ICT4D: a brief history

A brief history of ICT4D is presented as found in Heeks (2008). Heeks attributes the first era of ICT4D to two events of the 1990s: the expansion of the internet and increased interest in international development, as embodied in the Millenium Development Goals. ICT4D's initial main characteristic was the rolling out of telecentre projects. The failure of many of the telecentres drew attention to the typical challenges encountered, namely sustainability, scalability and impact evaluation. The technology associated with the first era of ICT4D was a traditional computer connected to a landline. This setup had very limited potential reach, due to inherent problems with affordability and availability of infrastructure. The current rapid diffusion of mobile telephony with the potential of associated internet access is indicating a

new era for ICT4D, which Heeks (ibid.) terms ICT4D2.0. ICT4D2.0 comes with much opportunity but also with new challenges, such as around availability of relevant applications, services and content, as well as new innovation models. Heeks claims that ICT4D2.0 will require not only inputs from computer scientists and IS professionals, but also that of development studies.

It can be seen that Heeks' (2008) notion of ICT4D is in line with Avgerou's (2009) definition of the contribution of ICT to "the improvement of socio-economic conditions in developing countries."

2.2.3.2   Discourses in ICT4D

ICT4D research can be categorised in different discourses, according to the underlying assumptions on aspects such as development and the processes of innovation and transformation. Avgerou (2008) identifies three general discourses in ICT4D research, which she terms "transfer and diffusion", "social embeddedness" and "transformation". The latter is subsequently divided into "progressive transformation" and "disruptive transformation" (Avgerou, 2009). According to Avgerou (2009), the transfer and diffusion discourse and the social embeddedness discourse represent different sets of assumptions related to ICT innovation. The progressive and disruptive transformation discourses respectively represent different sets of assumptions related to socio-economic development.

In the transfer and diffusion discourse, the value systems, rationality and assumptions with which systems were originally developed, are transferred along with the technology. The focus is on how to adapt these systems to suit local conditions in the developing country. The theoretical origins of the transfer and diffusion discourse are technology diffusion and the technology acceptance model (Avgerou, 2009: 5). The transfer and diffusion discourse holds similarities with Silva and Westrup's (2009) "conventional wisdom" cluster of assumptions, which include the belief in free market drivers for development, first world management practices, change driven by technology, little focus on local context, and using participation as a means of inclusion.

The social embeddedness discourse described by Avgerou (2008) focuses on the local situation and its challenges, and promotes a locally determined process and agenda for developing and/or implementing ICT. The theoretical basis of the social embeddedness

discourse is contemporary social theory, such as structuration theory and Actor Network Theory. These theories are used to investigate the dynamic relationships between and within technology, social actors and the social environment. The sentiments of the social embeddedness discourse is shared in Silva and Westrup's (2009) "emerging understanding" cluster of assumptions, concerned with local, institution level innovations, local adaptation, a socio-technical focus, an inclusive approach and recognition of unique contextual factors.

The two "transformation" discourses discussed by Avgerou (2009) consider the processes of change and development within the developing country setting, and how ICT is implicated in these processes. The progressive transformation stance regards ICT as a benevolent agent of change, and as necessary for socio-economic development within the existing political and social structures in a developing country. In contrast, the disruptive transformation stance takes a more critical approach, often drawing from critical social theory. It questions the agendas for development and of donor agencies. It also attempts to uncover imbalances and power struggles within the local environment. It often takes in a position, siding with the poor or an exploited party.

Using the mentioned categorisations, Avgerou (2009) proceeds to create four paradigms of ICT4D research, as indicated in Figure 2.1. On the one axis is IS innovation, with the transfer and diffusion and social embeddedness as the two possible options. On the other axis is transformation, with progressive transformation and disruptive transformation as the two possible choices. She states that it is normally easy to see whether an ICT4D study follows a transfer and diffusion or a social embeddedness approach to IS innovation. However, since development assumptions are often not made explicit, the transformation position is often not clear. She believes ICT4D research can benefit from an increased awareness of development assumptions, and an increased use of development theories. In Chapter 3, the ICT4D research approach of this study will be located within Avgerou's four paradigms.

