Exploring the Link between ICT Intervention and Human Development through a Social Capital Lens: The Case Study of a Wireless Project in the Mountain Region of Nepal

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Abstract

While it is generally accepted that information and communication technology (ICT) can lead to development, the process through which this may happen remains unclear. At the core of this debate is the very definition of the term 'development'. In this thesis, I adopted Amartya Sen's definition. According to Sen (1999), human development is built upon a particular capability approach. He inferred that human development is the enhancement of human capabilities (freedom of choice) in order that people can live a life which they value and have reasons to value. The capability approach has, however, been criticized for its individualistic stance. In responding to this criticism, this thesis integrated the societal level by adding collective capabilities to conceptualize development. Such capabilities, which are not simple aggregates of individual capabilities, are built on collective action that can be fostered through social capital. Social capital is characterized as shared norms or values that promote social cooperation within and between communities. It can be further categorized into three forms: bonding, bridging, and linking social capital. Bonding refers to networks between homogeneous groups of people, bridging refers to networks between socially heterogeneous groups, and linking refers to vertical ties between different hierarchies of power and social status.

The research approach used in this thesis was interpretive; specific research questions emerged with the progression of data collections and analyses. The eventual outcome of the research process is a proposition that ICT intervention can promote social capital building process, which in turn encourages collective action that can create collective and individual capabilities. Two sets of research questions emerged during this course of action:

RQ. (1) The purpose of the first set of research questions is to understand the process of building social capital through ICT intervention and its implications for development.

(a) What is the process needed to create, maintain, and extend the bonding, bridging, and linking of social capital through ICT intervention in the mountain regions of developing countries?

(b) How does extended social capital foster development in the mountain regions of developing countries?

RQ. (2) The purpose of the second set of research questions is to further understand the process of building collective and individual capabilities through a social capital and collective action perspective.

(a) How does social capital promote collective action in the mountain regions of developing countries?

(b) How does collective action enhance collective and individual capabilities of the mountain communities of developing countries?

To explore the answers to these questions, this thesis drew on the analytical lenses of actor-network theory (ANT), social capital, collective action, and collective capabilities. Insights from the interpretive case study of a wireless project carried out in the Myagdi district, a mountain region of Nepal, were used to connect data and theory. Three rounds of data collections were carried out in ten villages of the Myagdi district within the span of three years. Data analysis was carried out to understand the process of building social capital through ICT intervention, and its relation to human development through collective action and extended capabilities.

The empirical findings are presented in the five papers published in peer-reviewed international journals and conference proceedings. Results show that the formation and extension of social capital due to the NWNP in the mountain district went through different phases. These related to the identification of the relevant actors, their roles, negotiations between them, and their interest alignment. The interaction between people in the community and the project enabled the residents of the village to create, maintain and extend their social capital. Subsequently, various forms of social capital, such as bonding, bridging and linking, assisted them in promoting collective action. This led to the building and development of collective and individual capabilities through the improvement of social opportunities, education, and income-generating activities. The study also identified challenges, such as over dependency on a single actor,

a high illiteracy rate, poor physical infrastructure, political instability, and lack of participation, all of which may impede the development process.

Based on the dialogue between existing ICT4D literature and observations from the case study, this thesis makes two substantive contributions to an understanding of the holistic view of ICT intervention and human development.

Firstly, this thesis contributes to the conceptualization of human development. It describes the role of ICT, social capital and collective action in fostering the development process in the mountain regions of developing countries.

Secondly, this thesis broadens the theoretical and empirical understanding of the process of building and extending social capital through ICT intervention. It does so by integrating the complementary lenses of actor-network theory and social capital.

This thesis also reveals some practical implications for policy makers. The findings suggest that the ICT policies and strategies of governmental and non-governmental organizations in developing countries should focus on analyzing the developmental context before embarking on an ICT4D project. They should, for example, consider development for what and for whom. The project should be attentive in identifying key actors whilst, at the same time, enhancing local participation and

the social capital building process in remote communities of developing countries. These underlining guidelines can promote collective action, and build collective and individual capabilities that can lead to human development in the long run.

ABBREVIATION

ANT	- Actor-Network Theory
AIT	- Asian Institute of Technology
ATM	- Automated Teller Machine
APT	- Asia Pacific Telecommunication
BBC	- British Broadcasting Corporation
CA	- Capability Approach
CC	- Collective Capabilities
CEO	- Chief Executive Officer
DFID	- Department for International Development of the United Kingdom
ENRD	- E-Networks Research and Development
GDP	- Gross Domestic Product
GDI	- Gender Development Index
GEM	- Gender Equity Measure
GIS	- Geographical Information Systems
HLCIT	- High Level Commission for Information Technology
HDI	- Human Development Index
HPI	- Human Poverty Index
ICASIT	- International Center for Applied Studies in Information Technology
ICT	- Information and Communication Technology
ICT4D	- Information and Communication Technology for Development
IOE	- Institute of Engineering
ISP	- Internet Service Provider
ITDJ	- Information and Technology for Development Journal
ITU	- International Telecommunication Union
ITUA-J	- International Telecom Union Association of Japan
JIIA	- Japan International ICT Association
KDDI	- Japanese Telecommunications Operator
MDG	- Millennium Development Goals
MIT	- Massachusetts Institute of Technology
MPP	- Madan Puraskar Pustakalaya
NGO	- Non Governmental Organization
NTA	- Nepal Telecommunication Authority
NWNP	- Nepal Wireless Networking Project
OLE	- Open Learning Exchange
SC	- Social Capital
TAM	- Technology Acceptance Model
TPB	- Theory of Planned Behavior
UK	- United Kingdom
UNDP	- United Nations Development Program
VDC	- Village Development Committee
VOIP	- Voice over Internet Protocol

Table of Contents

List of Figures

List of Tables

1 Introduction

The world is witnessing the emergence of widespread use of information and communication technology (ICT) in industrialized and emerging market economies. However, the current global information boom has had a limited impact on access to information and developmental activities, particularly in the mountain regions of developing countries (Aitkin, 2009; Akhtar & Gregson, 2001). Despite huge investment and a massive rate of telecom penetration in urban areas, ICT[1] services still fall short of meeting demand in mountain communities. For example, in Nepal there are more than 1000 Internet access points; however, 50% of them are concentrated inside Kathmandu Valley (HLCIT, 2004; NTA, 2010). It shows that the distribution of ICT services in terms of geographical dispersion has been mainly located in urban areas and that mountain regions are deprived of an opportunity to access Internet services.

It is broadly agreed that ICT can play an important role in the development of developing countries in general, and in mountain communities in particular (Aitkin, 2009; Akhtar & Gregson, 2001; Heeks & Kanashiro, 2009). The reduced cost of technological advancement has led to increased opportunities for the diffusion of ICT in these remote areas. Several studies have given examples of development that has been achieved through

[1] Information and communication technology (ICT) is defined in many ways, such as TV, Radio, Mobile Phones, Internet and other digitally stored information. For the clarity of the research objective, ICT in this thesis refers to the wireless Internet services.

the implementation of ICT (Dabla, 2004; 06; Kanungo, 2004). Regardless of such episodic case successes, as depicted by a question mark in Figure 1-1, there is a knowledge gap that shows a direct link between ICT intervention and development in the context of developing countries (Avgerou, 2003; Heeks, 2010). Researchers and practitioners are still trying to understand and explain the development process that specifically emerges from ICT intervention (Heeks, 2010; World Bank, 2003; Zheng, 2009).

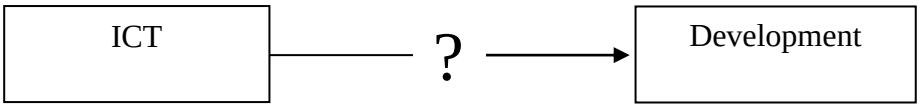


Figure 1-1. Elusive link between ICT and Development

Initial studies of ICT4D have focused on the narrow concept of bridging the 'digital gap' in terms of physical access to the Internet (Cullen, 2001). Contemporary discourses on this issue have consistently identified technology as a means to bridge the gap; however, the dimension of 'digital gap' has extended beyond the physical access to embrace the broader aspects of the social, political, human and economic spheres (Warschauer, 2003). International development agencies credit ICT for enhancing the functioning of markets, facilitating institutional development, and building human capacities. More specifically, these development agencies are trying to understand how ICT can be utilized to achieve the Millennium Development Goals (MDGs), such as reducing poverty, improving healthcare, providing better education, and fostering gender equality in

developing countries (Avgerou, 2003; World Bank, 2003). Thus, the need to understand the relationship between ICT intervention and development can be seen both in academia and practice. The relation between ICT and development that has been suggested in contemporary discourses is still dubious and misleading. Such studies are based on narrow economic theories that pay little attention to developing theory on the interplay between technological change and socioeconomic contexts (Avgerou, 2010). It is argued that existing theories remain weak in forming convincing arguments about IT-enabled socioeconomic development (Avgerou, 2003).

The design and outcome of ICT4D projects are influenced by the development context (Prakash & De, 2007); therefore, before investigating the connection between ICT and development, we need to understand the meaning of 'development' (Heeks, 2010). There are multiple definitions of development. For instance, in utilitarian theory, development is seen as an increase in happiness. On the other hand, libertarian theory conceptualizes development as individual freedom. A theory of fairness comprises the liberty principle, equality of opportunity and the difference principle (Sen, 1992). Sen criticized such an individual and social evaluation because it is only based on such variables as happiness, primary goods, resources, or real income. He regarded these variables as the means rather than the ends to freedom (Sen, 1992), and argued that individual substantive

freedom (capabilities) is the primary end objective and the principal means of development (Sen, 1999).

This thesis defines development as an enlargement of capabilities. Such a definition is adopted from the capability approach put forward by Amartya Sen (1999). This capability approach provides a theoretical foundation for the human development paradigm. It proposes that capabilities give an individual the freedom to make decisions that can help in achieving the life he or she values - and has reasons to value (Sen, 1999). Sein and Harindanath (2004) argued that the 'enabler' view of ICT essentially relates to the enhancement of an individual's capabilities through empowerment and knowledge. Similarly, Oxoby (2009) pointed out that the key to development is to build these capabilities through commodities (e.g. ICT).

This capability approach has been criticized because of its individualistic focus. The approach emphasizes the development of individual capabilities and de-emphasizes the role of collective capabilities. Sen considered the collective or social arrangement as merely instrumental in fostering the development of individual capabilities. However, in remote mountain areas of developing countries in particular, individuals are more dependent on their community for realizing their individual capabilities (Evans, 2002; Ibrahim, 2006). The capability approach can be extended by incorporating a communal

perspective. The collective capabilities approach (Evans, 2002; Ibrahim, 2006) is used as the concept of development in this thesis. Collective capabilities focus on shared (social) capabilities (Comim & Carey, 2001; Ibrahim, 2006). Proponents of the collective capability have argued that Sen's capability approach provides an analytical and philosophical foundation for the study of human development, but it is insufficient; thus, it should be complemented by incorporating theoretical premises that are based on a collective level (Evans, 2002; Ibrahim, 2006).

After establishing that development can be defined as 'collective and individual capabilities', the question arises as to how these capabilities are built. Some studies in the literature have advocated that collective action, the process of doing something together (Gilbert, 2006), is a prerequisite to the attainment of collective capabilities (Evans, 2002; Ibrahim, 2006). The collective action is yet again contingent to the social norms of reciprocity and trust (Ostrom, 2000). For example, some studies have shown that increased social interaction can promote the trust, acceptance, and alignment that is necessary for collective action (Ostrom, 2000; Syrjänen & Kuutti, 2004). These contingent characteristics, such as network, norms and trust, are the imperative element of social capital (Ostrom & Ahn, 2003).

A social capital perspective that focuses on resources embedded in social networks for the mutual benefit of parties within them (Putnam, 2000) has occasionally been used to explore the effects

of ICT intervention in communities (Urquhart et al., 2008). It has been argued that social capital can be built through social interaction among individuals and groups within a social unit (Portes, 1998), through the reproduction of symbols and meanings in groups (Bourdieu, 1986), through sharing embedded resources (Lin, 1999a), and through individual and civic engagement in the social network (Coleman, 1986; Putnam, 2000). Social capital has been put forward as an approach that can be used to explore the ICT-enabled development process (Díaz Andrade & Urquhart, 2009; Urquhart, et al., 2008). In this regard, ICT can play an instrumental role in facilitating social interaction. It can also enhance civic engagement within and beyond remote communities, and foster the socioeconomic development of these communities (Díaz Andrade & Urquhart, 2009; Huysman & Wulf, 2004). For example, studies conducted in the mountain region of Peru demonstrated that ICT can be instrumental in overcoming remoteness and social exclusion problems through extending social capital (Heeks & Kanashiro, 2009). Another development initiative called InfoDes in Peru identified that ICT can be helpful in creating social capital and human capital in remote communities, which can lead to socio-economic development (Díaz Andrade & Urquhart, 2009). Studies have suggested that the positive consequences of building social capital include human capital, civic engagement, better healthcare, educational, and economic improvement (Putnam, 2000; Woolcock & Narayan, 2000).

Similarly, I used the social capital perspective to explore how wireless internet services promote collective action and interaction among different communities, which in turn builds the villagers' collective and individual capabilities. Social capital focuses on "the norms and networks that facilitate collective action" (Woolcock, 2001, p. 70), whereas the capability approach focuses more on "the arrangement which influences the individual's substantive freedom to live better "(Sen, 1999, p. 39). Thus, in this thesis, I argue that a social capital perspective is a more appropriate theoretical framework in which to explain changes at the societal level. In so doing, this study is in agreement with work carried out by Diaz Andrade and Urquhart (2009). They introduced social capital to explore changes in the social structures and networks following ICT intervention in rural Peru. In addition, this thesis also explores how various forms of social capital promote collective action.

However, research into social capital and its role in defining the relationship between ICT and human development is still in its early stages; more work is needed. In particular, the missing link is to understand the interplay between various social and technical actors that contributes to the process of building social capital (Lin, 1999a). While the instrumental role of ICT as an enabler to promote social capital is illustrated (Huysman & Wulf, 2004), more research is needed to understand the process of building social capital and its implications for the development of remote communities (Urquhart , et al., 2008). Social capital

formation and the extension process become more complex with the dramatic growth of technology and its pervasiveness in the modern society (Lin, 1999a). Technology itself has been transformed from a mere instrument to a socially embedded system (Orlikowski & Iacono, 2001). Such a transformation has restructured social networks so that resources are shared by a large number of participants who must abide by new rules and practices (Lin, 1999b). While social capital explains how various social ties can be mobilized to realize the benefits embedded in social networks, it does not describe how social capital is built in the context of technological change. Furthermore, it does not explain who the central actors are and how they build social networks.

To explore the role of various sociotechnical actors in the process of building social capital, I have employed the actor-network theory (ANT). It is a well-established theoretical lens in the IS field that analyses sociotechnical phenomena (Walsham, 1997). ANT describes the process by which focal actor(s) enroll various other actors to form a network, and mobilize the members of the network to achieve shared objectives. Existing literature on ICT4D has shown that interpretive research conducted using ANT can enhance our understanding of the interplay between various actors and the social network formation process (Stanforth, 2007; Walsham & Sahay, 1999). However, ANT is not without its limitations. It does not explain or describe the value of social networks, such as how networks

lead to human development. The theory discusses the enrolment process of different social and technical actors, but it does not discuss the role of social structures that influence the actors' enrolment decisions. Therefore, this study suggests that ANT can be complemented by other social theories, such as social capital, to take into account broader social structures. ANT focuses less on understanding the function and influence of social structures on actors (Walsham, 1997), while social capital comprises a variety of entities that make up the social structure, and facilitate the actions of individuals within that structure (Coleman, 1988).

From this perspective, I argue that ANT and social capital can be employed as complementary lenses. They can illuminate the process of building social capital with regard to technological intervention; furthermore, they pave the way for exploring the elusive link between ICT and human development by combining the collective action and capabilities approaches. This study takes an interpretive approach from the beginning. It starts with understanding the process of building social capital through ICT intervention, thereafter linking social capital to collective and individual capabilities through collective action.

1.1 The research questions

To explore and unfold the link between ICT intervention and development, I conducted an interpretive case study in the mountain region of Nepal. Throughout, this study was guided by different theoretical lenses, such as ANT, social capital, collective action and the capability approach. I employed these

lenses to explore the interaction between ICT and people in a community, and the consequences of such interaction on the social capital building process. In particular, ANT's translation process (Callon, 1986) was deployed. This thesis investigated how focal actor(s) create, extend and mobilize their social network through the enrolment process. Thereafter, it explored how an extended network can promote collective action through bonding, bridging, and linking social capital, which in turn builds collective and individual capabilities. This thesis enhances our theoretical and empirical understanding of the possible relationship between ICT intervention and human development. The findings of the research were published in five peer reviewed journal and conference papers.

The first of these published papers was a literature review into ICT4D. This identified that there is a lack of evidence of a direct link between ICT intervention and human development (Avgerou, 2003). As part of an empirical investigation of this issue, I conducted the first round of data collection in the Myagdi district. The findings, published in the second paper, were consistent with the existing literature; namely, that ICT can play an instrumental role in building social capital and may lead to some kind of development (DCITA, 2005; Huysman & Wulf, 2004; Urquhart, et al., 2008). After the first round of data collection, a missing link was identified: this was to understand the process of building social capital with regard to ICT intervention. For example, it raised the question: who are the

key actors in social capital building process? Furthermore, it was found that not enough research had been carried out into how the various sociotechnical actors interact, create and extend social capital. To address this problem, I continued my research by asking the following research question:

RQ.1 (a) What is the process used to create, maintain, and extend bonding, bridging, and the linking of social capital through ICT intervention in the mountain regions of developing countries?

To investigate this research question, I used an ANT lens for exploring the role of various actors in a wireless project in the Myagdi district. The finding of the study is published in the third paper, and discussed in detail in Chapter 5. The answer to the first research question identified the roles of the main actors, and the process of building social capital in the mountain villages. It did, however, raise a second question: what are the consequences of social capital on the socioeconomic development of remote communities? In particular, it is necessary to examine this question, in relation to various forms of social capital, such as bonding, bridging, linking, and socioeconomic development (Huysman & Wulf, 2004; Woolcock, 2001). The notion of bonding social capital is based on the relationship that exists between homogenous groups, such as family members, close friends, ethnic fraternal organizations, and religion-based groups. Bridging social capital is an idea that is based on the relationship between distant friends, associates and colleagues, civil rights

movements, and religious organizations. Linking social capital refers to the relationship between individuals and groups in different social strata in a hierarchy where power, social status and wealth are accessed by different groups (Field, 2003). To address the issue of how ICT plays a role in creating various forms of social capital and the effect it has on socioeconomic development, I formulated the following research question:

RQ.1 (b) How does extended social capital foster socio-economic development in the mountain regions of developing countries?

In order to provide an answer, it was necessary to explore this question from a social capital perspective. Formal and informal interviews of the community groups and individuals were analyzed to understand the role of various social structures in fostering socioeconomic development. The findings relating to this question were published in the fourth paper and are also discussed in Chapter 5 in this thesis. The role of ICT in the creation and extension of social capital and its implications for socioeconomic development were identified; however, the question of linking ICT intervention to human development remains unanswered. This thesis adopted the capability approach in which, human development brings about an enhancement of collective and individual capabilities. In recent times, there has been a wider acceptance of the capability approach by various disciplines. More recently, ICT4D literature has also begun to adopt this idea (Zheng, 2009). According to such literature,

social capital can promote collective action (Gilbert, 2006; Ostrom, 2000), and collective action can build collective and individual capabilities (Ibrahim, 2006). Nonetheless, there is still a lack of ICT4D research that identifies the relationship between social capital and collective action. In order to further such knowledge, I put forward the following research question:

RQ.2 (a) How does social capital promote collective action in the mountain regions of developing countries?

The empirical findings showed that the wireless project facilitated social groups in mountain communities to take collective action in the promotion of income-generating activities, social awareness, and healthcare activities. The findings of this study, which responded to RQ.2 (a) and RQ.2 (b), were published in the fifth paper, and are discussed in detail in Chapter 5 of this thesis. The final step in my study is to synthesize the relationship between social capital, collective action, and collective and individual capabilities with regard to ICT intervention in the context of mountain regions of developing countries. It will draw the overall picture of the relation between ICT intervention and human development. As discussed earlier, human development in this context is conceptualized as collective capabilities which can be achieved through collective action. However, collective action is contingent on elements of social capital. Existing literature on ICT and social capital has shown that increased access to information can build human capital (Díaz Andrade & Urquhart,

2009), reduce poverty (Urquhart, et al., 2008) and enhance community bonding (Rohde, 2004). Similar studies have explored the link between social capital, collective action, and collective and individual capabilities through ICT intervention. Thus, the following research question aims to gain a better understanding of the link between ICT intervention and human development:

RQ. 2(b) How does collective action enhance the collective and individual capabilities of mountain communities in developing countries?

1.2 Summary

The theoretical framework, as summarized in Figure 1-2, is the outcome of various interpretive phases that were not present at the outset, but emerged as the study progressed. Figure 1-2 should not be interpreted as linear and deterministic; although it is presented in linear fashion, it is the whole that should be interpreted. In this thesis, the conceptualization of development is based upon Sen's capability approach of 'enlargement of freedoms', which is characterized by the enhancement of individual capabilities. As argued earlier, in the context of remote communities, social or collective capabilities need to be enhanced to foster individual capabilities. Collective capabilities can foster development on their own account; they can also influence the enhancement and exercise of individual capabilities. It has also been argued that developing collective capabilities requires collective action (Ibrahim, 2006). The impetus for collective action, namely the willingness of individuals to act

collectively, can lie in the strength and level of social capital in such groups. In this particular context, ICT can be instrumental in developing and enhancing different forms of social capital, including bonding, bridging, and linking. Thus, ICT can foster development by enabling the building of social capital, which would lead to collective actions and, in turn, develop collective and individual capabilities. This study also explores the process of building social capital with regard to ICT intervention using ANT.

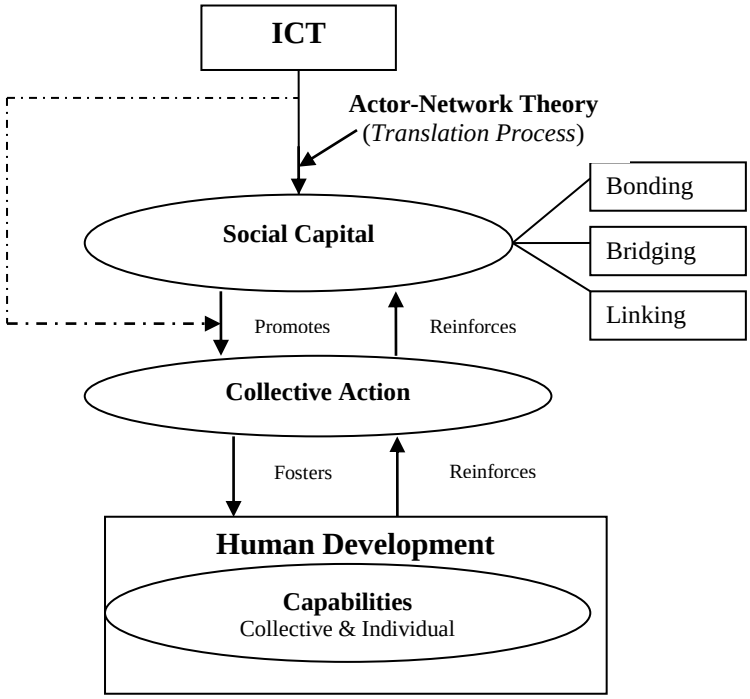


Figure 1-2. Theoretical framework to explore the link between ICT and human development

1.3 Structure of the thesis

The remainder of the thesis is organized as follows. Chapter 2 discusses the theoretical foundation of the framework formed. Chapter 3 describes the research methods, field setting, and interpretive methods adopted in this research. Chapter 4 summarizes the research publications and their contribution to the proposed research questions. Chapter 5 and 6 go on to present the research findings, and discuss their theoretical and empirical contributions to the existing body of knowledge. This thesis concludes with Chapter 7, which includes a summary, and a discussion on the limitations of the study, and possible future research endeavor.

2 Theoretical Premises

This section discusses the theories that informed the study. The results indicate that the use of multiple theories offers a better understanding of the phenomena than any of the employed theories on their own. In the context of IS research, it is suggested that the application of multiple theories, together with a suitable methodological approach, can enhance the plausibility of the research findings (Robey & Boudreau, 1999). Each theory adapted in this thesis is well-established in the social science arena. Many have also started to emerge in the ICT4D context. Used on their own, these theories have not been able to provide a comprehensive description or explanation of the elusive link between ICT intervention and human development. Thus, this thesis adapted four theories by combining their various strengths.

The integrated lens provides a deeper understanding of the studied phenomena. Some examples of integrating multiple theories to examine the research problem can be found in studies by Braa, et al. (2007) and Riemenschneider, et al. (2003). For instance, Braa, et al. (2007) used theories of complexity science, large technological systems, and ANT to explore the issue of strategies for developing information infrastructure for healthcare sectors in developing countries. Similarly, Riemenschneider, et al. (2003) combined the theory of planned behavior (TPB) and technology acceptance model (TAM) to understand the IT adoption decisions made in small business.

Subsequent sections will discuss how this thesis contributes to ICT4D research by employing multiple theories.

As shown in Table 2.1, ANT works well in our understanding of how ICT intervention creates the means (in this case, social capital) of development. To understand the meaning of development, however, it is better to adopt a capabilities approach. Likewise, to understand how social capital builds individual and collective capabilities, the collective action offers the best approach. Therefore, I argue that a complementary approach that uses multiple theories offers a better lens to comprehending the possible link between ICT intervention and human development. All the theories employed in this thesis are described in subsequent sections.

Table 2.1 Complimentary role of multiple theories

Objectives / Theories	What is the process to create social capital through ICT intervention?	What is the means to human development?	How does social capital foster human development process?	What is human development?
Actor-network theory	X			
Social capital		X		
Collective action			X	
Capabilities Approach				X

2.1 Human Development (Sen's Perspective)

In the context of ICT4D, the meaning of development was initially understood in the narrow sense of bridging a 'digital gap' (Warschauer, 2003), in terms of economic growth through information exchange and market efficiency (Jensen, 2007), or the reduction of poverty through access to information in a vulnerability context (Duncombe, 2006). The meaning of development was not, however, based upon a conceptual and philosophical framework (Zheng 2007). Within ICT4D, the term 'development' is elusive and can be interpreted in many ways. For example, in a quote taken from a blog (White African, by Hash) that illustrates one interpretation of ICT4D, the following statement is made by a Kenyan: "I always picture a team from the UN putting up toilets in Uganda when I hear of ICT4D." Therefore, it is necessary to define the concept of development before we can go on to examine how ICT can lead to development.

The conceptualization of development is an ongoing discourse in academia and practice. Different competing theories under particular paradigms have been developed to characterize the notion of development. For example, according to modernization theory, development is characterized as the displacement of traditional values, beliefs and actions in society (Pieterse, 2001). From this perspective, development can be achieved by imitating the strategies and ideologies applied in developed countries or so called 'modern societies'. On the other hand, a neo-liberalist approach favors market efficiency. Initial approaches taken by

development agencies were consistent with such thinking. Alternatively, dependency theory viewed modernization as a proponent of capitalism, with the emphasis on national or auto-centric economic growth (Escobar, 1995). This theory predicated that poverty is not accidental, but caused by the processes of colonization and trade in which resources flow from underdeveloped to developed countries, making them rich at the other's expense. Other theories, such as alternative development theory, insisted on community participation and grassroots politics (Pieterse, 2001).

Sen (1999) criticized development approaches that were merely focused on economic growth; for example, by looking at gross domestic product (GDP). He argued that economic growth is a means rather than an end to freedom, and that an individual's achievement of substantive freedom or capabilities is the primary end objective and the principal means of development. Capabilities give an individual the freedom to make decisions that can help in achieving the life they value - and have reason to value (Sen, 1999). The United Nations Development Program (UNDP) has formulated statistical measures of human development based upon Sen's capability approach (Robeyns, 2005). Some examples include: human development index (HDI), gender development index (GDI), gender equity measure (GEM), and human poverty index (HPI). In the ICT4D context, the capability approach has also lately begun to appear in the

literature (Díaz Andrade & Urquhart, 2009; Hatakka & Lagsten, 2012; Toboso, 2011).

In this thesis, development is defined and conceptualized according to Sen's capability approach, which is built upon a human development paradigm and is deeply rooted into philosophy (Nussbaum, 1988). In the context of this study, which focuses on remote mountain communities, a human development approach (Pieterse, 2001), such as that adopted by Sen, can be argued to be a more relevant conceptual framework. This capability approach has been used in development studies (Robeyns, 2005) in general and in ICT4D (Kleine, 2010) areas in particular. In recognition of the importance of this approach, one journal has recently published a special issue on the capability approach (Information Technology for Development (ITD) Journal (Volume 18).

The capability approach infers human development as the extension of people's 'freedom of choice', so that they can lead lives that they value and have reason to value. It calls for an alternative e-development beyond the space that centers on economic growth or modernization (Zheng, 2009). The major constituents of the capability approach are "functionings" and "capabilities". Functionings refers to achievements already realized (social, political, and environmental opportunities), whereas capabilities are opportunities and freedoms that are needed to achieve these functionings (Sen, 1999). The capability

approach makes a distinction between *means*, such as ICT services, and *ends*, such as education, healthcare and employment. Put simply, resources are needed to enable people to do and to be. Three groups of conversion factors exist: *personal*, *social*, and *environmental*. These influence the relationship between *commodities* (goods and services) and *functionings* to achieve certain beings and doings (Sen, 1992). Personal conversion factors denote any personal characteristics, such as physical conditions, gender, reading skills and intelligence that convert commodities into a functioning. Social conversion factors are features such as social norms, public policies, gender roles, caste systems and power relations. Environmental conversion factors include geographical location, climate and infrastructure. A*chieved functionings* refers to the combination of the means to achieve, the freedom to achieve them, and personal preferences and social influences on decision-making mechanisms.

To understand how ICT may increase individuals' capabilities to function in their societies, it is necessary to look at knowledge gained not just from welfare economics and development, but also from an information systems perspective (Zheng, 2009; Zheng & Walsham 2008). Sen's approach has been criticized because of its emphasis on individual capabilities. It is argued that, although the capability approach is a suitable lens through which to study development, it is not complete (Comim & Carey, 2001; Evans, 2002). Thus, the concept of individual capabilities

needs to be complemented by the inclusion of collective capabilities (Evans, 2002; Ibrahim, 2006). In the case of remote communities in particular, converting resources into *functionings* is not exclusively determined at an individual basis. Subsequent sections illustrate these notions and their relationship with each other.

2.2 Collective Capabilities

As previously stated, Sen's capability approach is a suitable but incomplete lens for studying development. This is because it focuses mainly on individual capabilities whilst de-emphasizing the collective level. The concept of individual capability needs to be extended to include collective capabilities (Evans, 2002; Ibrahim, 2006). As Alkire (2010:40) stated, human development is : "to expand people's freedoms – the worthwhile capabilities people value – and to empower people to engage actively in development processes, on a shared planet…People are both the beneficiaries and the agents of long term, equitable human development, both as individuals and as groups" (See in Hamel, 2010). The notion of collective capabilities refers to the freedom of a group of individual agents to perform a set of distinct actions in combination (Ibrahim, 2006). Such capabilities are not simple aggregates of individual capabilities; rather, they are distinct in the sense that an individual can only attain them as a member of a group. For example, in remote communities, women groups are able to achieve a financial freedom that individual members are unlikely to attain by acting alone.

Regarding the role of ICT in building capabilities, a research survey has shown that, despite major inequalities across the world and continued gaps in access to ICT, such tools and techniques can have positive impacts on human development (Hamel, 2010). Some studies have illustrated that ICT can empower communities (Gigler, 2004) and help to avoid social exclusion (Zheng & Walsham 2008) through building collective and individual capabilities. Recent examples can be found in the Middle East (Ghannam, 2011). These have revealed the vital role played by the social media in enhancing the political capabilities of ordinary people to break the authoritarian status quo. Likewise, several independent studies have shown how ICT intervention can enhance individual and societal opportunities through education; for example, by distance education, improved pedagogy, and access to a pool of information (Sellinger, 2009). In healthcare, ICT intervention can take the form of remote consultation, coordination, and diagnosis using telemedicine (Bellows et al., 2006). Income generation activities can lead to improved market efficiencies (Jensen, 2007). This thesis has tried to assimilate this fragmented knowledge through an integrated lens of collective capabilities.

Development agencies and academia have expressed their great concern for understanding the specific use of technology and the extent to which it can help communities and individuals build their capabilities (Hamel, 2010). Recognition of the need to understand the link between ICT and collective capabilities is

also evident in ICT4D literature (Hatakka & Lagsten, 2012; Kleine, 2010; Zheng 2007), although relevant research is still lacking. In the main, however, the conceptualization of development as collective capabilities and its relationship with ICT intervention are rarely found. This study is an effort to explore this development perspective in the context of the mountain region of Nepal. Evans (2002:56) argued that, in these areas, "individual capabilities depend on collective capabilities". He went on to point out that the development of individual capabilities and the exercise of the resultant freedom are often dependent on acting collectively with others, i.e., through collective action. An individual can acquire these "social capabilities" (Comim & Carey, 2001) through engagement in collective actions (Evans, 2002; Ibrahim, 2006). Therefore, collective capabilities are contingent on collective action. The next section briefly illustrates the notion of collective action.

2.3 Collective Action[2]

As stated earlier, collective capabilities result from social interaction through an individual's engagement in collective actions (Evans, 2002; Ibrahim 2006). Defined as "doing something together or acting together" (Gilbert, 2006:4), collective action is the pursuit of a goal or a set of shared goals (capabilities in this context) by a group of people. By virtue of their participation in a group, they somehow find the means to cooperate in the process of achieving the shared goal.

[2] Much of this section is extracted from Paper 5

Cooperation leads to a group act that is backed by social norms and values, as well as group commitments that oblige them to act as agreed upon.

Studies have shown that collective action may act as an engine for collective capabilities in poor communities for various reasons (Ibrahim, 2006). First, collective action may promote income generation and resource sharing, and encourage poor people to participate in local decision-making. Second, collective action may influence the formulation of values and beliefs, as an outcome of a social context. Thirdly, collective action and collective freedom are mutually reinforcing, where freedom widens the possibilities for collective actions. Again, this allows individuals to exercise their freedom (Ibrahim, 2006). Evans argued that organized collective actions are "fundamental" to the exercising of freedoms, especially when powerful forces oppose them (Evans, 2002). He concluded that, "fostering the expansion of such means of collective action is central to the expansion of freedom" (Evans, 2002:56). It has been further argued that collective action and collective freedom are mutually reinforcing, where freedom widens the possibilities for collective actions, which again allows individuals to exercise their freedom (Ibrahim, 2006).

Research into ICT and collective action has shown the use of computer-mediated communication as an organizing tool. It facilitates collective action by creating large, dense networks of

relatively weak social ties (Hampton, 2003). Studies have shown that social networks created through ICT can enforce collective action that can also cross over into the physical world (Hampton, 2003). Other research has shown that collective action taken through Internet-based business forums in rural areas can create new business opportunities by providing access to market spaces and external resources (Galloway et al., 2004). According to one study, such ICT initiatives as the CD-ROM project promote collective action that can lead to the empowerment of women (Dralega, 2007). However, in the context of ICT4D, evidence of collective action appears implicitly in the form of anecdotes (DCITA, 2005). Hence, there is a need to investigate the theoretical underpinnings of collective action and, similarly, its role in enhancing collective and individual capabilities in the remote communities of developing countries.

Collective action rests on a special kind of interpersonal commitment called a "joint commitment" (Gilbert, 2006). A joint commitment is not just a set of personal commitments independently created by an individual; for example, to make a personal decision to do something. It is also a single commitment by a group in which each an individual makes a contribution. Such commitments are often implicit and voluntary through processes that are more extended in time. Gilbert (2006) advocated that collective action through joint commitment put each individual in a position to demand corrective action of the other if he or she acted in ways that had a negative effect on the

completion of their shared objectives. This leads to the central question of why individuals should take part in collective action. In other words, what is in it for them? This question is at the core of Olson's "zero contribution thesis", which states that in the absence of external forces such as coercion, no rational individual will take part in actions to achieve a group goal (Ostrom, 2000). Yet, empirical evidence shows that people do act collectively and that they do contribute. So, the potential conflict between individual agency and collective goal does get resolved.

How does this happen? Findings in experimental economics, particularly the body of work authored by Elinor Ostrom, a Nobel Laureate, have provided some evidence. A few aspects that are most relevant to this thesis are presented here. One aspect is that individuals do cooperate and that this behavior is learnt and reinforced over a period of time, especially if they work in the same group and members of the group actually contribute (i.e. free riders are absent or are censured). Empirical evidence has shown that, in the long run, individual agencies build trust and cooperation through social interaction; they go on to develop a shared understanding, taking part in collective actions to achieve a group goal (Ostrom, 2000). Such groups are more effective and act more harmoniously if they are locally organized and self-governing, and if external mandates are either nominal or absent altogether (Ostrom, 2000).

However the finding on collective action that is most relevant to this thesis is that social norms play a vital part in promoting collective action. Individuals bring in their own set of values and norms that emphasize cooperation (Ostrom, 2000). Empirical findings show that social norms and trust are a fundamental part of fostering collective action (Ostrom & Ahn, 2003). Historically, every individual brings in their own set of values and norms that emphasize cooperation and they form groups that further influence collective action (Ostrom, 2000). Since such action is in most cases voluntary, the ties that bind heavily rely on goodwill, fellowship and social interactions amongst individuals of a social unit (Ostrom, 2000). In other words, it depends on the "level of social capital" (Ostrom 2000:148). Collective action results from a social network, norms of reciprocity and mutual trust that are only meaningful at a collective level (Putnam, 2000). Consequently, collective action can be fostered through social capital. The following section describes social capital in detail.

2.4 Social Capital

The advancement of the concept of social capital can be traced back to the 18th and early 19th centuries. Scholars such as Tocqueville, Durkheim, Weber, and Marx were the first to suggest that participation in groups promotes collective action, with positive effects on individuals and the community (Ostrom & Ahn, 2003). Durkheim and Marx emphasized group life as a solution to social instability and self-destruction. Later, Hanifan coined the term "social capital" in 1916, defining it as

instrumental to goodwill, fellowship, sympathy, and social interaction among individuals and groups within a social unit (Huysman & Wulf, 2004). The contemporary proponents of social capital—Bourdieu, Coleman and Putnam—conducted further research into social capital (Portes, 1998). Bourdieu's instrumental treatment of social capital focused on the benefits accruing to individuals by virtue of participation in groups based on the deliberate construction of sociability for the purpose of creating this resource (Bourdieu, 1986). Bourdieu defined social capital as the aggregate of actual or potential resources, which are linked to the possession of a durable network of relatively institutionalized relationships of mutual recognition or acquaintanceship.

Social capital has been presented as a variety of entities that share two common characteristics: they consist of some aspect of a social structure, and they facilitate certain actions of individuals within the structure (Coleman, 1988). Considering these theoretical definitions, social capital can be characterized as a network of norms and social trust that facilitates collective action for the mutual benefit of individuals and groups (Ostrom & Ahn, 2003; Putnam, 2000). It can also act as a means of accessing resources embedded in the relational social structure (Lin, 1999a), possibly leading to economic development (Woolcock & Narayan, 2000). Social capital can be categorized into either individual or collective social capital, depending on the perspective of the level of analysis (Portes, 2000; Yang et al.,

2009). Individual social capital is a resource that is generated by an individual's social network for the mutual benefit of the network's members. Collective social capital consists of individuals' social networks and norms that contribute to the common good of a community or even a nation. It has been categorized according to six dimensions: groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and empowerment and political action (World Bank, 2006). In the context of developing countries, particularly in remote mountain villages, individuals rely on social networks to make up for their lack of individual resources; therefore, in this thesis a collective approach has been adopted.

Social capital may also have negative consequences; the same mechanisms appropriable by individuals and groups can have other "less desirable consequences" (Portes, 1998). Such consequences can include: restrictions imposed on actors who do not belong to a network; negative social dynamics within the network and downward spiraling norms; dependency on central actors and their loyalty towards the network; restrictions on autonomy; and irrational economic behavior (Field, 2003; Huysman & Wulf, 2004). Social capital can be structurally classified into three different forms: bonding, bridging, and linking (Field, 2003). As summarized in Table 2.2, bonding social capital is useful for maintaining existing relations. However, strong bonding social capital may have adverse

impacts. It may serve to exclude and create a context for the growth of reactionary ideology (Portes, 1998). Bridging and linking social capitals are crucial for extending social networks, and could be an important resource for socioeconomic growth (Woolcock, 2001).

Table 2.2 Forms of Social Capital

Forms of Social Capital	**Description**
Bonding Social Capital	Denotes ties between people in homogenous groups and similar contexts such as immediate family, close friends and neighbors and ethnic fraternal organizations.
Bridging Social Capital	Denotes ties among distant friends and, associates, as well as between institutions such as religious organizations, and civil rights movements.
Linking Social Capital	Denotes ties among unlike people in dissimilar situations, such as those who are entirely outside the community and in different social strata in a hierarchy of power social status and wealth.

2.4.1 ICT and Social Capital

Research into the relationship between ICT and social capital has recently emerged. Such research shows that ICT facilitates the building of social capital through increasing flows of resource and information (Huysman & Wulf, 2004). Studies indicate that ICT can lead to the creation and maintenance of bridging, bonding, and linking social capital (DCITA, 2005). For example, findings have indicated a positive relationship between social media and the maintenance and creation of social capital (Ellison et al., 2007). According to some research, ICT can promote

interaction between community participants that increases trust, acceptance, and interest alignment between communities (Syrjänen & Kuutti, 2004). A case study on Iranian NGOs found that computer-based centers facilitate the building of e-communities and extend existing community networks through improved transparency and participation (Rohde, 2004). Such studies illustrate the impact of ICT on social capital by showing that ICT can be helpful in creating social capital, which in turns, builds human capital, and promotes collective action that can foster human development (Díaz Andrade & Urquhart, 2009).

In the existing literature, social capital has been studied as an effect of ICT intervention, or as an end in itself. Such studies show that ICT can facilitate communication, leading to enhanced social networks, norms and trust, and improve societal engagement. Very few ICT4D studies have examined social capital in an instrumental way, or as a means to human development (Díaz Andrade & Urquhart, 2009). Therefore, the role of social capital in building capabilities has not yet been thoroughly discussed. This thesis attempts to fill this gap by further exploring the role of social capital as a means for promoting collective action that can enlarge collective and individual capabilities. Furthermore, this study supports some economists (Ostrom, 2000; Ostrom & Ahn, 2003) and policy-making bodies (World Bank, 2006) in their belief that there is an intricate and mutually reinforcing relationship between social capital and collective action. This thesis further builds on this

research, seeking to understand the role of ICT in creating, maintaining, and extending social capital and its implications for collective action in remote communities of mountain regions in developing countries. Specifically, I studied the Nepal Wireless Networking Project (NWNP), an ICT initiative carried out in the Myagdi district in Nepal.

ICT can be viewed as an enabler for information access and exchange (Avgerou, 1998; Sein & Harindranath, 2004), creating the social capital for economic and social progress in a community (Urquhart, et al., 2008). However, the process by which various sociotechnical actors build their social capital in the context of developing countries is still the subject of debate. Every interaction between sociotechnical actors has wide ranging and unpredictable outcomes on the structure of the social capital, and consequently, on the development process at various levels. The nature of social capital in developing areas such as the mountain region of Nepal may be significantly different, in both form and substance from that found in developed countries. Reasons for such differences include prevailing caste structures, nepotism, and ethnic diversity (Bista, 1991). Therefore, the pattern of interactions between ICT, social capital, and its consequences on development can be different in developing countries. Considering the limitations of social capital theory in explaining its formation and extension process with regard to ICT intervention, I employed ANT as an analytical lens to

understand the process. The following section describes ANT in detail.

2.5 Actor Network Theory (ANT)

The core idea of ANT is to trace the role of human and non-human actors (actants) in acting or inspiring others to act as a mediator to create some form of network (Latour, 2005). For example, an interaction in a lecture hall involves students, professors, their ideas, and non-human actors, such as computers, slides, tables, and chairs. Together they form a single network; at the same time, however, the network itself is an actor and works as a single entity. An actor-network, in simpler terms, is a heterogeneous network of aligned interests, including people, organizations, and standards (Walsham, 1997). Whilst ANT has been criticized for its limited analysis of social structures, moral issues, and generalized symmetry, it does, have some stable elements. These include its sociotechnical approach, which can be exploited to perform process analyses (Hanseth et al., 2004; Walsham, 1997); something that is particularly exploited in this thesis.