	Progressive transformation		
Innovation by transfer and diffusion	ICT and development as socio-economic improvements through transfer and diffusion	ICT and development as socio-economic improvements through locally situated action	**Socially embedded innovation**
	ICT does not necessarily result in development for all: the transfer and diffusion of ICT leads to uneven development	ICT does not necessarily result in development for all: it is subject to the power dynamics of IS innovation action	
	Disruptive transformation		

Figure 2.1: Four paradigms of ICT4D research

(Avgerou, 2009: 21)

2.2.4 Development

'Development' is the aim of ICT4D. However, most ICT4D studies do not interrogate what is meant with development, possibly to avoid controversy (Avgerou, 2009). Avgerou (2009: 2) refers to "the improvement of socio-economic conditions", and "the realisation of perceptions of desirable world orders", with criteria such as the Millenium Development Goals. Apart from Avgerou (ibid.) there are some leading ICT4D scholars who also pay attention to the matter of development. Among them, there is broad consensus that development should be defined in more than economic terms (Walsham, 2005; Sein and Harindranath, 2004; Qureshi, 2005; Roode et al., 2004; Silva and Westrup, 2009). "The certainties of a market-based framework of development and the scope of a managerial set of recipes for development are being cast into question" (Silva and Westrup, 2009: 60). Some authors extend the traditional economic view by including factors pertaining to social development (Qureshi, 2005). Other authors call for a focus on human level development (Sein and Harindranath, 2004; Roode et al., 2004), an alternative notion rather than a linear extension of the economic view. Roode et al. (ibid.) use the work of Todaro (1997) and Max-Neef et al. (1991) that promote human-centred notions of development. For example, Max-Neef et al. (ibid.) advocate development towards self-reliance, where self-reliance does not mean isolated self-sufficiency, but includes horizontal interdependence and vertical integration. This leads Roode et al. (ibid.) to state that

sustainable development is achieved though self-reliant human scale development. This thinking is in line with Hettne's (1990: 153) definition of "another development", which is about meeting human needs in a way that is endogenous, self-reliant and ecologically sound.

Development theorists whose views are at times promoted and used in ICT4D, usually as alternatives to the narrow economic view, include Todaro and Max-Neef (Roode et al., 2004), Sen's capability theory (Alexander and Phahlamohlaka, 2006; Walsham and Sahay, 2006; Silva and Westrup, 2009; Avgerou, 2009; Zheng, 2009; Thapa and Sæbø, 2011) as well as the more radical ideas of Escobar (Walsham, 2005; Avgerou, 2000; Silva and Westrup, 2009). The development theorist Hettne's work is used by Mursu et al. (2004).

This study will rely on the definitions of 'development' by Avgerou (2009: 2), namely "the improvement of socio-economic conditions" as well as Roode et al.'s (2004: 4) notion of "self-reliant human scale development which flows from the individual level to the local, regional and national levels, and which is horizontally interdependent and vertical complementary".

2.2.4.1   The problematic relation between ICT and development

According to Bollou (2010), one of the challenges faced by ICT4D is that the contribution of ICT to development is often unclear, in particular in less developed countries. He investigates the impact on development of ICT infrastructure expansion in six West African countries, and concludes that these projects did not show a positive effect on a number of development indicators, such as productivity and the Human Development Index (HDI).

Other researchers concerned with the problematic relation between ICT and development include Avgerou (2003), Sein and Harindranath (2004), Qureshi (2005) and Heeks (2010). Avgerou (2003) questions the optimistic generalisation made by international development agencies such as the World Bank and UNDP, namely that ICT is an instrument that leads to development. She shows that the instrumentalist view is underpinned by assumptions of neo-classical economic theory, while the conditions for economic actors in developing countries differ vastly from those in first world countries. Avgerou's (ibid.) arguments indicate that it cannot be assumed that ICT will necessarily lead to development. Qureshi (2005) and Sein and Harindranath (2004) address the question of how ICT affects development. According to Sein and Harindranath (2004: 15), "we do not know exactly how ICT affects national

development." They suggest that one first needs to address the question of how development takes place, secondly assess how the development process can be positively influenced, and then attempt to indicate the effect of ICT on the development process. Qureshi (2005) investigates a number of historical ICT4D case studies to derive a process model of how ICT could lead to development. Although some of these cases show evidence of outcomes that could be linked to development, in many cases the development impact is only suggested. Qureshi (2005) as well as Sein and Harindranath's (2004) work imply that the impact of ICT on development can only be indirectly assessed. Heeks (2010) argues for more research on ICT's *downstream* impact on development, such as its impact on sustainable livelihoods and enhancing of capabilities. According to Heeks (ibid.), the effort to date in ICT4D impact assessment has been on indicating its upstream impact, such as on providing infrastructure and accessibility. Accordingly, he calls for "more theory-based evidence about ICT's impact on development" (Heeks 2010: 635).