As a well-established theoretical lens in the field of information systems, ANT can be used in analyses of sociotechnical phenomena. The concept of ANT can be characterized in two ways: "traditional ANT" often focuses on the role of key actors or actants; and "after ANT", which is more concerned with a post-structural understanding of the phenomena, such as complexity, failure, and risk (Gad & Jensen, 2010; Law &

Hassard, 1999). Contemporary IS studies have identified the roles of different actors and networks in the successful or unsuccessful implementation of certain technologies in some specific contexts. For instance, ANT has been employed to understand the trajectory of eGovernment implementation processes (Heeks & Stanforth, 2007; Stanforth, 2007) to build socially embedded healthcare information infrastructures (Braa et al., 2007); to examine the design dynamics of an IS over time, space, and use-context (Mengesha, 2010); and to understand the local context of Geographical Information Systems (GIS) implementation (Walsham & Sahay, 1999). Similarly, using this lens, one study found errors in *problematization*, parallel translation, betrayal, and irreversible inscription of interests, which can contribute to the failure of business process change (Sarker et al., 2006).

The main focus of ANT, when applied in this particular context, is to understand the process whereby various social and technical actors create and extend social networks of aligned interests. The use of ANT in this study is more in line with several existing studies (Díaz Andrade & Urquhart, 2010; Heeks & Stanforth, 2007; Walsham & Sahay, 1999) in seeking to understand the role of various socio-technical actors in social capital formation process in the mountain regions of Nepal. This thesis has adopted the theory as a 'sense making device' (Walsham & Sahay, 1999) rather than for critically viewing the examined case. Furthermore, this study focused on ANT's translation process to

understand how a focal actor initiated the idea of a wireless project, identified various actors, and enrolled them on to his social network and initiative, and, consequently, how community people benefitted from the extended social capital. As summarized in Table 2.3, the translation process has four phases that are not sequential and may overlap: *problematization*, *interessement, enrollment,* and *mobilization* (Callon, 1986).

Table 2.3. Four Phases of Translation Process

Problematisation	What is the problem that needs to be solved? Who are the relevant actors? Establish obligatory passage point.
Interessement	Getting the actors interested and negotiating the terms of their involvement.
Enrollment	Actors accept the roles that have been defined for them during interessement.
Mobilization	Do the delegate actors in the network adequately represent the masses?

In the *problematization* phase, different actors define the problems that need to be solved. Subsequently, the actors identify other relevant actors and select a delegate that represents them. The delegate or focal actor sets the roles and responsibilities for other actors and establishes him as an obligatory passage point. The obligatory passage point is a common channel through which other actors and those involved in the network can collaborate and cooperate. The focal actor(s)

plays an important role in determining the characteristics of the social capital structure. Hence, it is suggested that the study should follow the trail of the focal actor in order to understand the network formation process (Latour, 2005).

In the *interessement* phase, the focal actor (s) seeks to propose norms (formal and informal) and other actors' roles through negotiations and physical actions (inscribing into device). For all the actors and groups involved, the device helps to create a favorable balance of power. It attempts to interrupt all potential competing associations and to construct a system of alliances composed of different sociotechnical actors (Callon, 1986). This process promotes social norms and trust, and creates a network of heterogeneous actors. Successful negotiation and consolidation among actors during the *interessement* phase leads to the enrolment process. To describe *enrolment* is to describe a group of actors with various interests and negotiations, and to finally synthesize their interests with a common goal. In terms of social capital, it can also be called an alignment of shared interest (Fischer 2005).

In the *mobilization* phase, the focal actor seeks to ensure that specific representatives of the other actors are chosen and accepted by their groups. All unions have their delegates or spokespeople; even ICT artifacts have representation in project blueprints, such as wireless stations, equipment, and software. Thereafter, the focal actor is accepted as the main voice or as a

delegate who speaks on behalf of all the actors in the network. Successful translation processes, with agreement among various social and technical actors, can result in the stabilization of social capital. The actor-network theory can provide a comprehensive understanding of the processes, controversies, and negotiations that lead to the formation and extension of bonding, bridging, and linking of social capital in this particular context. An example of the translation process is taken from the third paper and shown in Figure 2-1 below.

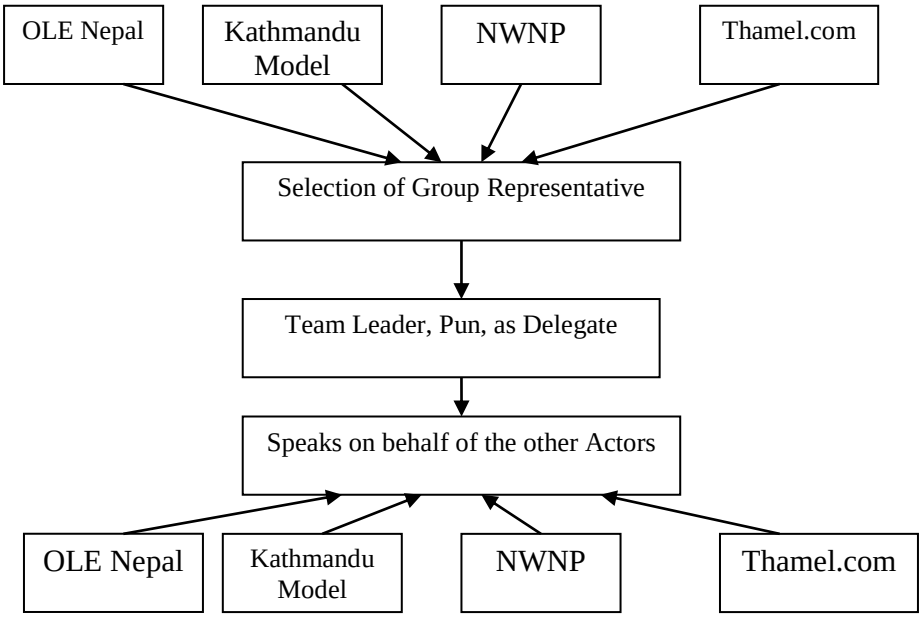


Figure 2-1. Example of the translation process (adopted from Paper 3)

To theoretically and practically examine the research questions, I used the given theoretical framework (Figure 1-2) to describe the study.

3 Research Approach

Researchers have recognized that there is a need to consider the social, cultural, and economic issues, as well as the technical issue, for IS impact analysis on societies (Braa, et al., 2007; Heeks, 2002; Kumar & Best, 2006; Sahay & Avgerou, 2002; Walsham & Sahay, 2006). This led IS researchers to adopt empirical approaches that focus particularly on human interpretations and meanings. The methodology which can be applied to this kind of empirical research, where a researcher needs to make frequent visits to the research location, is interpretive case study. The following sections describe the interpretive research approach employed in the study and the techniques used to collect and analyze the data.

3.1 Interpretive Research and Relevance to the Case Study

Interpretive research has emerged as an important strand in IS studies (Walsham, 1995a; Walsham, 2006). It falls within the realm of qualitative research methods, though they are not interchangeable terms (Klein & Myers, 1999). The interpretive method is not an unconventionally developed methodology; it has deep philosophical roots throughout its development. Studies have illustrated that interpretive study contributes to our deeper understanding of rich contextual information. At the same time, these kinds of studies are more appropriate in situations where we need to understand a sociotechnical phenomenon, such as ICT4D (Ashraf et al., 2009; Walsham & Sahay, 1999).

It has been suggested that, in order to draft a research framework, it is necessary to define explicitly both our ontological and epistemological assumptions before embarking on any research project (Guba & Lincoln, 1994). Complying with these research norms the philosophical base of proposed study is in phenomenology and hermeneutics (see Table 3.1).

Table 3.1. Methodological Background of the Case Study

Philosophy	Phenomenology and Hermeneutics
Ontology	Constructivism
Epistemology	Interpretivism
Methodology	Interpretive Case Study

Hermeneutics philosophy and theory can be employed in social sciences, particularly in IS research, to examine, describe and understand sociotechnical phenomena, such as interplay between ICT and social capital. Phenomenology is related to an understanding of the context of the phenomena (Butler, 1998). The ontological assumption of this research, which is concerned with the nature of reality, is constructivism. Constructivism views social phenomena and their meanings as being continually constructed by humans through their action and interaction (Bryman, 2008). For example, as mentioned in Section 2, the structure, content, and outcome of social capital can be different in the developed and developing world based on their inter-subjective constructions. From the previous assertions, it is apparent that interpretive researchers believe that reality is the outcome of interaction between different human and non-human

actors (Walsham, 1995a). Constructivism also believes that the world is strongly bounded by a particular time and specific context. For example, in this thesis, the social capital structure and content of social capital is bound up with the contextual setup of a mountainous region in Nepal.

The epistemological stand point of a researcher which is concerned with the nature of his knowledge claims should be coherent with his ontological view. In these terms, the epistemological assumption of my research is interpretivism. Thus, facts and values are intertwined, and hard to disentangle, and both are involved in scientific knowledge (Walsham, 1995b). Therefore, reality is a social product and, as such, is incapable of being understood independent of the social actors that construct and make sense of that reality. It requires an understanding of the local context (Pettigrew, 1985), and the process of acting and reacting by different actors in a social system (Latour, 2005). Similarly, a methodological assumption can help to identify which research methods and techniques are appropriate for the gathering of valid empirical evidence. According to the philosophical, ontological, and epistemological assumptions explained above, this paper identified interpretive research as being the most appropriate approach for the proposed case study.

Interpretive research does not use predefined dependent and independent variables; rather, it focuses on the complexity of human sense making as the situation emerges. It attempts to understand phenomena through the meanings that people assign

to them (Walsham, 1995a). Interpretive methods of research in to IS are aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and in influenced by the context (Walsham, 1995b). If we look into the two keywords of interpretive research methods, *context* and *process*, then being able to understand the local context and interaction process of the various sociotechnical actors are two core components of this case study. Similarly, a list of capabilities is very interpretive in its building process; it is not something 'out there'. It is interpreted differently in different sociocultural contexts. This approach is vital, since the study was conducted in the mountain regions of Nepal. In addition, the aim of this field study was to share and understand the researcher's perspective of ICT intervention, social capital formation and human development.

This study aims to present the sociotechnical phenomena without introducing the researcher's personal influence into the interpretations of the subject. Although the researcher has a Nepalese background, the role played was that of an outside observer. The merit of this approach is that the researcher was well informed about the contextual setup, but did not have a direct personal stake in various interpretations and outcomes. In an interpretive case study, the role of the researcher may be changed, but it is essential that the reasons are given explicitly when reporting the results (Walsham, 1995b).

The main data collection techniques used in this case study were in-depth interviews, which are the primary data source. Through this method, it is possible to access and assess the interpretations that actors have regarding the sociotechnical phenomena and their consequence on human development. It is also possible to observe the individual circumstances so that the researcher can use appropriate approaches, such as note-taking or tape-recording during interviews, to capture people's interpretations effectively. A data analysis phase followed data collection. This study applied coding scheme based on the grounded theory method that put forward by Corbin and Strauss (2008). Collected qualitative data was analyzed in line with existing studies (Díaz Andrade, 2009; Urquhart, 2001). For instance, categorization and sub-categorization of the coding were based on constant data comparison. A standard software tool known as nVivo was deployed to analyze the qualitative data that was observed and collected through interpretive case studies. These standard techniques enhance the legibility and reliability of data during interpretive reporting.

3.2 Case Description: Nepal Wireless Networking Project (NWNP)

Nepal is a landlocked country situated on the southern slopes of the Himalayas. It lies between India and China. The total area is 147,797 sq. km. The country is comprised of three main geographical regions: the Tarai in the south (17%) of the total land area), the central mountain region (64%), and the Himalayan region (19%) in the north. Nepal is divided into 5

development regions, 14 zones and 75 districts. The Village Development Committee (VDC) is the administrative unit below the district level. There are around 3,914 VDCs all over Nepal. The lowest administrative division is the ward. There are around 9 wards on average per VDC. The total population is around 27 million; of whom about 75% live in rural and remote areas, mainly in mountain regions. A large proportion of the population lives below the poverty line. The literacy rate in Nepali, the national language, is 82% and in English is approximately 18%. Computer ownership per 100 inhabitants is 2.80, and telephone lines per 100 inhabitants are 3.5 (ENRD, 2009).

The mountain region has the lowest human development index (HDI) scores amongst the three regions and is also the poorest (UNDP, 2004). The social, political, and economic disparities between regions have led to the flare-up of conflicts among different communities and political institutions. Consequently, the social capital that existed between communities (the binding elements of trust) has been eroded, along with severely disrupted indigenous forms of social networks and institutions (the bridging of the elements). Clearly, the mountain region is the most underdeveloped. It was here that the NWNP project being studied was initiated. It is situated in the Myagdi district of Nepal, which is located at an altitude of 2,700 meters above sea level.

3.2.1 Inception of the NWNP

In 1996, the idea of Nepal Wireless Networking Project was conceived by Mahabir Pun, a school teacher at Himanchal High School, Nangi in the Myagdi district of Nepal. Pun completed his primary education in a village school. The teachers were not well qualified and it was difficult for him to get a good quality of education. In remote schools such as this, it was also difficult to obtain paper, pencils, and textbooks. In an interview, Pun stated that each of the students had a wooden board blackened with charcoal, and a soft marble stone from a nearby cliff to write with. Teachers in the school were mainly retired soldiers who had a very basic knowledge and were untrained. Pun was given pencils and paper for the first time when he was in the seventh grade and text books in the eighth grade. His father, who was a retired army person, had dreamt of his son going on to higher education. Due to the lack of higher educational institutions in his home town, it was quite difficult to make this dream come true. Therefore, Pun's father moved with his family to Narayanghat, a city near the southern plain of Nepal.

There, Pun completed his high school education, and worked as a teacher for about 12 years. In 1989, he received a scholarship to the University of Nebraska at Kearney, from which he graduated in 1992 with a Bachelor's Degree in Science Education. From the very beginning, he recognized the need for a good education and healthcare system in remote areas. The inhabitants in these villages, who were not able to get a good education, used to practice shamanistic rituals for healing.

Shamans were respected as traditional doctors and healers. There were no medical clinics in that region. While in the US, he recognized the potential offered by IT for providing educational and economic opportunities to remote communities. Thus, after completing his bachelor's degree, Pun returned to teach at a village high school located in Nangi (see Figure 3-1). Initially, villagers were skeptical about his ideas on development. They thought he would return to the US after a while. To win their trust, he was involved in educating school children and community people from 1993 to 1996; at the same time, he also started working on rural development programs. His efforts were gradually supported by community groups, such as mothers' and fathers' groups, youth groups, retired army personnel, school management committees, and district development committees.

In 1996, with the help of a US professor, he created a website for Nangi village, and briefly described the village school. The presence of a remote village on the Internet attracted some foreign volunteers to come and teach in the school. Those people who knew about Nangi but were not able to come donated books, teaching materials, and money. He also installed two small hydro-generators with the help of community people in the village to provide electricity to the school. In 1997, some students from Australia donated four used computers. Pun began to teach basic computer applications at the high school in Nangi. Later, the school received more donated computers from international volunteers. His dream was to connect the village

with the outside world through the Internet. When he first came up with the idea of introducing the Internet to Nangi there were no telephone lines, electricity or computers. At that time, villagers had to walk around five hours down the hill and take a four-hour bus ride to the nearest town (Pokhara) to make phone calls and to check their e-mail from friends abroad. At that time, the Maoist insurgency was still ongoing. Thus, the political situation was unstable. It was very difficult to set up wireless Internet stations in the mountain regions because of restrictive trade policies with regard to imported wireless technologies. In fact, it was illegal to install wireless stations. However, Pun was never discouraged. As he used to say," It's better to be crazy than to die."

Mahabir Pun	Hidden Antenas	Wooden Box Computer
		
Nangi Village	Narjhang Village	Villagers of Swantha
		

Figure 3-1. Inception of NWNP

3.2.2 Exploration of Idea to install Wireless Internet Station

In 1998, a telephone line was installed in the village, raising Pun's hopes of also bringing an Internet connection to the village. However, the quality of the telephone connection was not good. He started thinking about different technical solutions. A satellite connection was one possible solution, although this was not affordable. Still dreaming of being able to offer Internet services to remote communities, he once again returned to the US, this time to complete his Master's Degree in Educational Administration. In 2001, he returned to Nepal and started working to connect the village to the Internet. One day, out of curiosity, he wrote an email to the British Broadcasting Corporation (BBC) asking for ideas to connect such remote villages to the outside world through the Internet (BBC, 2008). When the BBC published his email, the response was overwhelming. The email was read by many foreign students and volunteers who were eager to contribute to the mountain village through voluntary services. The volunteers gradually started to come in Nangi village to teach English, mathematics, and science subjects to school children.

Thereafter, Pun extended his network through emails with international volunteers; in particular, graduate students from western countries helped to bring computer equipment, set up the network, and taught basic computer skills to the villagers. Gradually, people in the community were taught by volunteer students to assemble donated computer parts in wooden boxes

(see Figure 3-1). After several years of work as a social worker in the Myagdi district, Pun identified that the information technology could be used for more than just acquiring information. However, he also knew that the project needed several other individual, organizational, and institutional actors to accomplish his objectives. Therefore, he started to look to extend his network to include other like-minded actors.

3.2.3 Pilot Test of NWNP

In 2001, with the help of a technical team, Pun established an non-governmental organization (NGO) called E-Networks Research and Development (ENRD, 2001). The purpose of this NGO was to conduct ICT research and development in remote areas. The NGO provided initial technical support to install wireless stations in Nangi. In 2002, Pun, along with people in the community (see Figure 3-2), the NGO, international volunteers and a technical team from an Internet service provider (WORLDLINK), conducted a pilot test. They tried to connect Pokhara base station, where the server is located, with Mohare relay station, at over 3,000 meters elevation, in Nangi. They used antennae and dishes, donated by international volunteers, which were placed in tall trees.

All the equipment was carried and installed by the villagers themselves. Through regular testing, they succeeded in setting up a wireless connection between the base station at Pokhara and Mohare. Subsequently, they extended the network to Nangi and a few other villages using basic wireless technologies.

In 2003, Pun formally established the Nepal Wireless Networking Project (NWNP) to provide Internet services in the mountain regions. The technology used during this period was desktop and laptop computers, Internet telephony equipment and high resolution network cameras. This equipment was used to operate tele-teaching and telemedicine services. In addition, they acquired resources to build the network infrastructure, which includes wireless devices, a network server and associated software, and power generation equipment at the relay stations.

Community people installing Wi-Fi equipment

Figure 3-2. Pilot test of NWNP

The wireless project was gaining popularity in Nepal and other parts of the world. Consequently, computers and equipment were donated by individuals and businesses, such as the Himalayan Bank, and Solutions Consultant from Nepal, and international donors from the USA, Canada, the Netherlands, Germany, Singapore, Australia, and Japan. Tourists and volunteers coming to Nepal also brought unused computer parts, such as motherboards, memory cards, hard disks, and video and sound

cards. These parts were then assembled in the mountain villages inside wooden computer casings made by the villagers. Similarly, local committees, such as the Mustang District Development Committee and Himanchal Higher Secondary School, provided administrative and financial support to run and maintain the wireless project in the districts of Mustang and Myagdi.

3.2.4 Extension of NWNP Services in the Mountain Districts

During 2005 and 2006, NWNP further extended its network into other districts and expanded the coverage of the Internet services. They replaced old network devices with new and more robust equipment. International organizations such as the International Telecommunication Union (ITU) and World Bank granted funding through the Poverty Alleviation Funds of the Government of Nepal. Funding was supplemented by a grant from the International Center for Applied Studies in Information Technology (ICASIT) at the George Mason University School of Public Policy, USA to print handbooks, and for training and publicity. The wireless project also collected funds from village development committees, and schools for user training, network administration, and to provide salaries to its support staff.

In 2006, the political situation in Nepal reached a turning point when Maoist rebels agreed to sign a peace deal with the Government of Nepal. Considering the favorable political situation, NWNP organized a seminar in Kathmandu with

government ministers, political leaders, government bureaucrats, and Internet service providers to discuss existing regulatory and legal issues. Pun lobbied the government to put the remote communities on the priority list of IT policy in 2010. Consequently, the Nepal Government de-licensed the 2.4 GHz and 5.8 GHz bands. In addition, it allocated some funds to all village development committees to introduce computer and Internet education in schools. Since 2006, the wireless project has started to provide communication (VOIP, email, bulletin boards, etc.), education (tele-teaching, e-learning), healthcare (telemedicine), business (e-commerce, e-tourism, local marketing, and remittance) and employment opportunities in the mountain regions. For example, to achieve the educational goal, in 2007, NWNP collaborated with the Open Learning Exchange (OLE), Nepal, an NGO based in Kathmandu. The OLE project was initiated by a social entrepreneur Rabi Karmacharya, who had completed his Master's Degree at the Massachusetts Institute of Technology (MIT) in the USA. He established OLE Nepal in 2007 with the vision of transforming Nepal's public education by integrating technology in the classroom and giving children the tools and platform necessary to learn and excel (OLE, 2007). OLE developed online educational content in the Nepali and English languages for the students. The contents were based on the government curriculum from grade two through to grade six. They have implemented the content in several schools in remote places. In addition, OLE developed e-library content and made it available for the students and villagers.

Similarly, to address the challenges of bringing specialist doctors into the mountain villages, in 2008, NWNP initiated a partnership with Om Hospital at Pokhara, Nepal Medical College and Kathmandu Model Hospital in Kathmandu to provide telemedicine services to various remote communities. These services were tested in three villages at Myagdi district. Thanks to the telemedicine services, the health workers of these villages started to communicate with medical doctors in the urban center of Pokhara and Kathmandu to obtain medical assistance. As shown in Figure 3-3, video conferencing were used by village health workers to facilitate communication between the doctor and the patient; thus, they could provide the medicine prescribed by the doctor.

In 2008, to generate employment opportunities and for the sustainability of NWNP, it started working with Gandaki Software Engineering College, Pokhara to develop an intranet e-commerce platform, known as Haat Bazar, within mountain communities. On Haat Baazar websites, villagers advertised local produce for sale, such as cows, buffaloes, goats, chickens, vegetables, and cheese. In addition, the NWNP was collaborating with Thamel.com, an e-commerce portal that sells goods online. It was targeted at expatriate Nepalese who can purchase gifts, which were then delivered in Nepal by the company (thamel.com, 2001).

The company grew rapidly after their story of selling goats was published on a BBC website (Brinkerhoff, 2008). The director of thamel.com, Joshi, and team leader, Pun, came together when Joshi was exploring business opportunities in mountain regions and Pun was looking for a platform to provide e-commerce services to remote communities. In 2008, they conducted a pilot test of virtual ATM machines to operate credit card transaction services for tourist on different trekking routes. In addition, they planned to start a remittance service in remote areas, so that many family members working abroad could send money using online services.