2.2.5   Sustainability

'Sustainable development' is defined in the 1987 Brundtland report as "development that meets the need of the present without compromising the ability of future generations to meet their own needs" (Scott and Marshall, 2005). This definition is specifically concerned with environmental sustainability.

According to the Oxford Dictionary, the meaning of 'sustain' includes among other to support, give strength to, endure, maintain or keep (Concise Oxford Dictionary, 1990).

In the IS context, sustainability refers to "addressing challenges in the design and implementation of IT solutions" in order for these to endure or to continue being operational in their environment of implementation (Jacucci et al., 2006). This definition can be associated with a technocentric approach, since sustainability is only used in reference to the IT solution implemented, i.e. it is about the sustainability of the technology intervention. The use of the term sustainability with reference to the information system itself, is widely encountered in ICT4D, e.g. Kimaro and Nhampossa (2005), Bailey (2009) and Hosman (2011). Ali and Bailur (2007) provide a more comprehensive view, which covers five types of sustainability: financial, technological, social, institutional, and to a lesser degree, environmental (Ali and Bailur, 2007). According to Ali and Bailur, financial and technological sustainability are purely concerned with the ability of the project to continue, given its own

financial and technological requirements, the two of which are interdependent. Social sustainability concerns the social acceptability of the project among the local community, and likewise institutional sustainability is about acceptability among institutional actors. Environmental sustainability is seldom addressed (Ali and Bailur, ibid.). Among the mentioned types of sustainability, the social dimension appears to be the only one where the needs of the larger community are sometimes included as part of the sustainability discourse. As an example, Mursu et al. (2004) take into account the demand for the technology as well as its appropriateness in the particular context, as prerequisites for sustainability. According to Pellegrini (1980, cited in Mursu et al., 2004), "technology should be considered 'appropriate' when its introduction into a community creates a self-reinforcing process internal to the same community, which supports the growth of the local activities and the development of indigenous capabilities as decided by the community itself." Similarly, Roode et al.'s (2004) definition of development in an ICT4D context includes the term self-reliance, which is about sustainability at the level of the encompassing social system.

To conclude: 'sustainability' in ICT4D usually refers to the ability to sustain an IS project that is developed and implemented in an ICT4D context. This study will however take the view that the sustainability of primary concern is that of the larger social system to which the ICT4D project should contribute; its own sustainability being a necessary but not sufficient condition for increased sustainability of the encompassing social system.

2.3 Dealing with development and sustainability in an alternative way: introducing systems thinking

If broader definitions of development and sustainability are adopted, such as those respectively proposed by Roode et al. (2004) and Ali and Bailur (2007), then it follows that the sustainability of the technology or system introduced in an ICT4D context, is a necessary but not sufficient condition for the increased sustainability of the larger social system, and for achieving self-reliant human-scale development. What does it help if the technology is successfully introduced, and one cannot show the downstream impact on development, whether with economic, productivity or HDI indicators? Further, how can one assess whether self-reliant human scale development is achieved?

It appears that some description of the larger social system in which ICT is introduced, is required – the system served, in Checkland's (1999a) terms. If the mechanisms, dynamics or

influences of the larger societal system can be sufficiently described, then one can start to investigate the impact of a new introduction into the system, namely ICT, on the existing mechanisms. This may be possible through a systems approach, which according to Ackoff (1999) is characterised by its *concern for the performance of the total system, even where changes are only made to a part of the system*. Systems thinking recognises that the performance of a subsystem relative to its own goals does not necessarily lead to increased performance of the larger system.

The general argument for systems thinking can be found in e.g. Jackson (2003) and Daellenbach and McNickle (2005). These authors argue the benefits of a holistic approach that provides a means to deal with the relationships between system elements, system processes and their effect on the system as a whole. A systems approach can help to identify and manage emergent behaviour. This is something required in ICT4D: to be able to show the effect of a technology intervention on the whole, or containing social system.

Heeks and Molla's (2009) ICT4D impact assessment compendium provides an overview of the prevailing views and thinking on impact assessment (IA) in ICT4D. Among the IA frameworks that are compatible with the development views stated earlier, is a capabilities framework based on the work of Sen, which according to Heeks and Molla (ibid.) is provisional and requires further work to develop, a livelihoods framework that is well developed but with limited links to ICT, as well as a cultural-institutional framework which focuses on the 'soft' issues related to ICT impact. However, there appears to be no framework that explicitly makes use of systems thinking.

2.4   Systems thinking in IS and ICT4D

How is systems thinking usually applied in the IS discipline, to assist in dealing with a social system? Some systems-related research and methods are available, such as Checkland's (1999) Soft Systems Methodology (SSM) and Mumford's (2000) sociotechnical approach. In addition to these, Alter (2004) mentions Actor Network Theory and Kling and Scacchi's web of computing as approaches in IS that are to some extent based on systems thinking.

However, according to Alter (2004), there is "surprisingly limited systems thinking in the IS discipline", which motivated his paper titled "Desperately seeking systems thinking in the IS discipline". Mingers and White (2010) confirm that although most IS researchers view

themselves as systems thinkers, very few of them are actually using systems theory. Lee (2004) states that IS studies seldom have a systems focus, but instead tend to view 'information systems' to be the same as 'information technology'. With some exceptions such as the work of Checkland and Holwell, "the IS research community has not come to realise the significance" of systems thinking (Lee 2004: 14). This is particularly true of ICT4D, where in dedicated ICT4D publications, searches for systems-related work return few or no results, as indicated in Table 2.1 below.

The publication titles in Table 2.1 are regarded to represent ICT4D thinking, while they are not the exclusive publication outlets for ICT4D research. Three international ICT4D journals have been searched, namely *Information Technology for Development*, *Information Technologies and International Development*, and *The Electronic Journal on Information Systems in Developing Countries (EJISDC)*. In addition, IFIP WG 9.4 Conference Proceedings were searched. Avgerou's (2009) ICT4D research review makes use of the same titles, but longer publication periods. The publication periods for this exercise were determined by what was available to the researcher as full-text electronic documents, since full-text searches were performed for all the systems phrases indicated in Table 2.1. In this manner, *Information Technologies and International Development* and *EJISDC* were searched for their entire publication history, while the last thirteen years of *Information Technology for Development*'s papers were included in the search. Proceedings with full papers were electronically available for only the two most recent IFIP WG 9.4 Conference Proceedings, namely 2009 and 2011. The latter search was appended with an archive search on IFIP WG9.4 Proceedings since 2002, through conference abstracts. Nepal and Petkov's (2002) paper was sourced in this manner. Seven papers were found in total.

Publication title	Period searched	Search terms (full text)	Returns[1]
Information Technology for Development	Vol 8(1) 1998 –Vol 17(2) 2011	"systems thinking" OR "systems theory" OR "systems approach" OR "systems method"	None
Information Technologies and International Development	Vol 1(1) 2003 – Vol 7(2) 2011		None
Electronic Journal of Information Systems in Developing Countries (EJISDC)	Vol 1 (2000) – Vol 47 (2011)		Corea (2000) Huy et al. (2004) Gunawardena and Brown (2007)
IFIP WG 9.4 Conference Proceedings[2]	2002 - 2011		Nepal and Petkov (2002) Turpin et al. (2009) Nicholson and Babin (2011) Twinomurinzi and Ghartey-Tagoe (2011)

Table 2.1: Searches for systems-related work in ICT4D publications

Walsham et al. (1988) made a call more than two decades ago for viewing information systems as social systems in ICT4D, and in particular to use interpretive systems approaches to deal with ICT4D's social context. It appears from Table 2.1 that this call was not well heeded. Walsham (2011), while reflecting back on the mentioned call, claims that it is still relevant and stresses the need for theory development in ICT4D, in particular pertaining to the social context.

2.4.1   Themes in systems-related ICT4D publications

To the seven papers listed in Table 2.1, Walsham et al.'s (1988) earlier paper is added, being a significant contribution even though sourced separately. The eight papers are scrutinised below for their respective views on systems, and the systems approaches used or advocated.

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[1] Excludes papers where reference to a search term was incidental.
[2] In the IFIP WG9.4 internet archives, abstracts are available for the 2002 and 2005 conferences, selected papers for 2007 and full papers for the 2009 and 2011 conferences.

An overview of each paper is given, ordered chronologically. The papers are quite diverse in philosophy and content, and the reader is warned that the overviews below do not form coherent reading. The papers' systems views and systems approaches are summarised in Table 2.2.