Telemedicine	Community Information	Communication
		

Figure 3-3. NWNP Services in the mountain regions

3.2.5 International Collaboration of NWNP

In 2009, NWNP was registered with the Ministry of Industry's Office of Company Registrar as a not-for-profit company (NWNP, 2009). During that year, NWNP implemented projects supported by Asia Pacific Telecommunication (APT). The project connected Lete, Kobang, Tukche, Marpha, Syang, and Jomsom villages of the Mustang district through wireless

technology. They subsequently connected Kagbeni and Muktinath villages. The network further extended to Bhuka, Sapet, Chimkhola, Jhin, Aulo and Kaphaldanda in the Myagdi district. They succeeded in connecting around 14 villages through the wireless network in this phase. They could not extend the services to other villages due to financial and technical limitations. To raise funds for a further extension of project services, the team leader initiated a 'One Dollar per Month' campaign. The idea was to collect one dollar per month from Nepalese citizens and those living abroad to implement the wireless project.

Gradually, NWNP extended its collaboration with various international organizations to extend its wireless internet services. For instance, Japan International ICT Association (JIIA) of Tokyo provided technical support to select appropriate technology by sending their experts to Nepal. Similarly, International Telecom Union Association of Japan (ITUA-J) helped to develop links with Japanese partners and supporters, and provided technical support and guidance. In addition, the Japanese telecom operator, KDDI Corporation donated 85 laptop computers to the wireless project. They also provided their expertise to install telemedicine services in the remote villages. NWNP was also working on environmental monitoring projects with the Asian Institute of Technology (AIT), Thailand. The project collaborated with the Kaski Association of the Blind to introduce computers and Internet services for visually impaired

people. As shown in Figure 3-4, from 2009 to 2011, NWNP started making its presence felt both nationally and internationally. The wireless project not only built up a physical infrastructure, but also a huge social network. The structure of the network was composed of many stakeholders, such as local schools, local governments, community people, hospitals, governmental and non-governmental organizations, businesses, and other international actors.

Figure 3-4. Extension of NWNP services in the mountain regions

The project also promoted a number of community development projects, such as those involved in forestry conservation, handicrafts, yak farming, Nepali paper production, and vocational training programs. These projects promoted income - generating activities within the mountain communities. For example, in a yak farming project the villagers crossbred a cow and a yak. These yaks were used to produce milk that can be also used to make cheese and other products. The villagers also consume yak milk, and sometimes drink its blood to cure certain

diseases. The NWNP facilitated the villagers to establish communication centers in the mountain villages. This allows an avenue for democratic participation, as well as risk- and profit-sharing.

3.2.6 Summary of the formation and extension of NWNP

As summarized in Table 3.2, the project started with the inception of an idea. The idea was not to provide Internet -based services as such, but to use them to create socioeconomic opportunities to the mountain communities. The case description also shows that single actor alone cannot convert ideas into realities; instead, he needs to identify other relevant actors, integrate them into network, interact with them to foster social capital, and take action together.

Since 2003, the NWNP has been in full-fledged operation. The project is an example of early grassroots movements to use ICT in rural areas within the context of developing countries. It is making every possible effort to adapt modern technologies to the local context. Despite difficult circumstances, such as lack of government support, lack of funding, lack of technical knowledge, lack of power, lack of human capacity, and an unstable political system, the project succeeded in providing Internet-based services to mountain regions.

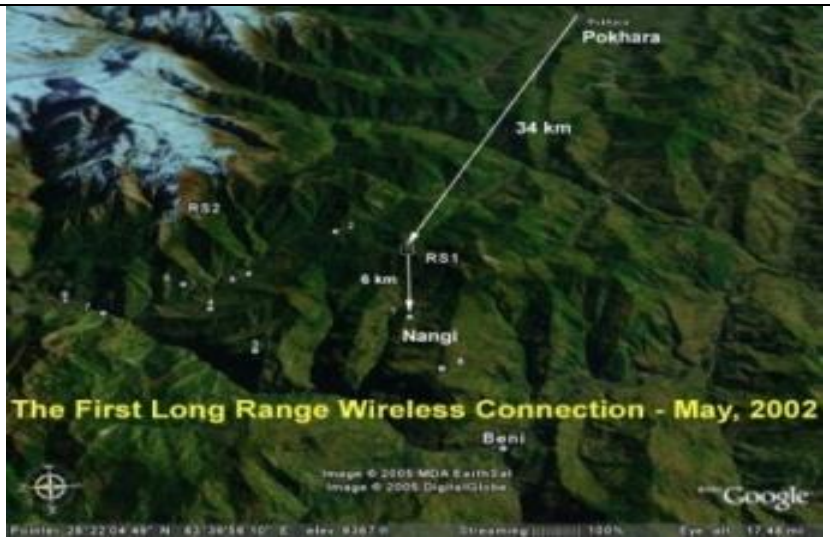
Table 3.2. NWNP: From Inception to Extension

Time	Events	Actors
1989	Mahabir Pun received Scholarships and left for US for undergraduate study	University of Nebraska at Kearny
1992-1996	Pun returned to Nepal and started teaching and social work	Community people school teachers
1996	First website of Nangi village and school launched	Volunteer Professor
1997	Nangi school received 4 used computers	Australian students came as a volunteer
1998	Nangi village got a telephone line	Nepal telecom
1999	Pun left for US to study Master's degree	University of Nebraska at Kearny
2001	Pun finished master's degree and returned to Nepal. Wrote an email to BBC	BBC
2001	E-Network Research and Development (ENRD) Established	Some technical experts from Nepal
2002	Pilot test of the Nepal Wireless Networking Project (NWNP) between Pokhara and Nangi	ENRD, ISP, Volunteer students
2003	NWNP services fully operationalize between Nangi and Tikot villages	School teachers, community people, ENRD
2005-2006	NWNP extended to other villages	World Bank, ITU, ICASIT
2006	NWNP lobbied with government, and succeeded reduction in license fee and allocation of budget to village development committees for computer education	Government ministers, political leaders, ISPs, Pun
2007	NWNP collaborated with OLE, Nepal Pun won Roman Magsaysay Award	OLE, NWNP, Ministry of education

2008	NWNP Initiated telemedicine project	Om Hospital, Kathmandu Model Hospital, NWNP, Health Workers, Doctors
2008	NWNP created Haat bazaar website a local intranet ecommerce service, and tested virtual ATM machine	Gandaki engineering college, thamel.com
2009	NWNP registered as a non-profit sharing company, extended internet services to 14 more villages, in addition, started one dollar per month campaigning	APT, Diaspora
2009-2011	NWNP initiated many local development project with villagers, such as Yak farming, Cheese Production, building trekking routes, building lodges, Virtual ATM, etc.	JIIA, ITUA-J, KDDI, AIT, community people
2011	NWNP extended its internet services to 150 villages, and continue to connect many more villages	Collective action of all the actors involved as mentioned above

The project started with minimal wireless technology, home-made antennae, and relay stations that had to be positioned in trees. By 2011, as shown in Figure 3-5, NWNP had already built networks in around 150 villages in Myagdi and other districts. It has also gradually enrolled local, national, and international actors in the formation and extension of the wireless project and its services. Pun received many prestigious awards, including the Overall Social Innovations Award (2004) and, in 2007, an honorary degree as Doctor of Humane Letters (2007) from University of Nebraska, Kearny, and the Magsaysay Award (the Asian equivalent of the Nobel Prize).

NWNP in 2003 (Google Map)



NWNP in 2011 (Google Map)

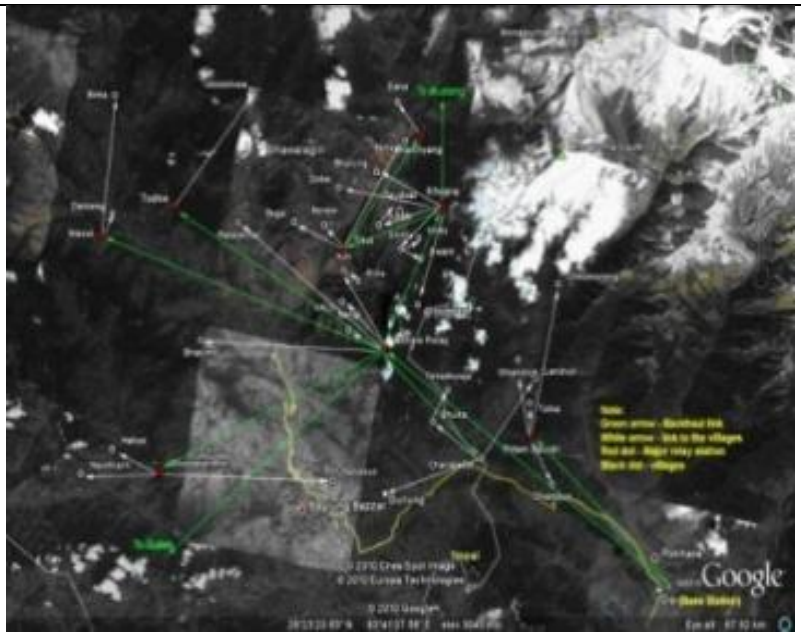


Figure 3-5. Trajectory of NWNP from 2003 to 2011

3.3 Research Site

The study was conducted in 10 villages (Nangi, Tikot, Dana, Ghatpo, Sikha, Narjhang, Swantha, Pouder, Khibang, and Kendo) in the Myagdi district (Figure 3-6). Nangi was the first village in the mountain region to receive an Internet connection through the Nepal Wireless Networking Project (NWNP). The central office of NWNP is the Nangi telecenter, which is run by Himanchal Higher Secondary School. Nangi telecenter coordinates the whole wireless network, which covers the different villages of the Myagdi, Parbat, Mustang, and Baglung districts. The second and third rounds of data collection covered eight other villages in the Myagdi district. The NWNP has extended its services to several other remote villages (including the sites of my field study).

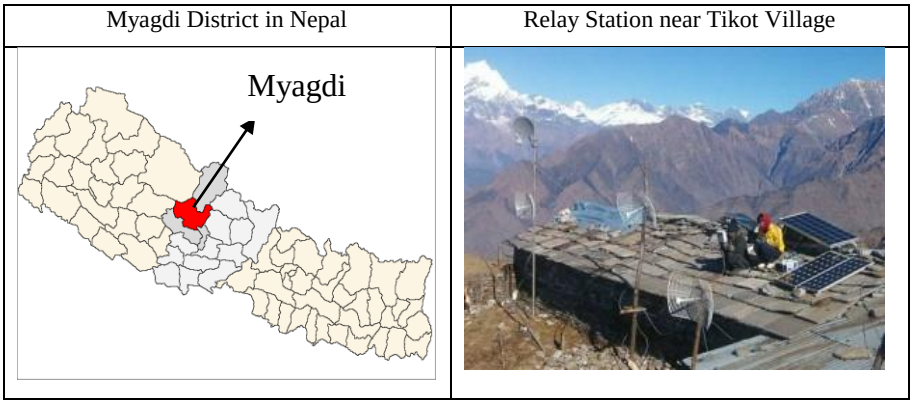


Figure 3-6. Research Sites at Myagdi District

The average population of these villages is between 800 and 1,000. Only one village (Sikha) has a population of around 2,000. Most of the people in these villages have to go to urban areas for

employment, education, and healthcare services. Except for four villages, they are not accessible to motor vehicles by road. Even the connected villages take about four hours by Jeep to the nearest town of Beni. Historical reasons mean that the inhabitants of these villages are predominantly composed of people from the Magar ethnic community. However, there are other minority groups as well. Although the area has become better connected via roads that are open to motor vehicles, the geo-political configuration has confined them to traditionally formed strong ties or bonding social capital. The communities make most of their local decisions in the presence of village development community chairpersons.

Most of the young people from these villages migrated to urban places to search for employment, leaving behind retired army personnel and elderly people. One young social activist ironically stated that 'the place become a dumping site for disabled and elderly people. Educated people are not staying in the village; they are migrating to urban places.' Most of the villages are running some kind of community-based co-operative society. These co-operative societies invest in local projects, such as yak farming, Nepali paper production, agriculture, and honey farming. Remittances from foreign countries are one of the main sources of revenue for the villagers, as the majority of the young people work outside Nepal. Farmers have also started to sell their agricultural and dairy products online. This is an arable area, suitable for growing oranges and potatoes. The

NWNP has motivated some young people to choose teaching and farming rather than joining the army in India or the UK. Joining the British or Indian army is preferred in many mountain regions as it does not require a high level of education. The villagers still practice shamanistic rituals and shamans are respected as traditional doctors and healers. Medical services are still in a dire state.

The villagers consider ICT as a vital tool for the development of remote mountain communities. They are optimistic and believe that IT can offer them better socioeconomic opportunities. The villagers are also very enthusiastic about NWNP and its services. However, they are still not able to use them. One of the many reasons is that the older generation doubt whether it's worth learning this sort of technology at their advanced age. This kind of opinion makes ICT less effective among the older generation. However, younger people are keen to learn, even though they have very basic knowledge of how to use ICT applications. One of the school teachers told me that ICT use is gradually increasing following the introduction of services by NWNP and other telecommunication companies. However, Internet services frequently get disrupted because of technical problems, particularly outside the villages of Nangi and Tikot. Similarly, teachers and students are the main beneficiaries of these services, while other people seem reluctant to learn this technology. However, there are a few social activists, such as Tak Pun who is considered to be another Mahabir Pun by his fellow villagers. They believe that people like him, who work for the benefit of

community development rather than economic benefit, can utilize this technology for the betterment of their village.

3.4 Data Collections

The explorative nature of this study takes into consideration that "research is a continuous process of data collection, followed by analysis and memo writing leading to questions that leads to more data collection" (Corbin & Strauss, 2008). Three rounds of data collection were carried out in the ten villages of Myagdi district. In addition, focus group interviews were also conducted in Hetauda and Kathmandu districts. The data collections were done during 18 March, 2010 to 31 March, 2010 (first round), 10 December, 2010 to 31 January, 2011 (second round), and 17 May, 2011 to 25 May, 2011 (final round). The purpose of this study was to seek real life experiences in real situations; therefore, I visited the villages and stayed for around three weeks during my three visits. During that period, formal and informal discussions with people in the community enhanced my familiarity with the cultural and social context, and also aided insight. Similarly, I tried to discover the meanings that participants attach to their behavior; for example, I explored how they interpret situations and their perspectives on ICT and development.

While exploring and understanding the social process and social phenomena, my perceptions were also shaped and reshaped. This immersion in a real life situation was useful for discovering

whole processes and for producing rich description. The data were collected without a predetermined theoretical framework at the beginning, although through the interpretation and reinterpretation of existing theories, it started to gradually make sense. Based on the informed theoretical framework presented in Chapter 1, various modes of data collections were deployed; these have been described in papers 2, 3, 4 and 5. These relate to how an understanding of the link between ICT intervention and human development was formed. The main sources of information in this study were interviews with relevant actors; an example of interviews with 20 representatives and their interpretation is shown in Table 3.3. Interview data was used to assess the actors' interpretations of the ICT4D and its implications for community development. Using the snowball technique, we selected the interviewees from different social groups and institutions. Total 60 interviews were conducted in three rounds of data collection from 10 villages. The interviews were semi-structured, lasted from 20 to 60 minutes, and were tape-recorded. In addition, an in-depth interview with the team leader of the wireless project was also recorded.

The dialogue involved people with various backgrounds. For example, the interviewees were service users, such as teachers (aged 30 - 40 years, males), social activists (aged 30 - 60 years, males and females), health workers (aged 30 - 40 years, females), students (Standards 11-12, aged 16 -18 years, girls and boys), and non-users, such as drivers, SME workers, retired army

personnel, and farmers. I took extensive personal notes during interviews, informal discussions, and observations. The interviews and notes were focused on understanding the state of the community's development and how their interaction with NWNP could lead to the development of social capital. An example of these interviews is given in Appendix (A)).

Table 3.3 List of some informants and their objectives

Organization	**Position**	**Objectives of using ICT**	**Duration**
Nepal Telecommunication Authority	Director	To connect all the district headquarters to optical fibers	40 m
OLE Nepal	Director	To facilitate learning and teaching using computer mediated program	60 m
Thamel.com	CEO	To expand ecommerce services in remote areas	50 m
High Level Commission for Information Technology (HLCIT)	Joint Secretary	To monitor and evaluate eGovernment services	40 m
Kathmandu Model Hospital	Doctor	To install telemedicine services in the mountain regions	In-depth*
Nepal wireless network project	Team Leader	To promote socioeconomic development of mountain regions	In-depth**
Himanchal Boarding School	Teacher/Technical support	To facilitate computer based teaching and learning	40 m
Tikot School	Computer teacher	To facilitate computer based teaching and learning	30 m
VDC Nangi	Chairman	To access information and communication services	45 m

Kipang VDC	Chairman	To access information and communication services	40 m
Institute of Engineering (IOE), Tribhuvan University	Asst. Professor	To improve research, teaching and implementation of ICT4D and eGovernment projects	40 m
Madan Puraskar Pustakalaya (MPP)	Director	To promote localization through developing online contents in Nepali language	45 m
Nangi Health Center	Health worker	To provide better healthcare services to remote communities	In-depth*
Tikot Health Center	Health worker	To provide better healthcare services to remote communities	In-depth*
Tikot School	Principal/activist	To provide better education, and foster socioeconomic development	60 m
NWNP	Technical expert	To provide better internet connection to remote places	40 m
BBC	Journalist	To broadcast the socioeconomic development activities in the mountain region through the wireless project	In-depth*
Narjhang Village	Social activist	To promote socioeconomic development of mountain regions	In-depth*
Kendo co-operative	Employee	To promote socioeconomic development	40 m
Yak project	Employee	To promote business opportunities	40 m

*The participants accompanied me during my first and second round of data collection in the Nangi and Tikot villages.

**Interview with team leader was more of an ethnographic nature as he accompanied me during most of my field visits.

3.5 Data Analysis

Data analysis was based on the coding techniques suggested by grounded theory approach. Particularly that put forward by Díaz Andrade (2009), and was partially based on work by Corbin and Strauss (2008). The focus of my analyses was not on generating theory out of data, but to apply coding techniques to categorize the qualitative data. Following the procedure, the recorded interviews were transcribed, coded and categorized in accordance with the proposed framework. However, as mentioned earlier, the research process was conducted in accordance with the interpretive approach; thus, the framework emerged during the course of data interpretation and reinterpretation. The outcome of the empirical research was published in four different papers. Each paper was coded and the data categorized for its specific purpose. The thesis finally synthesized the theory and the data from the individual papers in order to create a coherent story. For instance, after the first round of data collection, initial coding was carried out, which kept the Asset Pentagon as a guiding framework, as discussed in Paper 2. Furthermore, two core-category opportunities and challenges were added. Through initial coding, I identified the key role of social capital in building other political, human, financial, and physical capital. Accordingly, the subsequent data analysis focused on understanding the process of building social capital through ICT intervention.

To understand the process, I analyzed the roles of various actors in social capital formation process. The coding and

categorization of the data were guided by ANT, as discussed in Paper 3. First, I investigated the process of building social capital through ICT intervention. The next phase was to relate social capital and development. At this stage, I grouped the codes into categories and sub-categories, such as bonding, bridging, linking social capitals, collective action, and collective and individual capabilities. As discussed in papers 4 and 5, codes for different groups in the community, their communication patterns, their expectations, and the achievements of NWNP so far in education, healthcare, and business were all drawn from the data.

To organize and manage the qualitative data I used nVivo software. To check the reliability and validity of interviews and interpretation, I held regular discussions with other researchers and practitioners throughout the project. My knowledge and experience as both an insider and an outsider helped with understanding the research context. The first round of field study was accompanied by another researcher who had a critical view of the context as an outsider.

As suggested, "two researchers can capture greater richness of data and rely more confidently on the accuracy of data" (Benbasat et al., 1987, p. 374). In addition, the outcomes of the study were debated and discussed in international conferences, workshops and peer-reviewed journal publications to validate the research findings. For instance, an ICT4D workshop was organized in Kathmandu. The workshop attracted around 30 participants, comprised of researchers, practitioners, experts,

medical doctors, government officials, a telecom director, teachers, students, and members of the Nepal Wireless Networking Project. The idea of the workshop was to discuss our findings and experiences with different stakeholders, and to synthesize and triangulate our findings from these villages. To insure rigor, I evaluated the research process using the set of principles developed by Klein and Myers (1999), as shown in Table 3.4. Throughout the project, constant data comparison was used to make a connection between different categories and interview codes. I then followed an iterative analysis process to connect codes with categories and sub-categories. The Hermeneutic circle was used to map the codes to the theoretical concepts. For example, all the proposed theories were analyzed as a component to describe the overall process of ICT intervention and human development. The theoretical concepts that emerged in the interpretive process were used to gain a richer understanding of the process as a sensitizing device rather than to test or falsify any hypotheses.

3.6 Validity Issues

Interpretive researchers cannot claim that they are reporting facts; rather, they are reporting their interpretations of other people's interpretations. Therefore, the process validity of the interpretive case study is required. The natural science model of social science is useful in evaluating case study research. However, the positivist criteria suggested are inappropriate for interpretive research. Therefore, in this context, a set of seven principles based on the philosophy of hermeneutics were applied to

conduct and evaluate the field research (Klein & Myers, 1999), as shown in Table 3.4. These principles can be used as guidelines to evaluate the interpretive research process and, at the same time, to analyze the interview data. These principles are centered on hermeneutic circle, and are useful to understand the complex phenomenon that emerges out of the interaction between sociotechnical actors (Klein & Myers, 1999). The principles were useful for addressing criteria such as authenticity, plausibility, and criticality in order to validate the methodological approach adopted in this particular study (Walsham, 2006). In this context, to confirm authenticity the research was conducted in the Myagdi district and three rounds of data collection were carried out. Furthermore, an ICT4D workshop and IFIP WG 9.4 conference were conducted in Kathmandu, to which actors from a wireless project were invited to discuss research findings. To confirm plausibility, research findings were presented in ICT4D conferences, and published in peer-reviewed ICT4D journals. To confirm criticality - which concerns the way in which the text probes readers to consider their taken-for-granted ideas and beliefs - the perspective of more than one researcher was useful for supporting or contradicting the interpretation and evaluation of the findings.

Table 3.4 Evaluation of case study using seven principles defined by Klein & Myers (1999)

Principles	Examples
The fundamental principle of the *Hermeneutic circle* **This principle suggests that all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they form. This principle of human understanding is fundamental to all the other principles.**	Iterative analysis during data collection and data analysis were done to understand whole as presented in the proposed theoretical framework and part as data collected from various participants of the mountain districts to synthesize the meaning of the parts and the whole. In addition, enhanced the pre-understanding of the researchers and participants about the studied phenomena.
The principle of *contextualization* **Requires critical reflection of the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged.**	The social and historical background of research setting were described in detail, particularly, the case of Nepal Wireless Networking Project in Myagdi district in Chapter 3.3.
The Principle of *Interaction Between the Researchers and the Subjects* **Requires critical reflection on how the research materials(or "data")were socially constructed through the interaction between the researchers and participants.**	Interaction with different stakeholders during field visit in Myagdi district was useful to socially construct the meaning. Three rounds of data collection, interaction with the locals, and critical reflections in various stages of the study enhanced my understanding of the phenomena.
The Principle of *Abstraction and Generalization* **Requires relating the idiographic details revealed by the data interpretation through the application of principles one and two to theoretical, general concepts that describe the nature of human understanding and social action.**	Based on my contextual and theoretical understanding of the phenomena, I made constant comparison between data and theories (actor-network theory, social capital, collective action, and capability approach) to draw cogent and plausible conclusion.

The Principle of *Dialogical Reasoning* **Requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings ("the story which the data tell") with subsequent cycles of revision.**	Various theories were integrated and their relations were synthesized with the progression of the study. In other words, theoretical preconceptions were amended and extended to make my understanding of the phenomena more valid and coherent.
The Principle of *Multiple Interpretations* **Requires sensitivity to possible differences in interpretations among the participants as is typically expressed in multiple narratives or stories of the same sequence of events under study. Similar to multiple witness accounts even if all tell it as they saw it.**	Multiple interpretation and viewpoints of the different stakeholders, such as IT vendors, Politicians, Activist, Local People, Teachers, Government officials, and private entrepreneur have been taken into account. Example is given in the 'third paper'. It influenced my understanding as well.
The Principle of *Suspicion* **Requires sensitivity to possible "biases" and systematic "distortions" in the narratives collected from the participants.**	To minimize 'biasness' and data 'distortions': first round of field study accompanied by another researcher, critical reflections in the ICT4D workshop, and tried to minimize the influence of the team leaders by talking to stakeholders outside the projects.

4 Research Publications

Table 4.1 Summary of the published papers

#	Title	Authors	Research Question	Main Findings	Year	Publication
1	Exploring a Link between ICT and Development: A Literature Review	Devinder Thapa Ø ystein Sæ bø	What is the relation between ICT and Development?	Concept of development in the ICT4D research is vague. Need to understand the relation between ICT and development.	2011b	11th IFIP WG 9.4, Social Implications of Computers in Developing Countries, 22-25 May, Kathmandu, Nepal.
2	Demystifying the Possibilities of ICT4D in the Mountain Regions of Nepal.	Devinder Thapa Ø ystein Sæ bø	How locally-initiated ICT4D projects may help to foster socioeconomic development in the mountain regions?	Opportunities to create and extend Social, Human, Political, Financial, and Physical Capital. The study also identified several barriers such as, high illiteracy rate, poor infrastructure, language barrier and lack of participation that may impede the extension of ICT4D project and development activities.	2011a	Proceedings of 44th Hawaii International Conference on System Sciences (HICSS-44), CD-ROM, pp 1-10, IEEE Computer Society, Kuai, Hawaii.
3	The role of ICT Actors and Networks in Development: The case study of a mountain region in Nepal	Devinder Thapa	How does different ICT actors form and extend ICT4D projects and how does extended networks in turn foster socioeconomic development?	The formation and extension of ICT4D projects goes through different phases of identification of relevant actors, roles, negotiations, and their interest alignment.	2011	The Electronic Journal of Information Systems in Developing Countries, Vol. 49, 1, pp 1-16.

4	ICT, Social Capital and Development: the Case of a Mountain Region in Nepal	Devinder Thapa Maung K. Sein	How does ICT create and extend social capital and how does social capital in turn foster socioeconomic development?	The wireless project led to strengthening of bonding, bridging and linking social capital. It opened up prospects in education, healthcare, communication, and ecommerce.	2010	Proceedings of pre-ICIS SIG GlobDev Workshop 2010, St. Louis, USA, AIS Electronic Library.
5	Building Collective Capabilities through ICT in a Mountain Region of Nepal: Where Social Capital leads to Collective Action	Devinder Thapa, Maung K. Sein, Ø ystein Sæ bø	How does ICT create and extend social capital and how does social capital in turn foster the collective action that enables the building of collective capabilities?	The wireless project enabled the villagers to create, maintain, and extend their bonding, bridging, and linking social capital. Subsequently, this social capital enabled them to take collective action which assisted them in developing collective capabilities while simultaneously enhancing individual capabilities.	2012	Information Technology for Development Journal (ITD), Vol.18, 1, pp 5-22

This chapter summarizes the five research papers and their relevance in providing answers to the research questions. The list of publications is listed in Table 4.1, and the full text of each publication is given in Appendix B. The papers are ordered in sequence, ignoring publication dates in order to tell a coherent story.

4.1 Paper 1: A Literature Review

The objective of this first paper was to conduct a literature review of ICT4D research and to look at existing work on relating ICT and development in the context of developing countries. The paper discussed different development approaches. It went on to suggest Sen's capability approach as a suitable framework for understanding the development process with regard to ICT intervention in remote communities.

Eighty research papers related to ICT4D research were reviewed. The review found that there are numerous views on the conceptualization of development and that it is a common topic of discussion in both academia and practice. The paper argued that Sen's capability approach may be a common approach for both practitioners and researchers to understand the relation between ICT and development. To illustrate the capability approach, ten papers that focused on the impact of ICT on remote communities using Sen's capability approach, were analyzed. Finally, based on the literature review, we identified gaps in current research and suggested areas for future research.

Findings

The literature review showed that there is still a need to understand the relationship between ICT and development (Avgerou, 2003; Nair & Prasad, 2002; Urquhart, et al., 2008). Nonetheless, little is being done to address this issue. Interrelationships between various factors, such as social, cultural, political, human and economic, make it a complex issue. Therefore, to understand the relationship between ICT intervention and development, we need to understand interaction processes in ICT and social, organizational and economic contexts. Several research approaches should be combined to address the issue. A few studies have employed, for example, social capital (Urquhart, et al., 2008), capability approaches (Zheng & Walsham 2008), and actor-network theories (Rhodes, 2009). The review identified that the concept of development in ICT4D research is varied. In practice, development context influences project design, implementation, use and effects (Prakash & De, 2007). Findings also showed that more research is needed to identify how various views on development, such as modernization, neo-liberalism, and human-oriented approaches influence project outcomes.

The review also revealed that social-cultural issues such as de-politicization, corruption, caste structures and context-dependent power structures have, so far, not been as well-investigated in ICT4D research. More research is needed that focuses on mountain regions, where one third of the world's population resides (Heeks & Kanashiro, 2009). The literature has also

suggested that the concept of 'digital divide' should be extended to include broader socio-political issues, such as gender, and rural versus urban areas. Accordingly, the use of mixed-method approaches and action research has also been recommended. The first paper provided the conceptual understanding of ICT4D, an area that was a useful starting point for my empirical research. Accordingly, I conducted the first field study to explore the opportunities and challenges of Internet-enabled services in the Myagdi district of a mountainous region of Nepal. The findings were reported in Paper 2.

4.2 Paper 2: An Explorative Study

The second paper focused on an interpretive case study in Nepal to widen our understanding of how locally-initiated ICT4D projects may help to foster socioeconomic development in the mountain regions. The study employed the Assets Pentagon Model to identify the opportunities and challenges of introducing ICT initiatives in the mountain district of Nepal.

This research was conducted in the Nangi and Tikot villages in the Myagdi district of Nepal. We conducted interviews from two villages. To understand the collective views, we conducted focus group interviews with teachers, activists, and experts, such as the Director of Nepal Telecommunication Authority, Joint Secretary of High Level Commission of Information Technology, and Directors of Borderland Travels and Tours, ENRD, OLE Nepal, and Thamel.com. The findings of this study were

corroborated with ICT4D workshop discussions that were organized after conducting the field study.

Findings

In this study, we explored the multifaceted opportunities that NWNP offered to Nangi and Tikot villages. For example, NWNP facilitated in creating social, human, physical, financial, and political capital. It also identified the basic challenges faced by ICT4D projects, such as higher illiteracy rate, language problem, lack of participation by elderly people, and a dependency on a 'champion'. From the study came the importance of bridging and linking social capitals in the development process, the need for local content development, and the need for champions in order to realize the macro level socioeconomic impact. The Asset Pentagon Model provided a holistic lens on the exploration of this study to increase our knowledge of the interrelationship between the various assets. Based on our findings, we argue that the holistic view on ICT initiatives is important as long as the project is initiated to overcome social, and not technical, challenges. The study explored five capital assets: human, financial, social, political, and physical. It identified that these five capital assets are interrelated and that social capital is the key asset for building other capitals. The findings gave impetus to a better understanding of the process of building social capital through ICT intervention. The subsequent paper discusses the process by which the wireless project in the Myagdi district led to social capital formation and extension in that region.

4.3 Paper 3: The role of ICT Actors and Networks in Development

The third paper examined the roles of various stakeholders, activists, and people in the community who helped to start NWNP. It described how one social activist conceived and acted on his idea to form and extend a wireless project vis-à-vis a social network from one village to more than 150 villages. The specific research question was: *How do different ICT actors form and extend ICT4D projects and how do extended networks, in turn, foster socioeconomic development?* To examine the research question, we analyzed the data from our previous case study in the Myagdi district. The study explored the role of heterogeneous actors in the formation and extension of NWNP. This study employed ANT to understand the formation and extension process of NWNP in their local context. A major focus of the theory when applied in this particular case was to explore the interaction processes among various actors and their roles during the formation of the wireless project and its subsequent extension. The study also identified the socioeconomic impacts of the wireless project on remote mountain villages.

Findings

This paper highlights the importance of sociotechnical actors, and their roles and actions in the formation and extension of ICT4D projects. Using ANT, we found that the formation and extension of ICT4D projects went through different phases in the identification of relevant actors, roles, negotiations, and their interest alignment. The study revealed the initiation taken by

different actors and community people, in the midst of many challenges, to enable education, healthcare, and economic opportunities in the mountain villages. The roles of different actors and the interconnection between technology and society can provide us with a better lens for understanding how ICTs can effectively be used to enhance the livelihoods of poor and marginalized communities (Unwin, 2009).

Theoretically, this paper contributes to how ANT can be used for a deeper understanding of how ICT actors play their roles in the formation and extension of ICT4D projects. The study has some practical implications. It shows that ICT actors can play a major role in the formation and extension of an ICT4D project and foster socioeconomic development through enrolling in a common objective. At the same time, however, such challenges as a lack of political stability, skilled manpower, and physical infrastructures can unsettle the enrolment process and dissolve a network. Using ANT's translation phases helps in explaining how the case adds value. These phases break up ANT into its temporal elements; thus, ANT can be used as the phases of an ICT project. After exploring the role of NWNP in the social capital building process I wanted to know the consequences of the various forms of social capital on the socioeconomic development of the mountain district. The following study investigated how social capital fosters the development process in mountain regions.

4.4 Paper 4: ICT, Social Capital and Development

The fourth paper illustrated how ICT helps to create or strengthen the social capital of communities, which in turn may foster the development process. To understand this process, the role of NWNP in building various forms of social capital was examined. Furthermore, the consequences of the extended social capital on the development process were also explored.

In this paper, we addressed a specific research question: *How does ICT create and extend social capital and how does social capital in turn foster socioeconomic development?* To examine our research question, we illustrated a case study of the wireless project. In the second round of data collection, we conducted various formal and informal interviews, participatory observations, and group interviews. The study explored the role of ICT in creating bonding, bridging, and linking social capital and its implications for socioeconomic development in the mountain villages.

Findings

This research contributes to a better understanding of the instrumental role of ICT in building various structural forms of social capital and its implications for socioeconomic development. The study provided evidence in the context of a remote mountainous region. For example, the wireless project led to strengthening of bonding, bridging and linking social capital. It opened up prospects in education, healthcare, communication, and e-commerce.

Until this stage, the meaning of development had not been formed using any particular philosophical and conceptual framework. This was the final task of my research: to conceptualize the development and find the link between ICT intervention and development. The subsequent paper explored these issues.

4.5 Paper 5: ICT, Social Capital, Collective Action and Capabilities

The fifth paper delved into conceptualizing development as collective capabilities, building on Amartya Sen's capability approach and social capital. The study explored how ICT strengthens social capital in communities, which in turn promotes collective action and fosters human development by building collective and individual capabilities.

Our specific research question in this paper was: *How does ICT create and extend social capital and how does social capital in turn foster the collective action that enables the building of collective capabilities?* To find an answer to this question, I analyzed the data collected from 10 villages in the Myagdi district. In this phase, I explored how an ICT initiative in a mountain region built social capital which in turn promoted collective action and fostered collective capabilities.

Findings

Our findings indicate that the project enabled the villagers to create, maintain, and extend their bonding, bridging, and linking

of social capital. Subsequently, this social capital enabled them to take collective action which assisted them in developing collective capabilities while simultaneously enhancing individual capabilities.

4.6 Summary of the Contribution of Five Papers

Based on the interpretive case study, I produced five peer-reviewed conference and journal papers. In these papers, I described, analyzed, interpreted, and represented the course of action. Each provided a foundation for a holistic view of the phenomena that I studied; in other words, to explore the link between ICT intervention and human development. Figure 4-1 depicts how these five papers contributed to this thesis.

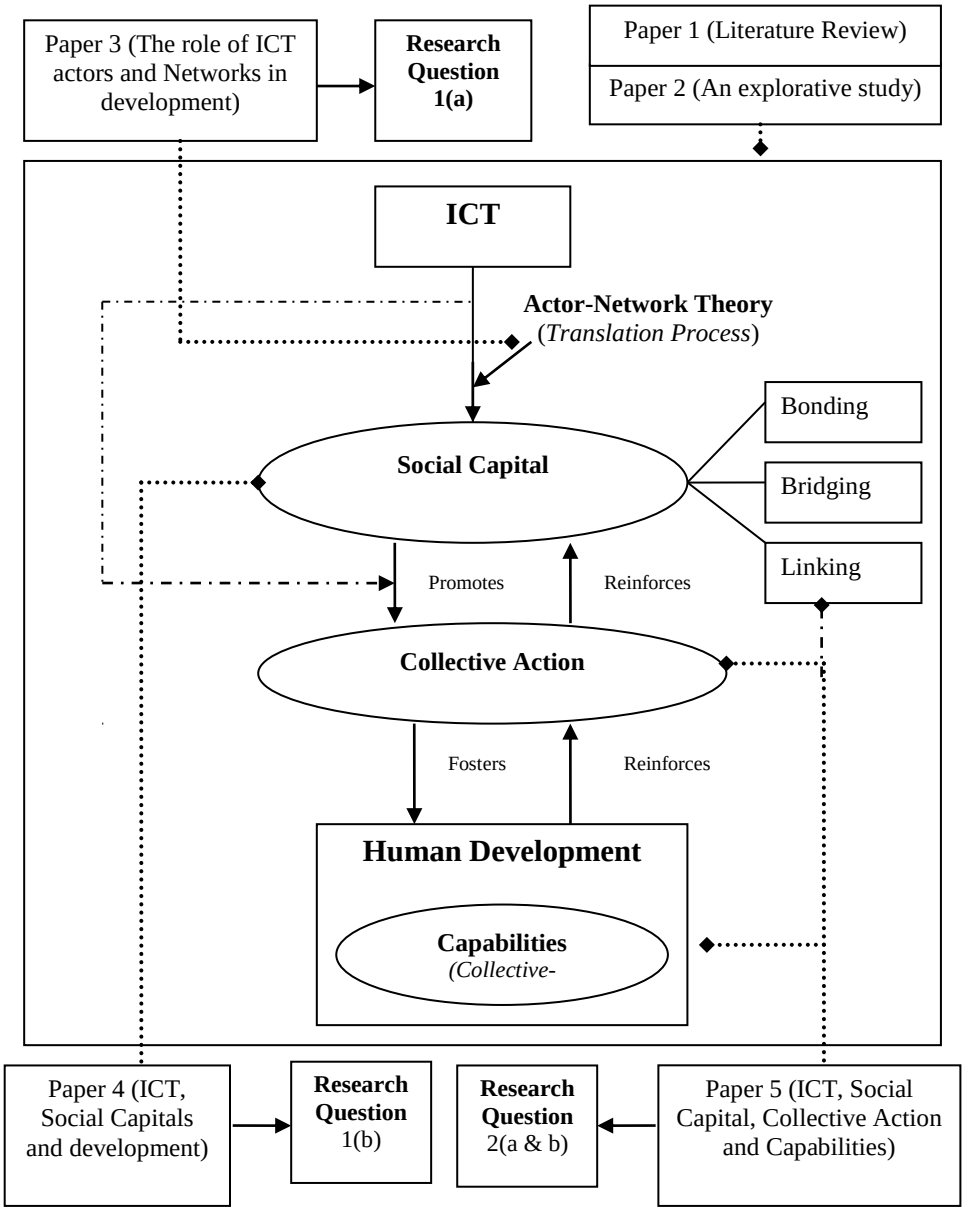


Figure 4-1. Contribution of the five papers

5 Research Findings

As depicted in Figure 5-1, this chapter discusses the answers to the research questions formulated in Chapter 1. The process is guided by the five papers discussed in Chapter 4, and the theoretical and methodological approaches discussed in chapters 2 and 3. Subsequent sections discuss in detail how these research questions were explored.

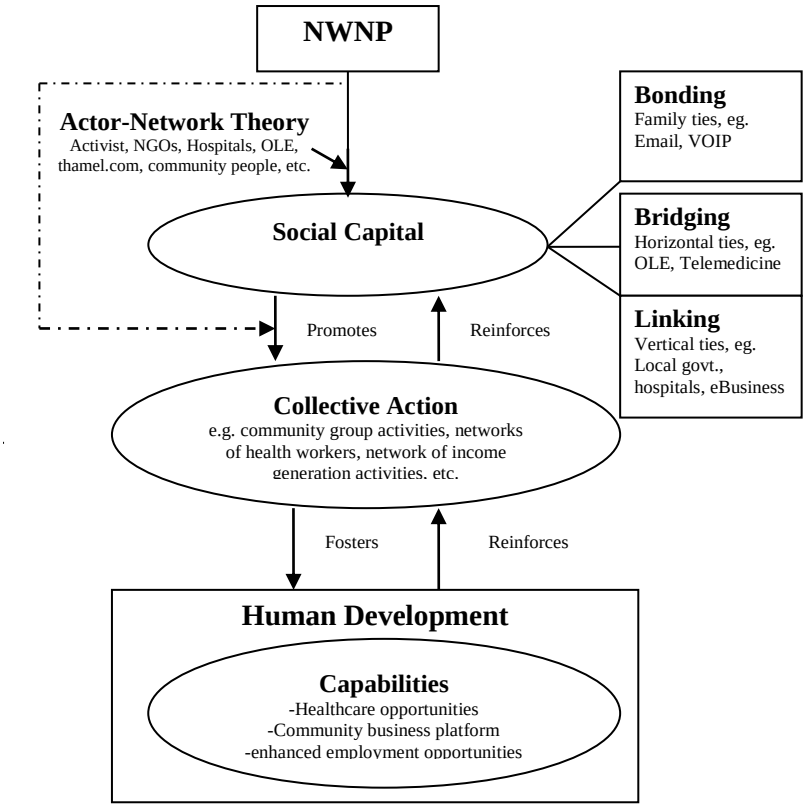


Figure 5-1. Empirical summary of Linking ICT to Human Development

5.1 Findings of Research Question 1(a)

This section describes my response to the first set of questions (1.a): what is the process needed to create, maintain, and extend bonding, bridging, and linking social capital through ICT intervention in the mountain regions of developing countries? As shown in Figure 5-2, the study employed ANT's translation process to explore the social network formation process. Although I discussed the four phases of translation process sequentially, they can be overlapped in a real context. In Figure 5-2, I encircled all the arrows of *problematization, interessement, enrollment,* and *mobilization* to indicate that they can be overlapped. In this particular study, however, certain phases manifested themselves as more apparent than others in some given time periods.

The process started with *problematization;* that is to say, the identification of the problem, relevant actors and obligatory passage point. The focal actor(s) plays an important role in determining the structures of the social network. Hence, the study followed the trail of the focal actor (Mahabir Pun), in order to understand how he proposed different roles for other actors to create links between these actors and their prospective objectives. As discussed in Chapter 3.3 and Paper 3, the idea of introducing Internet services in the village was conceived in Pun's mind when he started teaching at Nangi High School after returning from the USA.