The first paper discussed is Walsham et al. (1998). The authors argue for an information system to be regarded as a social system, where human, organisational and technical factors all influence its development and implementation. Since ICT4D involves implementing information systems in a context with extraordinary challenges around social, political, cultural and infrastructural factors, to name a few, a broader conceptualisation which take these factors into account becomes all the more important. According to Walsham et al. (ibid.), if this broader conceptualisation is done in a formal-rational manner by modelling organisational and human factors as part of a bigger 'machine', the exercise will not be helpful. Rather, social systems need to be studied interpretively, in a way that incorporates the meanings that the humans in the system attach to their actions. As an example of an interpretive social systems approach, Walsham et al. (ibid.) refer to an approach that they applied, based on Checkland's (1981) SSM and Kling's web models (Kling and Scacchi, 1982, cited in Walsham et al., 1988). SSM provided the authors with a way to surface the world views and conflicting perspectives of role-players. The web models helped to describe a system as an ensemble of objects with requirements, capabilities, social interests and constraints, which include equipment as well as humans in the same web. This approach has been applied in a western setting, but Walsham et al. (ibid.) argue that the characteristics it exemplifies are suited to the conditions in developing countries. Walsham's (ibid.) paper makes the point that information systems in developing countries are multifated social systems that can benefit from interpretive social systems approaches.

Paper	Systems view	Approach promoted
Walsham et al. (1988)	IS, especially in developing countries, is a multifaceted social system requiring interpretive approach.	SSM with web of computing
Corea (2000)	Society as social system. Its behaviour drives innovation which drives development Development = social process, technological innovation = technical process. However, socio and techno to be viewed as part of same system.	STS (modern Dutch variant)
Nepal and Petkov (2002)	Telecommunications project evaluation in rural areas to recognise Habermas' three worlds (material, social and personal). Critical systems thinking / multimethodology is required to address these worlds, in interpretive fashion.	Systems framework based on Total Systems Intervention (TSI) Pluralist: SSM and AHP are main components
Huy et al. (2004)	Integration is required among courses in an MIS curriculum; a systems approach can facilitate interdisciplinarity.	Heckhausen's six level framework towards interdisciplinarity
Gunawardena and Brown (2007)	Project management in developing countries is a messy, complex social system.	SSM
Turpin et al. (2009)[3]	The social context of IS in developing countries is a messy system that can benefit from the Multiple Perspectives Approach, recognising technical, personal, organisational, ethical and aesthetical views on same situation.	Pluralist: Multiple Perspectives Approach, combining rational, interpretive and critical methods
Nicholson and Babin (2011)	Global IT outsourcing is a complex multi-system, with multiple stakeholders, differing viewpoints and unintended consequences.	SSM combined with philantrocapitalist and development models
Twinomurinzi and Ghartey-Tagoe (2011)	E-government that can counter corruption in developing countries is a system that requires proper work processes.	Work system method

Table 2.2: Systems views and approaches found in systems-related ICT4D papers

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[3] This paper does not bear relation to the core of this study.

Corea (2000) belongs to the school of thinking that technological innovation is the most important driver of economic development. He proposes that development has to happen from within. This needs to be done by creating an environment that is conducive to technological innovation. Technological innovation is characterised by behaviour that seeks continuous improvement and irreversible change. According to Corea (ibid.), this behaviour distinguishes prosperous, fast-changing societies from stagnant, poorer ones. In order to achieve economic development, the systems design of societies needs to be revisited. A systems approach is required that incorporates the technical process of technological innovation as well as the social process of development. Sociotechnical systems (STS) theory recognises both human and technical dimensions. Corea (ibid.) recommends the modern Dutch variant of STS that regards technology as human expression, rather than separating the social and the technical. Corea concludes that such an approach is conceptually suited to the design of a social system with technologically innovative behaviour that is development-oriented. Corea's (ibid.) paper argues that economic development of societies need to be addressed by revisiting the societal systems design, recognising human as well as technical dimensions.