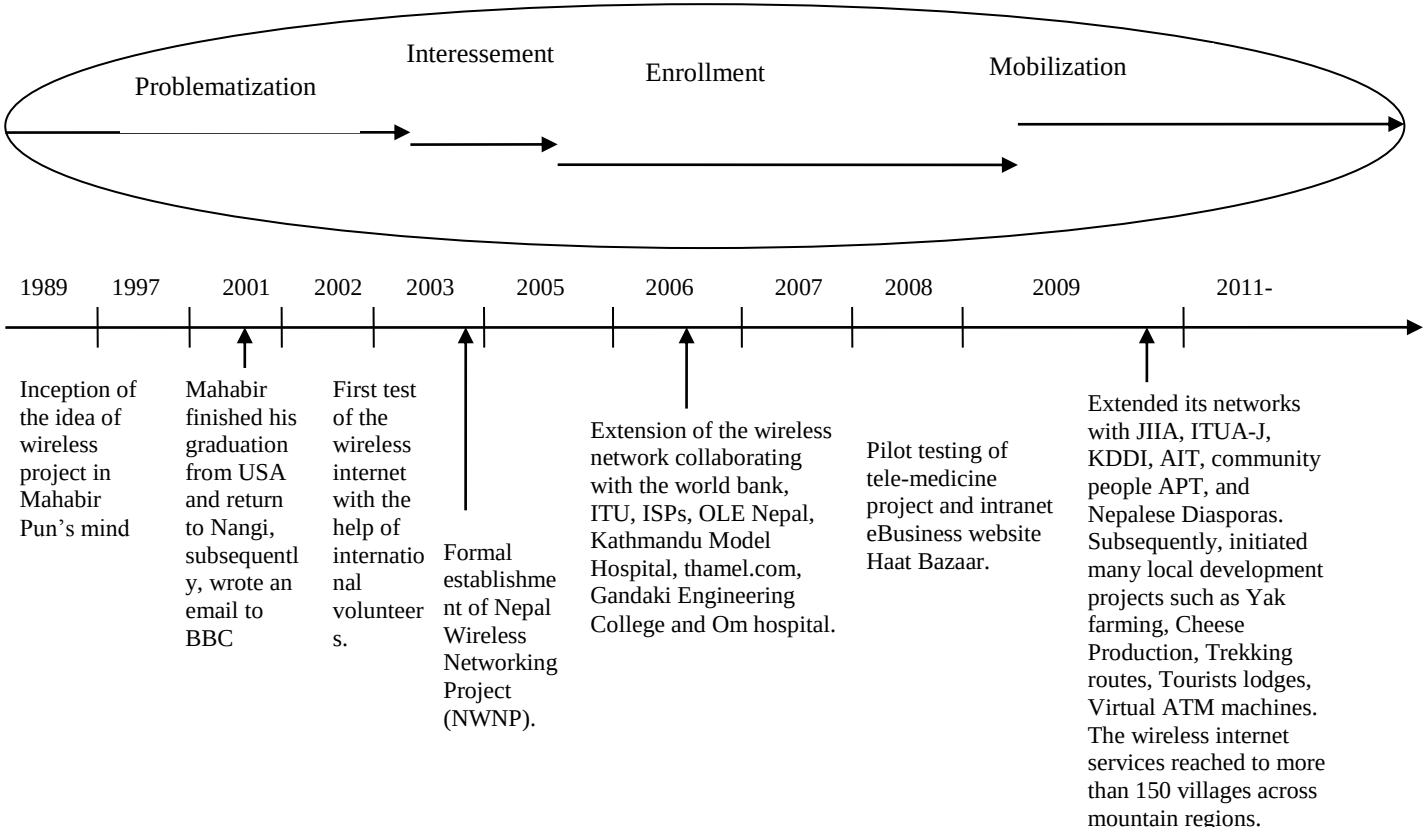


Figure 5-2. Trajectory of NWNP and network formation process

The bonding social capital within the community at that time was strong, although there was a lack of bridging and linking social capital. The villagers were disconnected from main cities and they had to make two-day trips to the nearest town (Pokhara) just to make a phone call or check their e-mail. While staying in the USA, Pun identified the potential for IT in connecting his village to the outside world. At the same time, he realized the possibilities for fostering socioeconomic development. Pun, stated the reason for starting a wireless project as follows:

> *"One of the reasons I am involved in this project is because I have seen that this has good potential to provide some very basic services to the rural community. Like health and education services…I think ICT can help to bring this education gap closer. Similarly, to make this project sustainable we have to generate income, that's why we are working in e-commerce project and Internet telephony."*

As discussed in Section 3.3, in 1997, through personal correspondence (created bridging social capital), with one Australian school, Pun succeeded in acquiring four used computers. This communication helped people in the community to learn basic computer skills at Nangi High School. Later, the network extended still further and the school received additional donated computers. Still, there were no telephones and no Internet connection in the village. As Pun realized his limits as a single actor to deliver these services, he started seeking other

like-minded actors. In 2001, Pun wrote an e-mail to the British Broadcasting Corporation (BBC) asking for ideas to connect this remote village to the outside world through the Internet. The publication of his e-mail turned out to be an ice-breaker to extend his social capital; he received an overwhelming response. Consequently, volunteers from Europe and the USA began to come to Nangi to help him in setting up a wireless station using TV dish antennas and basic Wi-Fi equipment. They also started a micro hydro project to provide electricity to the telecenter in the village. At this stage, most of the activities were carried out by people in the community and volunteers.

Earlier success led him and the villagers to extend their social network with other schools, national and international volunteers, NGOs such as OLE Nepal, Kathmandu Model Hospital, and Thamel.com, to name a few. The extended social capital among these partners promoted collaboration in many projects, such as distance education, tele-medicine, and eBusiness. The installation of wireless services has enhanced communication among these actors. The improved communication promoted social norms and trust within and between various distant communities. At this stage, the roles and responsibilities of various actors were drawn according to their individual and social interests. Pun, as the main facilitator (focal actor), installed himself as an obligatory passage point for them.

In the *interessement* phase, NWNP was formally established (in 2003) as a common platform to implement and achieve different communities' shared goals. The project was inscribed as an *interessement* (balancing) device. The actors involved in this project negotiated and consolidated their roles and responsibilities; for instance, OLE focused on developing educational content, Kathmandu Model Hospital focused on introducing telemedicine services, and thamel.com focused on developing an e-business platform. All the actors involved in this undertaking acknowledged the central role of the wireless project in extending their bridging and linking social capital.

In the *enrolment* phase, Pun, as the focal actor, established formal and informal norms among various national and international actors. These norms bound them together by the roles attributed to them. Gradually, the network of NWNP vis-à-vis mountain communities started to extend across other parts of the world. Volunteers from several countries started donating computer parts, Wi-Fi equipment, and their skills to these mountain villages.

In the *mobilization* phase, the team leader successfully identified and enrolled people from different communities, activists, and institutions to his network. So far, the network of the wireless project has connected people across 150 villages. Although it will take a long time to create macro level impact, it is gradually enrolling local, national, and international actors in this

formation and extension of social capital. In the long run, the extended social capital can enhance the mutual benefits of the involved partners, which may eventually lead to socioeconomic development in these mountain communities. According to team leader Pun:

> *"This is a pilot study to learn about future possibilities…right now, we are not doing any big things or magic. What we are trying to do simply is to tell that in future those who will not know ICT will be like a blind man. Therefore, we are trying to open their eyes right now…So we cannot say the result of this project will be seen after one or two years. The impact can be seen after 10 or 20 years…the lesson they learned now will be very useful to them in the long run."*

5.2 Findings of Research Question 1(b)

This section describes my response to the first set of questions (1.b): how does extended social capital foster development in the mountain regions of developing countries? As shown in Figure 5-2, so far, I have investigated how the formation and extension of the network went through the different phases of identifying relevant actors, their roles, negotiations among them, and their interest alignment. The interaction between people in the community and the NWNP enabled the residents of the villages to create, maintain, and extend their social network. In this section, I will explore how bonding, bridging and linking social capitals in the network assisted them in improving social opportunities, education, and economic facilities by generating

economic activities. My response to this particular question has been taken from Paper 4.

The majority of the inhabitants of the villages being studied belong to the same ethnic group, namely the Magar. Thus, they already possessed high bonding social capital. However, they were not able to interact with their relatives and friends who were working or residing outside these villages. With the use of *bonding* social capital, the villagers are able to connect with their relatives through e-mail, chat and other social networking sites. High school students can use the network to write e-mails to each other and to their pen-pals abroad. The project provided a platform to maintain bonding social capital and created trust between and within the members of the communities. They share information about their cultural and other activities online.

The network in the *bridging* level extended relationships between various informal and formal institutions with different functions different locations. For instance, the wireless project is working with OLE Nepal as a partner to develop educational content for school children. The content is based on the government curriculum for grades one through to ten. The wireless project has enabled ten villages to connect with other villages across other districts, which has brought together people across diverse social divisions. Through extended bridging social capital and collective action, village people can enjoy capabilities that include better education and health care facilities.

For example, the project is in the testing phase of using the network for online-based distance education. The objective is to provide further education for youngsters living in the villages. To meet the challenge of bringing specialist doctors into the mountain region, the project has initiated telemedicine services in some villages in Myagdi district. The villagers also started small-scale industries, such as Nepali paper production. The extending of bridging social capital to Australia resulted in an international collective approach that provided an opportunity to sell indigenous products in e extended markets.

The initial success of the wireless project helped these remote communities to create a link between their villages and local government institutions in order to replicate similar projects. *Linking* social capital pertains to vertical connections between formal institutions mainly at a higher level of hierarchy (Woolcock, 2001). In the context of Nepal, this implies connections with people in powerful and influential positions, whether political or financial. The wireless project not only facilitated collaboration between the villagers and local government, but also assisted in building a relationship between these villages and central government. These relationships were also on a broader scale for macro level development. Through linking social capital, the team leader of the wireless project successfully lobbied parliament to de-license wireless technology and remove high customs levies on equipment in order to facilitate its adoption throughout the country.

The NWNP provided a platform for villagers to use Internet services, such as Voice over IP (VoIP) and social networking sites, to build new networks and relationships and reinforce existing ones. In turn, these extended networks fostered the socioeconomic development process in the mountain regions, particularly in education, healthcare, and income-generating activities. For example, extended social capital enabled school children in the mountain regions to search and share information about the availability of other resources. Teachers and students can now access educational materials on the Internet. At the same time, school children are motivated towards learning and teachers are motivating towards teaching. Likewise, telemedicine centers in the mountain villages facilitated health workers and patients in these villages in their communication with doctors in the urban centers.

The extension of social networks also created income generation activities. For example, a cross-breeding project located at 800 meters above one of the villages uses Internet applications like NetMeeting to communicate with members of the management committee to make quick decisions. As discussed in Chapter 3.2, Haat Bazaar, Virtual ATM, remittance services, and ecotourism are other income-generating activities that are directly or indirectly supported by NWNP. The next section will discuss how these bonding, bridging, and linking social capitals promote collective action.

5.3 Findings of Research Question 2(a)

This section describes my response to the second set of questions (2.a): how does social capital promote collective action in the mountain regions of developing countries? As reported in paper 5, implementation of NWNP itself was impossible without pre-existing social ties and collective action. The villages being studied were not connected to roads pass able by motor vehicles. It was the collective efforts of people in the community that helped to install wireless stations at higher altitudes. The bonding capital promoted different collective action in the community through mothers' group, youth groups, associations of ex-army personnel, and co-operative societies.

Consequently, the wireless project, along with other institutions and supportive actors, provided a platform on which to create and reinforce bonding, bridging, and linking social capitals in the Nangi and Tikot villages. Social capital fostered a trust between and within the members of the communities, which in turn encouraged people in the community to take collective action through formal and informal groups. For example, Aama Samoh (a mothers' group) is actively working on promoting awareness among villagers about healthcare, education, and particularly the role that women can plan in community development. Yuva Samoh (a youth club) is working on sanitation programs, cultural awareness and social development activities in the villages. The group exchanges its ideas to bridge a knowledge gap between younger and older generations. Similarly, ex-British and Indian

army associations and cooperatives societies use their collective actions and extended social capital to collect and invest funds to build the physical infrastructure of villages, including schools, public toilets, telecenters, tele-clinics, and roads that are passable with motor vehicles.

Extended bridging capital promoted collective action among NWNP and other organizations. For example, the project developed an e-commerce platform in collaboration with an engineering college in Pokhara. In addition, it is planning to start an online remittance service in cooperation with thamel.com and other software companies. The online remittance service will ease the money transfer process, as many people from these communities go to work abroad. Virtual ATM machine services are being piloted in Ghore Pani (a famous trekking route for tourists), and will be further extended to other tourist areas.

An important achievement of NWNP is the establishment of the telemedicine center. It introduced new networks in which village health workers are teamed up with specialist doctors in urban hospitals that promote collective action in providing healthcare facilities to villagers. By interacting with these doctors and peers from neighboring villages through daily virtual conferences, the knowledge and skills of local health workers were enhanced. These kind of social arrangements resulting from collective action play a constructive and instrumental role in enhancing the capabilities of an individual as well as communities. The

telemedicine services have allowed access to healthcare facilities for around 3,000 to 4,000 villagers in remote villages.

Both the linking social capital of NWNP and people in the community have enabled the villages to be able to take part in political decision-making, and also in enhanced collaboration with local and central government agencies. Similarly, promoting these villages through online media can attract international ecotourism as well as researchers. The linking social capital creates new opportunities to bring international standard education through collaboration with educational institutions abroad. These collective actions in turn foster collective and individual capabilities by providing better education, healthcare, and business opportunities. The following section will discuss in detail the consequence of social capital and collective action on human development.

5.4 Findings of Research Question 2(b)

This section describes my response to the second set of questions (2.b): how does collective action enhance the collective and individual capabilities of the mountain communities of developing countries? The fifth paper further illustrated the extended social capital of the villagers who promoted and reinforced collective action. The action taken by village people who formed, for example mothers' groups, youth clubs, and ex-army groups, along with institutions like NWNP and supportive actors, such as OLE Nepal, telemedicine hospitals, e-commerce organizations, and government organizations, all helped them to

build the collective and individual capabilities of the mountain communities.

As discussed in earlier sections, collective actions help to build collective capabilities. I will further illustrate the process of extending collective and individual capabilities of the mountain communities in terms of communication, healthcare, income generation and education. One of the major contributions of NWNP is easy access to a communication channel. Internet services, such as email, social networking sites, and VOIP, allow them the opportunity to exchange information and feelings with ease. Students can express their ideas and discuss problems with their teachers. They can collectively identify solutions; something that was once difficult in a face-to-face mode because of sociocultural factors.

Another important relation between collective action and capabilities is the telemedicine project. The project provided a common platform to bring doctors, health workers, and villagers online, which has increased the villages' collective capabilities with regard to healthcare facilities. Bringing specialist doctors to mountain regions is a difficult task; however, this technology has facilitated community access to doctors even for those living in remote places. The villagers enhanced their collective and individual capabilities, such as the quality of health care services, and the overall health of the villagers is also improved. Furthermore, the project enhanced the individual capabilities of

the local health care providers through distance training and education programs. The wireless project is collaborating with community people to run the yak-cow crossbreeding project and Haat Bazar projects, as described in Chapter 3.3. These initiatives also increased collective capabilities for economic opportunities and participatory decision-making in the villages. The villagers can use the Haat Bazar website for advertising local products, such as Doko, Namlo, Nepali paper, mushrooms, and cattle. At the same time, individuals were able to enhance their own capabilities by utilizing Internet services to explore employment opportunities. They could also enhance their knowledge and skill through the use of ICT. The findings show that extended social capital based on educational activities (increased bridging and linking social capital) helped to promote collective action. For example, NWNP is working with OLE to develop and implement educational materials which can be an enabling factor in the development of collective capabilities. Table 5.1 summarizes the relationship between social capital, collective action, and collective and individual capabilities.

The NWNP, along with an international research team, are currently implementing multicasting systems to support online teaching. It will promote collaboration and joint teaching activities between schools in the villages as well as between schools in urban and rural areas. International and national collaboration with schools and universities will help teachers to learn from each other. As a result, individual capabilities of

school children and teachers will be developed through increased knowledge and competence. The study shows that ICT intervention has empowered local communities and enhanced participation in the decision-making process, which is an important dimension of human development (Hamel, 2010).

Table 5.1. Relation between Social Capital, Collective Action and Capabilities

<table>
<tr><th>Social Capital</th><th>Collective Action</th><th>Capabilities</th></tr>
<tr><td>Bonding social capital
- Family ties</td><td>Community Group Activities
- Mother's group, Youth group, ex-army personnel groups.</td><td rowspan="3">Collective capabilities:
Healthcare opportunities
Consultative healthcare in telemedicine project
Business opportunities
Virtual market places, such as ATM, remittance, and participatory decision making, etc.
Educational opportunities
Joint teaching through multicasting systems
Group designing and development of educational materials
Individual capabilities:
Enhanced employment opportunities
Empowering health-workers
Developing technical skills</td></tr>
<tr><td>Bridging social capital
-Horizontal ties, e.g. OLE Nepal, Telemedicine</td><td>Networks of health-workers
-Group consultation in telemedicine project</td></tr>
<tr><td>Linking social capital
- Vertical ties with central hospitals, local and central government</td><td>Networks of
- community people with local and national government
- income generation activities e.g. Yak project, eco-tourism, OLE project, Kathmandu model hospital.</td></tr>
</table>

5.5 Challenges

The study identified several challenges, such as dependency on a single actor, exclusion of minority classes because of the caste system, lack of English language proficiency, higher rate of illiteracy, and lack of reliable Internet services, all of which can impede the network formation process vis-à-vis socioeconomic development. Furthermore, the supporting infrastructure, such as electricity supply, road network, and other fundamental infrastructures are not yet developed in the remote areas of mountain regions.

As was shown in this study, the socioeconomic changes in Nangi and Tikot villages were encouraging. For instance, an inflow of positive information resources helped them to develop physical, social, human, financial, and political capital. However, to realize the macro level socioeconomic impact, the completion of the information resource chain is needed (Heeks, 2005; Heeks & Kanashiro, 2009). This means that it is not enough just to be able to access information; they should also be able to assess and take decisions, whilst at the same time exporting local information to the global market. The resource movement framework has suggested that four resources are needed: data resources, social resources, economic resources, and action resources. However, I argue that political resources are also important in the context of developing countries if they are to successfully implement ICT4D projects. Here, a political resource means a government's IT policies, government support, ICT knowledge of government

officials, and political stability. Political resources sometimes affect the complete movement of the information resource chain.

It has been shown that in Nepal, political resources are not conducive to the information chain. Although the Nepalese government has embraced liberal policies since 1997 and have drafted IT policies, they have still not been implemented in practice. The reason for the delay is a lack of ICT knowledge and lazy bureaucracy. According to Nepal Telecom Authority (NTA) officials, despite allocating huge amounts to the Rural Telecom Development Fund (RTDF), the fund has not been distributed and utilized due to political instability and delays in the bureaucratic process. Decades of political instability in Nepal have hampered the overall socioeconomic growth; consequently, it has impeded the information resource chain flow in mountain regions. Over-dependency of the wireless project on a single actor like Mahabir Pun offers both opportunities and limitations. The project was not possible without him; there is still no replacement for him.

During the field study, the villagers complained that, while many people from foreign countries come to observe the project, no one is willing to come to the mountain villages to work with Pun. Therefore, there is a need to create more skilled manpower, like that offered by Pun, to ensure the sustainability of the project. Over-dependency on a single actor reveals another challenge: a lack of trained manpower to tackle technical problems. It has

also been shown that the majority of villagers are retired army personnel whose current occupation is farming. Their participation is crucial to access and assess the data, so that they can take action and use it in their own particular job. On the contrary, because of a lack of education and time, the participation of farmers is still a challenge.

6 Contributions

6.1 Theoretical

This thesis makes two substantive contributions to the existing body of knowledge. The first contribution of this thesis is to conceptualize human development and describe how, with regard to ICT, social capital and collective action contributes to this conceptualization. Second, this thesis contributes by revealing the social capital building process through ICT intervention using the complementary lenses of ANT and social capital. In this way, this thesis enhances our overall understanding of the link between ICT intervention and human development. Detailed discussions of these contributions are given below.

First, this thesis contributes to the conceptualization of human development. It describes the role of ICT, social capital and collective action in fostering the development process in the mountain regions of developing countries.

This process has been well described and interpreted in existing literature on ICT4D, including the design, development, and implementation of ICT artifacts in developing countries (Braa, et al., 2007; Walsham & Sahay, 1999), or its impact on remote communities (Heeks & Molla, 2009). Such studies, however, are insufficient for comprehending the link between ICT intervention and development because they show either the implementation process or the impact of ICT4D projects. Literature on ICT and development shows that there is a lack of

theoretical and empirical understanding to interpret and explains the phenomenon (Avgerou, 2010; Heeks, 2007). Therefore, further research is needed to investigate the question of how ICT intervention leads to some kind of development. What's more, the conceptualization of the term 'development' is still a matter of debate (Heeks, 2010).

In this thesis, I conceptualized development as human development that is grounded in Sen's (1999) capability approach. Sen's approach focuses on providing 'freedom of choice' capabilities to individuals so that they can lead a live which they value – and have reasons to value. Lately, ICT4D literature has started to include the capability approach as an evaluation framework (Hatakka & Lagsten, 2012; Kleine, 2010), in which focus was given to assess the impact of ICT4D projects in terms of the development process rather than just economic progress. These studies used a participatory approach to draw up a list of capabilities with regard to ICT, and investigated how various conversion factors enable or disable these listed capabilities (Hatakka & Lagsten, 2012; Kleine, 2012). Such studies are suitable in places where sociotechnical arrangements are in order. However, they fail to first explore the process by which social arrangements come into being in the first place. In remote mountain communities, it is important to consider the societal perspective of capabilities, rather than just the individual perspective, to explore social arrangements. In this thesis the capability approach is regarded as individualistic. It is, however,

an appropriate perspective of human development, despite the fact that it is 'insufficient' (Ibrahim, 2006) or 'incomplete' (Zheng, 2009), particularly in the context of mountain regions in the developing world. This thesis also addresses another criticism of Sen's approach, which is that it fails to discuss technology and its interaction with the social process (Zheng 2007). In the ICT4D context, existing literature describes ICT as an enabler by extending individual capabilities (Sein & Harindranath, 2004; Zheng & Walsham 2008); however, the process of social arrangement through ICT in building collective capabilities is not discussed. To respond to these views, I incorporated collective capabilities (Evans, 2002) to better understand the mutual reinforcing relationship between collective and individual capabilities. After conceptualizing development, the study investigated how ICT intervention can build and extend these capabilities within the context of developing countries.

This thesis also improves our understanding by exploring the process of how ICT facilitates social arrangement and creates collective capabilities by employing social capital and the capability approach. Subsequently, it illustrates their compatibility in researching collective capabilities with regard to ICT intervention. For example, this thesis concurs that social capital is not simply a means for enabling the development process, but an end resource in itself, which can be equated to collective capabilities (Comim & Carey, 2001).

Social capital has its origins in sociology and political science, whilst the capability approach is grounded in moral philosophy and development economics. Thus, social capital and the capability approach can be read simultaneously and complementarily when analyzing the extension of collective capability as human development process (Comim & Carey, 2001). In fact, Comim and Carey (2001) have formulated 'social capability', which is a form of 'collective capability'. A social capital lens helps us to understand the social structures and arrangements, while the capability approach provides us with a lens through which we can evaluate such arrangements.

In this thesis, I went on to argue that individuals alone in remote mountain communities are not able to acquire these capabilities; instead, they have to be a member of a social network and act together to achieve their common goal (Ibrahim, 2006). This notion of acting together is defined as 'collective action' (Gilbert, 2006). However, the question arises as to what are the sources of collective action? What is the process of creating these sources through ICT intervention? Existing studies advocate that social capital is one possible source that can promote collective action (Ostrom & Ahn, 2003; Woolcock, 2001).