Nepal and Petkov (2002) recognise the complex and messy nature of evaluating telecommunications infrastructure in rural areas, containing technical, social, cultural as well as political aspects. They want to describe the multifaceted rural communications system and its impact on local socio-economic development. They argue that no single methodology exists that can account for the complexity of the system. They propose Critical Systems Thinking (e.g. Flood and Jackson, 1991) as their theoretical foundation, since it acknowledges all of Habermas' three interests, namely the technical, practical and emancipatory. This theoretical foundation, in promoting multiple perspectives, is consistent with a pluralist approach. Nepal and Petkov (ibid.) categorise the multiple views as material, personal and social, again in line with Habermas' three worlds. For each of the views, suited methodologies or parts of methodologies are suggested. Nepal and Petkov present their systems framework as a process which at its evaluation phase uses multiple methods. The methods relied on most strongly are SSM and the Analytical Hierarchy Process (AHP). To demonstrate its application, a case is discussed where the systems framework is applied in rural KwaZulu Natal, South Africa. Nepal and Petkov used the framework while acting as consultants to the national public network service provider. This makes Nepal and Petkov's study one of the very few where a systems framework is both designed and applied in collaboration with stakeholders within an ICT4D context, so as to assess its practical value. Nepal and Petkov's

paper addresses the complex problem of evaluating rural communications infrastructure by means of a pluralist systems approach, incorporating multiple philosophical paradigms.

Huy et al. (2004) discuss the use of a systems approach to develop an interdisciplinary MIS curriculum at a Vietnamese university. According to the authors, the set of skills required from MIS professionals include business knowledge, communication and team skills, analytical and critical thinking skills, as well as technological expertise. MIS is an interdisciplinary field, but MIS curricula lack a framework to facilitate discipline integration. They propose Heckhausen's (1972, cited in Huy et al., 2004) framework, which they regard as a systems framework, to facilitate integration. The framework has six levels, ranging from teaching multiple topics with no integration at level one, to a unifying or truly interdisciplinary approach at level six. Strategies are provided to assist with moving from one level in the framework to the next. According to Huy et al. (ibid.) the interdisciplinary integration levels of MIS courses in Vietnam, a developing country, are very low. Rather than copying established integrated MIS programmes from developed countries, they propose that Vietnamese institutions move up Heckhausen's framework by themselves, one level at a time, thereby ensuring that the curricula remain relevant to Vietnam and its needs. They discuss a practical application-in-progress of the proposed approach at a university in Vietnam. Their overall impression is that moving towards interdisciplinarity is a "complex, socio-technical process which influences and is influenced by other institutional arrangements" (Huy et al., 2004: 11). To conclude, Huy et al. (ibid.) recognise and attempt to address systemic issues around an MIS curriculum in a developing country. Unfortunately, their reference to Heckhausen's framework as a systems approach is not substantiated.

Gunawardena and Brown (2007) investigate a number of donor agency funded projects in the Vocational and Technical Education (VTE) sector in developing Asian countries. The countries covered in their study are Laos, Sri Lanka and Vietnam. One of the problems identified in IS related donor projects in this context, is project management. The authors show that the project management challenges that are identified all relate to the complex, multifaceted social nature of the application environment in developing countries. Traditional 'hard systems' project management approaches are not well suited to deal with these situations, and the authors argue for the use of soft systems approaches. In particular, the authors advocate the use of SSM. To suit the particular context, an SSM based methodology is drafted and used on nine case studies, three in each Asian country studied. The analysts applying the methodology are the researchers, and the participants are expert representatives

from the stakeholder groups identified in each case. The SSM process involves the development of root definitions and conceptual models, and result in the reporting of suggested changes. The problems identified during the analysis are predominantly 'soft' issues, such as collaboration between key role-players. According to the authors, the identified problem areas confirm the necessity of a softer approach to IS project management in such a complex project environment in a developing country. They indicate the value of a soft systems methodology in dealing with this complex project environment.

Turpin et al. (2009) argue that the social context of IS in developing countries have the attributes of a messy system. Messy systems cannot be addressed by traditional systems approaches. The authors argue for the use of Mitroff and Linstone's (1993) Multiple Perspectives Approach (MPA) in a messy environment. The MPA assists in developing technical, organisational, personal, ethical and aesthetic views on a situation, making use of three sociological paradigms in the process. Two cases of the successful application of the MPA by the authors are presented, both considering the messy social issues within a developing country. In the one study, the MPA was used to analyse a national poverty alleviation programme in South Africa. The second was a teaching case, where graduate students had to use the MPA to investigate the xenophobia crisis experienced in South Africa in 2008. The authors conclude by recommending the MPA to ICT4D researchers, since the rich and balanced set of perspectives it assists in generating, can be used to describe and analyse better the messy social systems in a developing country.

Nicholson and Babin (2011) critically examine the social responsibility claims made by global IT outsourcing (GITO) companies. Their case study focuses on the French GITO company Steria, who sponsors Indian schools in areas where outsourcing centres are located. Sponsorship involves the establishment of a computer centre, IT training as well as addressing other possible infrastructural and mentoring needs, depending on the school. The schools project is analysed using Porter and Kramer's (2006, cited in Nicholson and Babin, 2011) framework for philantrocapitalism, from where it emerges as a clear win-win programme with benefits in terms of business as well as development. Nicholson and Babin (ibid.) are not comfortable with the optimistic conclusions from Porter and Kramer's framework, which are weighted heavily in favour of Steria's own interests. They argue that Checkland's soft systems analysis would be more suited to investigate the complex situation, with its multiple interrelated systems of interest, multiple actors and viewpoints, and unexpected consequences within the wider system. Nicholson and Babin show that all their points of criticism of the

Porter and Kramer framework are accommodated by Checkland's soft systems approach. They propose the joint use of the mentioned two approaches for future research on philantrocapitalism. Nicholson and Babin's (ibid.) paper indicate that global IT outsourcing is a complex multi-system, and hence a framework for philantrocapitalism should include soft systems thinking.

Twinomurinzi and Ghartey-Tagoe (2011) investigate the role of IS to address corruption in developing countries. Effective e-government is viewed as a means to counter government corruption. The authors study a number of historical success stories on e-government implementation in developing countries to find common underlying principles. As a case study, they investigate South Africa's state of e-government implementation, in particular where it concerns anti-corruption measures. One of the largest hindrances to e-government implementation in South Africa is found to be the lack of explicit and detailed work processes in government departments. To this end, the authors recommend the use of Alter's (2004) work system method. The authors did not use a systems method in their own research, but indicated how the attributes of the work system method would be able to address the concerns in the case they investigated. As with Nicholson and Babin (2011), a systems method is used as a way to critique an existing approach in ICT4D and to suggest improvements. To conclude, Twinomurinzi and Ghartey-Tagoe's (ibid.) paper views e-government in South Africa as a system that requires proper work processes, and that can benefit from a systems method to improve these processes.

In the summary presented in Table 2.2, the papers in which systems thinking plays a central role have been shaded. Of the eight papers discussed, systems thinking only plays a central role in five.

2.4.2 Assessment of ICT4D systems approaches

From the above discussions, a fragmentedness in the application of systems concepts is clear. Among the five papers identified where systems thinking play a central role, the following common themes are found:

The multifaceted nature of the problem situation in ICT4D, presenting challenges that are not only technical but also include cultural, political, infrastructural and regulatory concerns, are mentioned repeatedly (Walsham et al., 1988; Petkov et al., 2002; Gunawardena and Brown,

2007). These papers subsequently argue that the nature of the problem calls for a (soft) systems approach; one that can encompass much more than the technical system.

The phrase 'multiple perspectives' commonly appears as a means to address the multifaceted problem situation. 'Multiple perspectives' can refer to different views on paradigm level, such as 'technical' and 'emancipatory' (Petkov et al., 2002), or to different perspectives from different individuals (Walsham et al., 1988). At the very least, the different individual views call for an interpretive approach. If taken further, the different angles on the matter call for a pluralist or even a multi-paradigmatic approach.

When advocating particular systems methodologies to use, pluralist approaches are common. Among the methods advocated are soft systems methodologies (mainly SSM) and critical systems thinking, as well as approaches that can accommodate both social and technical aspects of a problem, such as STS and Kling's web models.

In papers that discuss practical case studies, the selected systems approach leads to a description and analysis/evaluation, which may be followed by recommendations (e.g. Petkov et al., 2002; Gunawardena and Brown, 2007; Turpin et al., 2009). Some work is at theoretical or conceptual level (Corea 2000), or proposes the use of certain methodologies (Walsham et al., 1988). In two papers where systems thinking does not play a central role (Nicholson and Babin, 2011; Twinomurinzi and Ghartey-Tagoe, 2011), a systems approach is suggested as an improved way of dealing with problems identified on the respective case studies.

As can be seen in the discussion above, based on publications that are regarded to represent ICT4D thinking, the use of systems thinking in ICT4D is limited and fragmented. A good portion of the papers refer to systems approaches that they do not apply themselves. The papers analysed show some common themes, although these papers do not provide a strong foundation on systems thinking in ICT4D, on which to base further work. If the conclusions from the above analysis are considered together with arguments for the use of systems thinking in ICT4D, it indicates a need for further work in this area. To confirm this need, the arguments presented for using systems thinking in ICT4D are revisited.