Studies on ICT and social capital have examined the characteristics of social capital, such as norms and trust, as being instrumental to collective action (Huysman & Wulf, 2004; Urquhart, et al., 2008). Collective action has not been studied in

detail in ICT4D research. The notion of collective action has been implicitly presented as a consequence of social capital (DCITA, 2005). In this thesis, to understand the connection between social capital and collective action, the concept of collective action is theoretically defined and empirically explored. This thesis also elaborated the role of various forms of social capital (bonding, bridging, and linking) in relation to collective action. It is argued that dense social networks encourage norms and trust through frequent interaction between its members; however, too dense a network, such as close family ties, can impede collective action among distant communities. Linking social capital with unequal power relations can also hinder collective action. However, to sustain social stability and collective action it is necessary to extend a social network beyond strong personal ties (Ostrom & Ahn, 2003). For instance, in the context of NWNP, Pun did not completely rely on mountain communities; he extended his network with OLE Nepal, Kathmandu Model Hospital, and many other national and international organizations. This is in line with the argument put forward by Woolcock (2001), that bonding social capital within communities alone is not enough. There also has to be bridging and linking social capital in order to achieve a macro level developmental goal. In addition, I argued that by employing the translation process of ANT, it is possible to reveal the social capital formation process with regard to ICT intervention. In this way, we can understand the holistic process of building social capital through ICT intervention. In turn, this promotes

collective action, which goes on to build collective and individual capabilities.

The findings of my study show that a social activist could, in the midst of challenge, initiate a wireless project to provide socioeconomic opportunities. He went through different phases in which the relevant actors were identified, along with their roles, and their interest alignment. The implementation of the project provided a platform to create and extend villagers' social capital, which, in turn, promoted collective action and extended collective capabilities. For instance, with the help of NWNP such villagers' groups as the mothers' group, youth clubs, and ex-army groups cooperated and collaborated with several other institutions, such as OLE Nepal, hospitals, international organizations, and local and central government organizations, in order to create social and economic opportunities. They can now access quality healthcare and education systems. Through their extended collective capabilities they were able to enhance their individual capabilities as well. For instance, by collaborating with the OLE project, NWNP was able to provide quality education to people in the community people. Furthermore, such collaboration enhanced the individual capabilities of the teachers and students who had previously been largely excluded from such resources. Similarly, a telemedicine project empowered the women health workers in the mountain villages. At the same time, the individual capabilities of teachers, students, and health workers reinforced the collective capabilities of the community

by providing useful information to the villagers. Overall, the findings shows that ICT intervention can create or extend bonding, bridging and linking social capital, which can promote collective action, and thus lead to the enhancement of collective and individual capabilities.

Second, this thesis extends the theoretical and empirical understanding of the process of building and extending social capital through ICT intervention by integrating the complementary lenses of actor-network theory and social capital.

Existing literature suggests that social capital may be a useful theoretical lens for understanding the relationship between ICT intervention and human development (Díaz Andrade & Urquhart, 2009; Huysman & Wulf, 2004). Social capital is heavily employed in such fields as sociology, political science, economics and organization science. However, IS studies in general and ICT4D research in particular have paid it minimal attention (Huysman & Wulf, 2004).

Some research on ICT and social capital has found that individual social capital, as an independent variable, affects the diffusion of innovation within an organization (Frank et al., 2004). Another study in a similar context found that the Internet is playing an important role in encouraging people to communicate more, which in turn develops social capital and strengthens civic engagement. Their study showed that the use of

the Web as a resource, and a forum in which to interact, strongly influences social capital and civic engagement more than traditional broadcast and print media (Walsham & Waema, 1994). Similarly, one study reported that distributed community members are more inclined to connect and use electronic networks to extend their social capital when they are motivated to share knowledge with others, able to share knowledge and have the opportunity to share knowledge (Huysman & Wulf, 2004). Studies in ICT4D have shown that understanding the role of social capital in successful community informatics initiatives and widespread adoption of ICTs can enhance the likelihood of the sustainability of such an initiative. Social capital can increase the benefits that the community may derive, and frequent interaction between ICT and social capital has the potential to improve quality of life by reducing the digital divide (Kanungo, 2004).

As discussed in Chapter 5, this thesis also corroborates previous studies on ICT and social capital. However, existing research has left some questions unanswered, including: who are the central actors in the social network formation process? How do they go about building the social networks and, what roles ICT play in this social network formation process? Likewise, what are the implications of this social network on the development process of remote communities? Therefore, the process by which ICT intervention creates or extends social capital in the mountain

regions of developing countries is one of the main topics of this thesis.

Based on a theoretical and empirical understanding, I attempted to examine these issues, arguing that ANT is helpful in exploring the roles of various sociotechnical actors, and interplay between them when building their social network, norms, and trust. To study the complex interaction of people, processes, and technology, ANT is significantly utilized in information systems disciplines. In ANT, technology is not rendered as an artifact, but instead examines how people and technology interact and shape or reshape networks. Lee (2001) noted that research into the field of IS examines more than just the technological system, or just the social system, or even the two systems side by side; it also investigates the phenomena that emerge when the two interact.

Social capital is a dynamic relationship between various communities that evolves constantly on spatial and temporal scales. Since ICT has rapidly changed the effect of space and time on social networks, every interaction between sociotechnical actors has wide ranging and unpredictable outcomes on the structure at various levels. Therefore, the transformation of technical actors into a socially embedded system and their entrenched role in the process of social capital formation justifies the use of ANT as an appropriate theoretical lens. This thesis provides a deeper understanding of the

processes, controversies, and negotiations that lead to the formation and extension of bonding, bridging, and linking social capital. The findings show how the interaction between technical and human actors plays an important role in the formation and extension of social capital in mountain districts. It also explains how groups and individuals in remote mountain communities can access opportunities by virtue of a social network. Using ANT's translation process to explore the case adds value, because it breaks up ANT into its temporal elements, showing that ANT can be used to analyze the various phases of ICT4D projects.

In contemporary society, ICT is becoming an indispensable part of our lives; thus, the relevance of ANT as an analysis tool is more obvious. It appears, however, that the use of ANT in understanding development processes is unusual, although some ICT4D studies have successfully employed it. Walsham and Sahay (1999) applied ANT for the analytical purpose of GIS implementation in district-level administration in India. The objective of this study was to identify the degree of penetration of IT use in an Indian district, and the reasons for the success or failure of the GIS projects. In their study, they found that there is a lack of aligned interest among different actors, such as those who develop GIS technology in western countries, and those who use that technology in India. The researchers mentioned that GIS developers inscribed their interest in the technology according to their own point of view. Consequently, cross-

cultural and sociotechnical conflict arose during implementation. This led to a lack of aligned interest among actors and the inefficient implementation of GIS technology for district-level administration in India. Similarly, Heeks and Stanforth (2007), used the theory to investigate an explicit understanding of the political interactions of stakeholders involved with an initiative to implement e-Government. The objective of this research was to identify aspects of an e-Government project's failure and success. Through the analytical lens of ANT, they explored the failure to mobilize a local network, and the failure to establish an obligatory passage point between the networks, which led to the disintegration of the global network.

Braa et al. (2007) used ANT to analyze standardization processes in complex systems. In this study the concept of complexity science, such as the emergence of order and the central idea of ANT, are used to investigate how actors succeed in their order-making efforts. They conducted multiple case studies in different developing countries, such as South Africa, Ethiopia, Vietnam, and Thailand. In their study, an attractor (hierarchical structure) was created at the national, district, and regional levels. Negotiations were aimed at making the standard compatible with national policy. Eventually, a final agreement was reached between different groups to develop national Health Information Systems standards. The standard can be depicted as a result of the translation process in ANT. The study conducted by Diaz Andrade and Urquhart (2010) used ANT to show that when

actors' interests are not aligned and the network procedures defined by the ICT4D initiative sponsors are unfamiliar to local people, the network cannot be established.

In summary, existing research into ANT and ICT4D has provided significant evidence that this theory can be useful in understanding the role of various sociotechnical actors and the networks or counter networks that influence the ICT design, development, implementation, and standardization process. The findings of my study have used ANT's translation process to support previous studies. For example, the findings show that the team leader of NWNP successfully established himself as an obligatory passage point within the community, and with various other actors, such as OLE Nepal, thamel.com, Kathmandu Model Hospital, and local and national government agencies. At the same time, the actors' interests were aligned and focused on the socioeconomic development of the mountain region. On the contrary, the actors' unsuccessful translation of interests might have jeopardized the extension of the social network formation process vis-à-vis the development process.

However, the theory was not utilized to explore the value of these networks. As discussed in Chapter 2, ANT is insufficient for exploring the value of the network; for example, it does not say how social networks may lead to development. Existing research does not explain how these networks can possibly foster development process. On the other hand, social capital

adequately describes the benefits of different forms of social networks and its implications for socioeconomic development (Urquhart, et al., 2008; Woolcock & Narayan, 2000). Insights derived from existing literature suggest that by combining the strengths of both actor-network and social capital theories, we can understand the process of building social capital through ICT intervention. At the same time, we can also understand its implications for human development in developing countries. To complement the existing research gap, this study utilized both ANT and social capital to understand the process of social network formation process and its implications for human development.

In this thesis, by employing ANT's translation process I investigated how a focal actor, Pun, identified various actors, their roles and responsibilities, at the same time, the roles of information technology in development. Pun as a focal actor gradually enrolled them and pursued their common interest through building and extending social network, norms, and trust among them. As well as exploring the characteristics of social capital, such as network, norms and trust, this thesis also examined how the network in its various forms (bonding, bridging, and linking) promoted collective action and enhanced capabilities of the villagers, which in turn opened up new prospects in education, healthcare, communication, and e-commerce activities. For example, they no longer have to travel long distances to make a phone call, they can access better

healthcare facilities through telemedicine, they can promote ecotourism and agricultural products online, and in time, children will be able to access better education and educational materials.

6.2 Practice

This study reveals some practical implications for policy makers. The findings suggest that ICT policies and strategies adopted by governmental and non-governmental organizations in developing countries should focus on **analyzing the developmental context** (development for what and for whom) before embarking on an ICT4D project. The use of ICT should be about empowering underprivileged people through participation and increased freedom, rather than just about installing technology for the sake of it (Unwin, 2009). For instance, the NWNP project was initiated to solve socioeconomic problems through technology. Pun started the project to solve communication, education, economic, and healthcare problems in the remote villages of Myagdi district. To understand the developmental context, the participatory role of local actors is very important. For example, the credit of extending Internet services to 150 villages goes to the collective approach taken by various actors, including local communities.

ICT4D initiatives should be attentive in **identifying key actors**. At the same time, they should enhance local participation and the social capital building process in the remote communities of developing countries. Policy makers should explore and

understand the patterns of social processes and the exchange of resources **with regard to emerging technologies**. Such understanding of sociotechnical phenomena can offer useful guidelines on how to facilitate bindings within communities (to enhance bonding social capital), between communities (to extend bridging social capital), and between different hierarchical levels (to create linking social capital) using ICT intervention. For example, the formation and extension of the wireless project went through different phases of the enrollment process, and collective action between international, national, and local communities.

Similarly, development policies should be focused on **extending the collective and individual capabilities** of the people. In the context of ICT4D, the notion of development should go beyond providing physical access only. Physical access is undoubtedly one of the necessary conditions for the development process, but it is not sufficient by itself. Any ICT4D projects should explore the multiple opportunities and challenges (or capabilities) that relate to understanding the role of ICT in the development process. A statement made by a farmer from Tikot village illustrates the possibilities as follows:

The Internet cannot help us with plowing, sowing, and harvesting. But by using the Internet, we can engage in a lot of other educational and financial development, I believe.

Local content generation is another prerequisite for the sustainability of ICT4D projects. For instance, NWNP started local bulletin and e-commerce services, such as Haat Bazar, and created educational materials with OLE Nepal for use by school children. At the same time, access of external market information is important for the creation of revenue and long-term sustainability (Heeks & Kanashiro, 2009). For example, villagers are able to access resources and training, which improves their human skills. The wireless services also enabled them to expand the social network, so that they no longer have to travel long distances to make a phone call to their relatives. Similarly, inflow and outflow of the healthcare information chain helped village people to access medical services in remote places. It reduced the transportation costs. It also helped to empower marginalized people and women through a training program. Likewise, planning a **business model** such as the marketing of ecotourism, and cultural and agricultural products through an Internet platform can facilitate revenue generation and aid socioeconomic development in the long run.

Underlying guidelines can be helpful for ICT4D initiatives in enabling social capital, promoting collective action, and extending collective and individual capabilities of deprived communities, thus leading to sustainable human development in the long run. The empirical findings show that efforts made by the NWNP's team leader created a positive wave in remote communities. The positive aspects of this wireless project are

more focused on the development of local content, and injecting income-generating activities for long-term sustainability. The extension of the project to more than 150 villages indicates its positive impact on reducing the communication, information, and educational gap. This ICT project is a good example of a development approach that is based on social capital, collective action and a capabilities framework.

7 Conclusion

7.1 Summary

In this thesis, I studied the process by which ICT may lead to development. I examined the process through two sets of research questions. The first set of research questions was focused on understanding the process of building social capital through ICT intervention, and its implications for development in the mountain regions of developing countries. The second set of research questions was formulated to explore and understand the relationship between social capital, collective action, and collective capabilities with regard to ICT intervention. An interpretive case study was carried out to explore the Nepal Wireless Networking Project (NWNP) in the Myagdi district of Nepal.

To study the first set of research questions, this thesis employed an integrated lens of actor-network theory (ANT) and social capital. The translation process within ANT described the phases of formation and extension of bonding, bridging, and linking social capitals. Furthermore, efforts were made to relate the various forms of social capital to the socioeconomic development process. For example, extended networks opened up new opportunities in areas of education, healthcare, communication, and e-commerce.

To study the second set of research questions, this thesis drew on the analytical lenses of social capital, collective action, and

collective capabilities. As discussed earlier, interaction between people in the community and the NWNP project enabled village residents to extend their social capital, which in turn assisted them in promoting collective action. The collective approach enhanced their group and individual capabilities through telemedicine, e-business, and online teaching and learning services.

This thesis also identified several challenges such as an over dependency on a single actor, a high illiteracy rate, poor physical infrastructure, and lack of participation, all of which may impede this development process. As summarized in Table 7.1, this doctoral thesis contributes to ICT4D research by offering a better understanding of the link between ICT intervention and human development within the context of developing countries. In promoting collective action, this study also contributes to theory by elaborating the importance of structural forms of social capital with regard to ICT intervention, in promoting collective action. It enhances the theoretical understanding of compatibility between social capital and a capabilities approach by illustrating the human development process. Furthermore, the thesis suggests some practical guidelines for policy makers and suggests that IT policies and institutional strategies should be focused on understanding the developmental context before embarking on development projects; in addition, they should promote social capital and collective action.

Table 7.1 Summary of research questions, findings and contributions

Research Questions	Findings	Contributions
RQ. 1(a) What is the process to create, maintain, and extend bonding, bridging, and linking social capital through ICT intervention in the mountain regions of developing countries?	The formation and extension of social capital goes through different phases of identification of relevant actors, roles, negotiations, and their interest alignment.	Enhanced the theoretical and practical understanding by thoroughly examining the roles of various actors in creation, maintenance, and extension of social capital in the context of developing countries.
RQ.1(b)How does extended social capital foster development in the mountain regions of developing countries?	NWNP provided a platform to make interaction and information exchange between and within different communities. Regular interaction created, reinforced and extended the bonding, bridging, and linking social capital. It opened up prospects in education, healthcare, communication, and ecommerce.	Enhance understanding of possible link between ICT and development through social capital perspective.
RQ.2(a)How does social capital promote collective action in the mountain regions of developing countries?	The social capital fosters a trust between and within the members of the communities, which in turns encouraged the community people take collective action through formal and informal groups.	Elaborates the role of characteristics as well as various forms of social capital in fostering collective action.
RQ.2(b)How does collective action enhance collective and individual capabilities of the mountain communities of developing countries?	Extended social capital promotes collective action which in turn builds individual and collective capabilities.	Enhances the theoretical understanding of link between ICT and human development, moreover, compatibility between social capital and capabilities approach in defining the human development process.

7.2 Limitations

This research is part of a doctoral study program with prefixed deadlines. The timeframe of the study, therefore, raises the possibility that it may not have captured the effects at the "right" time. Such projects may require a longer period to have a more sustained influence. I used the case study method, which is very context-sensitive. It may also be limited by the fact that the data were collected from one particular mountain district. The researched communities were mainly composed of homogeneous groups i.e., Magars. The results could have been different in other multi-ethnic communities. However, generalization through interpretive case studies is classified into four types: the development of concepts, the generation of theory, the drawing of specific implications, and the contribution of rich insight (Walsham, 1995b). This thesis can be generalized to these classes; for instance, the integrated framework of multiple theories.

The actor-network theory used in this thesis was mainly introduced by its proponents to understand the network of relations. I extracted some specific notions of the theory to understand the network formation process, and through empirical evidence illustrated the efficiency of the theory. However, that may violate ANT's original aim, which was that it should not be used as a framework into conduct research (Latour, 2005). However, the core concept of ANT – understanding the process of interaction between context (social) and content (technical), and their influence on each other – makes it an efficient tool to

study sociotechnical phenomena in IS research (Stanforth, 2007; Walsham, 1997). In using ANT in this way, this thesis also followed similar traditions in IS literature.

This study has attempted to analyze the specific elements (social norms and trust) and structure (bonding, bridging, and linking) of social capital. In the case of NWNP at least, I found some support. The study has provided fewer opportunities to look into the negative consequences of the social capital. It found a strong evidence of dependency on a single actor, as discussed in Section 5.5. However, Portes (1998) pointed out that the research literature on social capital strongly emphasizes its positive consequences. Portes considered seeing good things emerging out of sociability to be a sociological bias. He emphasized that the same mechanisms appropriable by individuals and groups as social capital can have other, "less desirable consequences" (Portes, 1998), all of which needs more investigation.

The study also inherits the limitations of the capability approach, such as difficulty in identifying the list of specific capabilities. To identify the specific list of capabilities, participatory discussions and intervention are needed (Kleine, 2012). Although this thesis focused on how ICT enhances capabilities through social capital and collective action, it observed some achieved functionings, such as the use of ICT services by people in the community for education, healthcare, and business

purposes. However, this thesis could not measure achieved functionings in detail.

One of the limitations of this thesis could be its use of eclectic theories to explain the link between ICT and development. There is a risk of 'too many cooks spoil the broth'. However, from the perspective of this thesis, social capital is the core lens that connects ICT intervention and human development. The actor-network theory explains the process of social capital formation through technology intervention; at the same time, collective action connects social capital with capabilities, and the capability approach conceptualizes the human development. Therefore, understanding the process of building social capital and its consequences on building capabilities can be one way to reveal the elusive link between ICT and development. The theoretical limitations were inherited mainly from imported theories. One of the obvious reasons is that none of the theories were intended to be used to study ICT4D, or at least they were not intended to understand the process of ICT intervention and human development. These limitations give impetus to indigenous theory building. Theory should be based on a participatory approach and action research, whilst at the same time being grounded in empirical data.

7.3 Further Research

This thesis attempted to demystify the link between ICT and human development by exploring the process of social capital

building, and how social capital can be extended to foster human development. Specifically, it was able to respond to the question: who are the central actors? How do they go about building social networks? How are members enrolled in these networks? And, how do networks in the form of bonding, bridging and linking social capital lead to human development. However, this study did raise questions for further enquiry. For example: Why do actors act the way they do? What motivates or drives them? To examine these issues, it may useful to explore theories that relate to stakeholders or genres of communication.

The topics of project sustainability and comparative impact analysis of projects are also avenues for future research. Although a Sustainability Livelihood Framework is being developed by DFID to investigate long-term sustainability that considers the context of vulnerability, and the influence of social structure and policies with regard to available assets (DFID, 1999; Duncombe, 2006), the role of champions and ICT are not integrated properly. Such framework can be refined and tested by combining it with a stakeholder perspective.

The methodology employed in this thesis is an interpretive case study. This study clearly contributes to the better understanding of the process of ICT intervention and human development. For example, the interpretive approach offers a deeper understanding of the context through ethnographic interviews, observation, and thick description. However, the question arises as to what comes

after understanding. For example, during my field visit people in the community asked me how my research contributes to their socioeconomic development. Therefore, this research can be further extended by attempting action research. In the context of ICT4D research in particular, the role of researchers should not be confined to understanding the problem, but trying to introduce changes as well – 'to influence as well as to inform' (Chambers, 2010, p. 3).

This thesis identified some interesting research areas in the Nepal Wireless Networking Project (NWNP): for example, technical research into wireless technology to connect different mountain villages; the use of computers in schools to improve education quality; the extension of telemedicine projects to connect remote villages with urban hospitals; the use of e-commerce services to create and promote business opportunities (ecotourism, remittance systems, virtual ATM machines), and small-scale industries (yak farming, the paper industry); and e-Government projects. These areas can be further studied by applying research methods such as action-design research (Sein et al., 2011). This method conceptualizes the research process as containing the inseparable and inherently interwoven activities of IT artifact building, intervening in the organization (communities), and evaluating it concurrently.

Based on dialogical reasoning and corroboration of multiple interpretations, this study puts forward a proposition: *Interaction*

among social (context) and technical (content) actors enhances networks, norms and social trust, and thereby builds bonding, bridging, and linking social capital. This social capital promotes collective action, which in turn extends collective and individual capabilities. There are further opportunities to empirically examine this proposition in some specific ICT4D projects.

Finally, as discussed earlier, imported theories inherit caveats; thus, there is a need to come up with some indigenous theories. Whilst the question of indigenous theories in the field of ICT4D has already been raised (Raiti, 2007) further investigation is still needed. These are avenues for future research.

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Appendix A. Examples of interview questions

To understand local context

1. Could you please tell me something about the history, technological change and development of this village?
2. Do the community people believe in this technology? For example, it will bring development in the village?
3. Do you think telecenter can help in social development?

To understand the network formation process

4. Who are the various actors involved in NWNP projects?
5. What are the roles of various actors in NWNP?
6. What is the role of Mahabir Pun?
7. How does Pun enrolled different actors in his endeavor?

To understand social capital

8. Do the people go to other countries? How do they contact you, when they are living abroad?
9. How many types of groups are there in this village?
10. Do you have any exchange with other communities outside this village?
11. How is the relation among these groups?
12. As there are many communities, how is the bonding between these communities?

To understand collective action

13. How do different NGOs, activist (Champions), funding agencies (public, private), telecom authorities, political actors, academician, ISPs, IT consultants, community groups, and IT vendors work together?

To understand collective and individual capabilities

14. What are the impacts of ICT availability in remote communities, such as political (gender issues), social (networking between communities), human (improved skill, better education), financial (remittance and ecommerce), information (what kind of new information can be disseminate), and physical (telecom infrastructure)?
15. How community people are realizing the benefits of ICT availability?
16. How do you visualize the future impacts of ICT availability in remote communities?
17. What is your opinion about Mahabir's wireless project? Do the women benefitted out of it?