2.4.3 Revisiting the arguments for using systems thinking in ICT4D

The following three arguments for the use of systems thinking in ICT4D have been presented in this chapter:

Firstly, in order to deal with the problem of assessing the contribution of an ICT4D project to the larger social system in which it is introduced, a systems approach was suggested. A systems approach is concerned with the performance of the total system when changes are made to a part of the system, and it recognises that good performance at the level of a subsystem does not necessarily translate into increased performance of the larger system (Ackoff, 1999).

Second, ICT4D's social context provides extraordinary challenges related to social, political, cultural and infrastructural factors (Walsham et al., 1988; Petkov et al., 2002; Gunawardena and Brown, 2007). The benefits of systems thinking include its ability to deal with complex situations and its transdisciplinarity (Jackson, 2003). Hence, a systems approach by its nature has the potential to deal with the social context of an ICT4D project.

Thirdly, within the broader IS field, the limited use of systems thinking is lamented by a number of its prominent scholars. Alter (2004) notes the surprisingly limited systems thinking in the IS discipline. Mingers and White (2010) state that although IS researchers generally regard themselves as systems thinkers, they are not actually using systems theory. Lee (2004) states that IS studies tend to view 'information systems' to be the same as 'information technology', and that the IS research community in general does not realise the significance of systems thinking. Lee (2010) comes to a conclusion similar to that of Mingers and White (ibid.), namely that the IS discipline claims to be a systems discipline while in practice it is not. Lee (2010) suggests that systems thinking should be put back into IS, to do justice to the name 'information *systems*'.

If systems thinking is undervalued in IS in general, and the complex, multi-dimensional problem situation in ICT4D calls for a systems approach even more than traditional IS research, why is systems thinking in ICT4D almost nonexistent? Is it perhaps too difficult or challenging? Are ICT4D researchers not sufficiently aware or convinced of its potential benefits? Can it really deliver the benefits it promises? Since there is so little empirical work on systems thinking in ICT4D from which to draw conclusions, an opportunity exists for

systems work in ICT4D, to ascertain whether any of the mentioned concerns are founded, and if not, to refute the concerns.

2.4.4   The way forward: searching for a social systems description

An argument has been presented for the use of systems thinking in ICT4D overall, and in particular for assessing the developmental contribution of ICT to the larger social system it serves. The next challenge is to find a suitable systems approach to do this.

In the light of the limited and fragmented literature on systems thinking in ICT4D, this thesis departs with a broad investigation of social systems approaches that could be used in an ICT4D context to describe the wider social system that affects and is affected by an IS intervention. The investigation attempts to find approaches that focus on the 'social' as well as the 'system' aspects of a social system. According to Checkland, who assumes a key role in the existing systems-related ICT4D literature, a social system has characteristics of a natural system as well as a human activity system (Checkland, 1999; see section 4.5.1), meaning that both sets of characteristics need to be recognised in a social systems approach.

The systems literature is firstly studied to see how systems theorists approach social systems. Since systems theories or approaches predominantly have biological and technical origins, they might not take the system's social nature sufficiently into account. Hence, the study also investigates the use of systems concepts in social theory, for possible useful social systems conceptions where the social domain is well captured.

From the literature survey on social systems methods, theories or approaches, a particular approach is derived or selected, using criteria specified for the appropriateness of such an approach. This social systems approach is developed further and applied to a case study, in order to assess the usefulness of the systems approach as well as to contribute to the concern stated above, namely to assess the contribution of the ICT4D project to the larger social system.

2.5 Conclusion

In this chapter, problems related to the notions of development and sustainability in ICT4D are discussed. A challenge noted in the existing literature is the difficulty of describing and assessing ICT's contribution to the socio-economic development of the larger social system it serves. The researcher identifies a related challenge, namely that sustainability is usually only assessed at project level rather than at the level of the community where an ICT4D project is initiated. The researcher then argues that systems thinking can help with describing the larger social context within which ICT4D takes place, so as to investigate the impact of a change at subsystem level on the development and sustainability of the larger social system of concern. A review of current literature on systems thinking in ICT4D shows that such literature is limited and fragmented, leaving an opportunity to contribute to this domain. In particular, there is no previous work using systems thinking that focuses on the impact on development and sustainability of the encompassing social system. A way forward is suggested, starting with a search for a suitable social systems approach.

Before commencing with this search, the study's research philosophy and strategy needs to be considered. This is done in Chapter 3, where a research methodology is presented to support the research aims discussed here and in Chapter 1.