To understand the challenges

18. What are the main challenges of villagers in general and Nepal Wireless Networking Project in particular?

Appendix B. Research publications

No	Title	Publication Outlet
1	Devinder Thapa and Ø ystein Sæ bø (2011). Exploring a Link between ICT and Development: A Literature Review	11th IFIP WG 9.4, Social Implications of Computers in Developing Countries, 22-25 May, Kathmandu, Nepal.
2	Devinder Thapa and Ø ystein Sæ bø (2011). Demystifying the Possibilities of ICT4D in the Mountain Regions of Nepal.	Proceedings of 44th Hawaii International Conference on System Sciences (HICSS-44), CD-ROM, pp 1-10, IEEE Computer Society, Kuai, Hawaii.
3	Devinder Thapa (2011). The role of ICT Actors and Networks in Development: The case study of a mountain region in Nepal	Electronic Journal of Information Systems in Developing Countries (EJISDC), Vol. 49, 1, pp 1-16.
4	Devinder Thapa and Maung K. Sein (2010). ICT, Social Capital and Development: the Case of a Mountain Region in Nepal	Proceedings of pre-ICIS SIG GlobDev Workshop 2010, St. Louis, USA, AIS Electronic Library.
5	Devinder Thapa, Maung K. Sein, and Ø ystein Sæ bø (2012). Building Collective Capabilities through ICT in a Mountain Region of Nepal: Where Social Capital leads to Collective Action	Information Technology for Development Journal (ITD), Vol.18, 1, pp 5-22.

EXPLORING THE LINK BETWEEN ICT AND DEVELOPMENT: A LITERATURE REVIEW

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Abstract: The quest of relating information and communication technology (ICT) to development (D) is a topic of open deliberation and critical scrutiny. The objective of this paper is to explore the relation between ICT to 'D', especially when looking at rural and remote communities. Our findings indicate a similar view of the role of ICT in development in academia as well as development organizations. The organizations adopted different development approaches such as; modernization, dependency, neo-liberalism, and post-development, to relate ICT and development. Similarly, academia applied different theories, frameworks, and models to analyze link between ICT and development. In this paper we argue that Sen's capability approach may be a common framework for both academia and development organizations to understand the link between ICT and development. In order to understand how literatures relate ICT to 'D', we analyzed ten empirical case studies focusing on projects in remote and rural areas, utilizing the capability approach as our guiding framework. Based on our findings we suggest six gaps in current research and, accordingly, six suggested areas for future research.

Keywords: ICT4D, Developing Countries, Rural and Remote Communities, Capability approach Literature Review

EXPLORING THE LINK BETWEEN ICT AND DEVELOPMENT: A LITERATURE REVIEW

1. INTRODUCTION

ICT4D is an interplay among 'information (I)', 'communication (C)', 'technology (T)' and 'development (D)' (Heeks, 2007). Information and communication technology (ICT) includes technologies like e.g. radio, internet, television, mobile phones, wi-fi, wi-Max, and information handling materials, such as CD and books (James, 2007). There is a need to understand the conceptualization of ICT artifact to clarify how and why social changes occur due to particular ICT artifacts (Sein & Harindranath, 2004). ICT4D is an multidisciplinary research domain (Unwin, 2009) which integrates wider perspectives of three study areas, such as computer science, information systems, and development studies (Heeks, 2008). Computer science focuses mostly on the technology and potential possibilities, the information system area focuses on issues related to the feasibility and organizational influences by introducing ICT, whereas development studies focuses mostly on what is desirable and what are the consequences of introducing ICT. Scholars in information systems acknowledge that both techno-deterministic and socio-deterministic approaches to ICT4D research have a lack of fidelity, as such; the notion of development is the consequences of interplay between these two (Dias & Brewer, 2009). Technology needs to be designed to be able to operate in a complex social, political, economic and cultural context. Thus, it is important to understand the multi - perspective approach of ICT4D domain (Dias & Brewer, 2009; Heeks, 2008).

The notion of ICT4D was introduced around 1980s. Technology-wise, it progresses through radio, television, Internet and mobile technologies. The dimension of applications proliferates around social, political, physical, natural, human, and financial issues. ICT is considered important to achieve the millennium development GOAL program, introduced by the UN (UnitedNations, 2000) to fight poverty, improve healthcare, provide better education, fostering gender equality, and extend global partnerships for development in developing countries (WorldBank, 2003). Despite an increased number of research publications from the ICT4D area more research is still needed to explore issues like implementation, scalability, sustainability, and macro level impact evaluations (Chapman & Slaymaker, 2002; Dias & Brewer, 2009; Heeks & Alemayeho, 2008), to increase the understanding of the role ICT may play for development. Our research address this call by focusing on how the development perspective is dealt with in project as well as research focusing on ICT- related projects.

There are a plethora of notions symbolizing the concept of ICT intervention and development in the research literature (Kleine & Unwin, 2009). A common perspective is to deploy information and communication technology for development. Development may have various meanings, referring to issues like changes in quality of life, empowerment, enhancing basic capability, equality and poverty reduction. The topic of ICT and development is discussed in development organizations and academia equally. For example, development organizations consider ICT as a means to achieve the Millennium Development Goal (Kuriyan, et al., 2008; Unwin, 2009). Similarly, academics consider ICT as a driver for development together with other factors, such as human, social, political, economical, and physical (Warschauer, 2003).

Some scholars have argued for more research focusing on understanding the link between ICT and development, exemplified by the work done on impact evaluation of ICT4D projects (Heeks & Alemayeho, 2008), or the quest to identify causal relationships between ICT and development (Avgerou, 2003; Avgerou 2008). From an organizational perspective, impact evaluation is

essential to ensure that ICT strategies are relevant, and to keep governments accountable for their implementation of projects (Bank, 2009).

Despite the huge investment each year by the public, NGOs and private sectors in the ICT development projects, only minor impact on remote communities are identified. The rather disappointing results are explained by the lack of political will, motivation, and knowledge on how to evaluate impact of ongoing and initiated projects (Heeks & Alemayeho, 2008). Impact evaluation, when conducted, often emphasizes the measurement of technical and financial aspects, with less concern on potential impact on development issues in broader terms. Some few studies looks into the effects of ICT services through multiple perspectives (Heeks & Shoba, 2009), but still there is a need to undertake a holistic research approach to understand the relationship between ICT and the development process. There is a need to understand the interaction between technology, and social, political, natural, physical, financial, environmental and human capitals (DFID, 1999; Duncombe, 2006).

The role of technology is seemed important in different development paradigms. As we will argue later on (section 3), the emergence of alternative development and human oriented development paradigms have contributed to change the understanding of ICT's role, from a more technical oriented view towards a more social oriented view, focusing on the influence ICT may have on human capacity buildings. For example, Nobel Laureates Amartya Sen's capability approach of development (Sen, 1992) argues that individual substantive freedom is both the primary end objective and the principal means of development (Sen, 2000). The capability approach suggests that impact evaluation may focus on the influence on people's capabilities to do and be, on the quality of human life, and the potential decrease of obstacles in peoples' lives, to maximize everyone's freedom to live and choose the kind of life that they have reason to value (Sen, 2000). Therefore, the capability approach put emphasis on the contribution technologies may have to increase capabilities (freedom and opportunities) of an individual to function in their societies (Zheng, 2009). In this literature review we deploy Sen's model as a guiding framework to analyze literatures and understand complex link between ICT and 'D', this paper scans through eighty articles and presents results in the subsequent sections.

The rest of the paper is organized as follows, Section 2, illustrates the research methodology and discusses potential limitations of the review process. Thereafter, different development paradigm and role of technology is explained in Section 3 & 4. Section 5 and 6 illustrates the link between ICT and development using capability approach framework. Section 7 discusses research gaps and suggests future research areas, before we conclude in section 8.

2. RESEARCH METHODOLOGY

Literature reviews can create a firm foundation for advancing knowledge, by identifying current status, research gaps and where more research is needed (Webster & Watson, 2002). Our selection process was guided by the suggestion made by Webster and Watson (2002). As shown in Table 1, articles were selected using ISI web of science library databases. In addition, to make our literature list more inclusive, we searched the literatures by topic across all relevant journals (Heeks, 2010) instead of some focused journals.

The search, based on keywords presented in Table 1, resulted in literatures from several disciplinary areas. This method generated a list of total 177 references. Thereafter, we performed backward and forward search of the five top most cited papers. We further conducted author-based search on the most cited authors, to make a cross check to confirm that we included probably most of the relevant articles. Although this search generated many redundant results, it extended our reference list to total 202 literatures. The authors independently read and shortlisted titles and abstracts of all the 202 literatures to identify a set of highly relevant ICT4D literature. We excluded the papers oriented towards software development, development in general, and not

focused on third world countries. Based on the most relevant articles we finally selected the 80 papers, which are included in this review.

All literature reviews are based on some kind of selection strategies, running the risk of excluding potentially relevant articles and reports from sources, which is not included. The inclusion of more material might have provided additional information regarding contemporary research in the ICT4D area. Despite these limitations, we believe the selected journal articles provide a good summary of current status in the ICT4D area. There is an open opportunity to validate and elaborate our findings by extending the literature list.

Search library	ISI web of knowledge, ICT4D journals
Keywords	ICT4D, information systems developing countries, information technology developing countries, ICT developing countries
Subject areas	Computer science and information systems, Information systems social science, computer science methods and theory, computer science and interdisciplinary areas and telecommunication
Total Search	202
Selected and Reviewed	80
Language	English
Inclusion/Exclusion	Cross checking: most cited paper, most cited authors, backward & forward search

TABLE 1. Literature review process

3. MEANING OF 'D' AND ROLE OF TECHNOLOGY

To understand how ICT influence and are being influenced by the development context we need to understand 'D', the development perspective (Boateng, et al., 2008), since the design and outcome of ICT4D projects are influenced by the development context (Prakash & De, 2007). Thus, understanding of development theory is important to facilitate and outline development strategies.

Development is a subject of academic and organizational discourse, and there are different competing theories to characterize the notion of development as illustrated in Table 2. Development is generally defined as an organized intervention in collective affairs according to a standard of improvement that varies according to class, culture, historical context and relations of power (Pieterse, 2001).

Up to around 1940 development was synonym to industrialization and colonization (Pieterse, 2001). In development thinking and economics in the post Second World War period, the core meaning of development was economic growth. Later on economic growth was combined with political and social changes and the meaning of development thinking was broadened to encompass modernization. Modernization theory characterized development as displacement of values, beliefs and actions of the traditional societies (Clarke, 2006; Pieterse, 2001). It advocates that development can be achieved through imitating the development strategies and ideologies applied in developed countries, so called 'modern society', into less developed countries to bridge the gap of differences, or to developed to become 'modern'.

During 1960 dependency theory or structuralism came into existence that emphasizes the national or auto-centric economic growth with dependent or national accumulation. Marxism, supporter of dependency theory, viewed modernization as proponent of capitalism, and describe structuralism as a system of antagonistic relations between several social classes, including the capitalist, who owned the means of production and power to appropriate surplus, and workers, who had no power and had to sell their labor. He blamed that capitalism had the potential of increasing the productive capacities within the society, bringing workers together in socialized labor and engaging them in production processes to generate wealth. Marx envisaged, in the long run, that capitalism might

lead to class struggle between capitalists and workers. Consequently, worker would overcome the capitalists and take over the productive capacities, and eventually form new political movements. In between these grand theories of development, the concept of alternative development arose during 1970. It was oriented towards community participation, grassroots politics and human development. Alternative development argues against the capitalism and envisions a post-capitalist world. They advocated that development should be informed by the value of cultural identity, self-reliance, social justice and ecological balance. They envision a post-capitalist world of continued modernization toward a socialist world order, an alternative to the western model of development (Pieterse, 2001).

During the1980s two development theories appeared, namely the Neo-liberalism and the Human Development theories. The concept of Neo-liberalism argues that there are certain institutional constraints influencing market efficiency, and thus contributing to the lack of development (Pieterse, 2001). Neo-liberalism advocates that self-regulated markets and motivated individual entrepreneurs can achieve development. It further argues that market capitalism could offer individuals more opportunities for entrepreneurship and specialization. Neo-liberalism eliminates the notion that developing economies represent something different than other markets. Economic growth is to be achieved by allowing market forces to operate through structural reforms, liberalization and privatization.

The notion of development known as the post-development paradigm (Escobar, 1985) criticizes the whole notion of development. The proponents of post-development argued that development could be contradictory process that generates intended and unintended outcomes far from its promise of development.

Technology, during this developmental transition period, played a crucial role as instruments to achieve economic growth and development (Castells, 2000). As depicted in Table 2, technology at the beginning was seen important for exploring new territories, to extend colonization and exploiting the natural resources. After 1940s the role of technology was boosting industrialization and mass production. During modernization, innovation of new technologies was done for economic growth. Similarly, the role of technology keeps on changing from economic growth to knowledge management. The alternative development paradigm advocated the use of appropriate technology. The purpose of appropriate technology was to preserve local culture and extract indigenous knowledge.

After the arrival of internet and ICT based services in the 1990s, the role of technology changed from a tool view, to a more holistic understand of how technology could act as a central force in the discourse of economic and social development (Castells, 2000; Orlikowski & Iacono, 2001). The new technology allowed "the small and new compete on equal terms with the large and the well-established, and permit leapfrogging to an 'information economy'" (Heeks, 2002a).

All the development theories have their own history and context. Even the perceptions of modernization are different in different nations and communities based on class, culture, historical context and relations of power (Pieterse, 2001). Existing development theories are extended largely state-led (modernization, and dependency), market-led (neo-liberalism) and society-led (alternative development). A prominent definition of development in the contemporary ICT4D discourse is human-centered development based upon the theoretical foundation of Amartya Sen's work on capability approach. In the context of ICT4D project, particularly focused on rural and remote communities, the human development approach (Pieterse, 2001) like Sen's capability approach (Sen, 2000) could be argued to be more relevant, as we will discuss more in the next section.

PERIOD	PERSPECTIVES	MEANINGS OF DEVELOPMENT	ROLE OF TECHNOLOGY
1870>	Latecomers	Industrialization, catching up	Boost industrialization
1850>	Colonial economics	Resource management, trusteeship	Exploration of new territories
1940>	Development economics	Economic growth – Industrialization	Innovation, mass production
1950>	Modernization Theory	Growth, political and social modernization	Mass production Innovation and Increased productivity
1960>	Dependency Theory	Accumulation – national, auto-centric	Creation of domestic product
1970>	Alternative Development	Human Flourishing, Participation	Enhancing local communities and cultures
1980>	Human Development	Capacitation, enlargement of people's choices	Develop human capabilities
1980>	Neo-liberalism	Economic growth-structural reform, deregulation, liberalization, privatization	Enhance Market efficiency
1990>	Post-development	Authoritarian engineering, disaster	Strengthen localization, extract indigenous knowledge

TABLE 2. Various development perspectives and roles of technology, adapted from (Pieterse, 2001)

4. CAPABILITY APPROACH (CA)

The capability approach is a broad framework for the evaluation and assessment of individual well-being and social arrangements, the design of policies, and proposals about social change in society (Robeyns, 2005). The major constituents of capability approach are "functionings ('beings' and 'doings')" and "capabilities". Functionings are well-being, whereas, capabilities are opportunities and freedom to achieve those functionings (Sen, 1992). Sen criticized the individual and social evaluation based on such variables as primary goods, resources or real income. He mentioned these variables a means rather than ends to freedom (Sen, 1992) and argues that individual substantive freedom (capabilities) is the primary end objective and the principal means of development (Sen, 2000). The UNDP has adopted such basic insights from capability approach and formulated statistical measures of human development based on it (Robeyns, 2005), for example, human development index (HDI), gender development index (GDI), gender equity measure (GEM), and human poverty index (HPI).

In terms of ICT4D research, the capability approach put emphasis on the contribution technologies may have to increase capabilities of human beings to function in their societies. For example, in addition to providing ICT services there is a need to create social and institutional environment so that poor and needy can access and assess information, build knowledge, and take decisions, in other terms, enhance their basic capabilities. The capability approach calls for an alternative e-development beyond the space that centers on economic growth or modernization (Zheng, 2009). Alternative e-development should focus on the space of substantive freedom where ICT may add to development by influencing change in quality of life through innovation and diffusion of human oriented technologies. Thus there is a need to add knowledge from other research disciplines besides welfare economics and development studies, like information systems area, to understand how ICT relates to development through capability approach (Zheng, 2009).

This paper utilized Sen's CA framework to analyze the selected articles and to understand the link between ICT and development. As shown in Figure 1, capability approach makes a distinction between *means*, such as ICT artifacts and services, on the on hand, and functionings *ends*, such as education, healthcare and social capital, and capabilities (freedom and opportunities to achieve functionings) on the other hand. The basic importance of resources, such as ICT services, is needed to enable people to do and to be. Goods and services refer here not only to exchangeable for income or money, but the characteristics, which interest to people. For example, setting up

telecenter in the village doesn't make difference if they cannot provide the localized contents to the community people, though telecenters are essential as well.

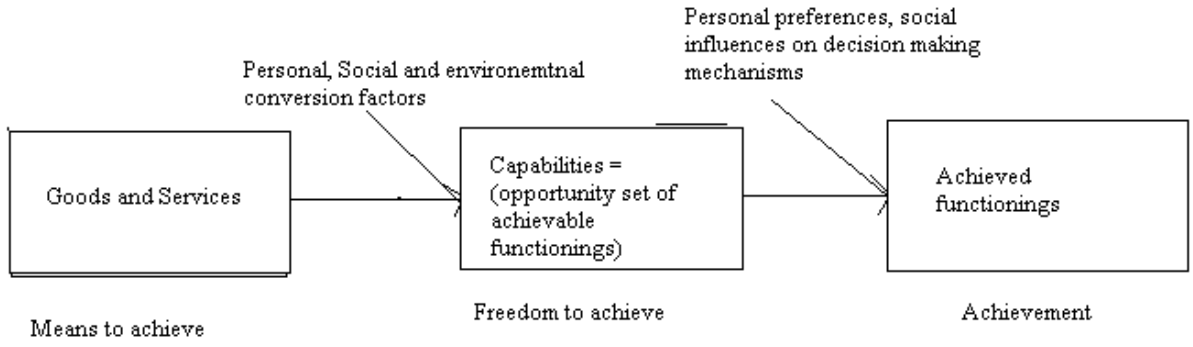

FIGURE 1. Core elements of capability approach (figure adapted from Robeyns, 2005).

Three groups of conversion factors *personal, social,* and *environmental* influence the relation between *commodities* (goods and services) and the *functionings* to achieve certain beings and doings (Sen, 1992). Personal conversion factors denote the personal characteristics, such as physical conditions, sex, reading skills and intelligence to convert commodities into a functioning. For example, an illiterate users cannot use the text based user interface (Medhi, et al., 2007). Social conversion factors are features like social norms, public policies, gender roles, caste systems and power relations. For example, priorities of dominant caste groups may determine information systems design and implementations that leads to the exclusion of marginal and non-dominant castes (De', 2009). Likewise, environmental conversion factor means geographical location, climate, and infrastructure. The *achieved functionings* is the combination of means to achieve, freedom to achieve them, and personal preferences and social influences on decision making mechanisms (Sen, 2000).

5. CONTEMPORARY RESEARCH ON ICT4D

Based on the presentation of various development perspectives we will now discuss how current research on ICT4D is approaching the link between ICT and Development, the main objective for this paper.

ICT4D research focuses on different subjects such as diffusion of ICT artifacts (Oyelaran-Oyeyinka & Lal, 2005), infrastructure building and implementation of ICT services (Braa, et al., 2007; Braa & Hedberg, 2002; Klosterman, 1995; Kshetri, 2007; Madon, et al., 2007; Meso, et al., 2005; Meso, et al., 2009; Sahay, et al., 2009; Walsham & Sahay, 1999), impact evaluation of ICT intervention (Daly, 2000; Kanungo, 2004b; Kumar & Best, 2006; Lee, et al., 2005; Thapisa, 1996; Thorpe, 1984; Wang & Chien, 2007), linking ICT and development, (Avgerou, 2003; Boateng, et al., 2008; Johnstone, 2007; Ngwenyama, et al., 2006; Urquhart, et al., 2008), and digital divide (Cullen, 2001; James, 2005, 2007; Warschauer, 2003). Researches related to implementation issues analyze the different social and technical factors as well as actors that impede the implementation process. Several authors argue that ICT4D projects may suffer if socioeconomic, political, cultural, and financial factors are ignored (Kraemer, et al., 2009; Lishan & Wood, 1999; Thapa & Sæbø, 2011). Likewise, diffusion of the ICT products and technologies from one pilot-study to a broader context might be obstacle by focusing on more on technology and vision, ignoring other socio-cultural, political and economical factors (Kraemer, et al., 2009).

Studies indicate that inaccessibility of Internet is enhancing the digital divide between those with access and those without. Different factors, such as various access to telecommunication infrastructure, education and employment opportunities are increasing the digital divide (Cullen, 2001). Proponents of ICT4D in academia suggest that concept of digital divide should be re-

conceptualized to widen the perspectives to include not only technological gaps, but also the intersection of socio-economic factors, gender, age, language, geographic location, various cultural dimensions, inadequate infrastructure and shortage of manpower (James, 2005; Johnstone, 2007). Broader term of digital divide may also include cognitive issues such an attitude of community people towards technology and their daily usage patterns (Cullen, 2001; James, 2007; Warschauer, 2003).

Existing research explained how numerous projects of ICT innovation in developing countries failed to achieve anticipated benefits (Corea, 2007; Heeks, 2002b). Some of the factors identified are poor management, resistance to change, and complex power structures (Silva & Hirschheim, 2007). Not only for impact analysis, but also for the successful penetration of IT artifact in the developing countries, socially oriented implementation policies have been recommended (Braa, et al., 2007; Heeks & Stanforth, 2007; Walsham & Sahay, 1999).

Different theories and frameworks has been introduced to understand the ICT4D projects, such as Structuration theory (Barrett, et al., 2001; Madon, et al., 2007; Sahay & Walsham, 1997), eCommece model (Boateng, et al., 2008; Kshetri, 2007), Social Capital (Díaz Andrade & Urquhart, 2009; Urquhart, et al., 2008; Yang, et al., 2009) Communities of practice (Puri, 2007), livelihood approach- sustainable framework of analysis, Information Chain (Heeks & Kanashiro, 2009), Complexity Science (Braa, et al., 2007), and Actor-network theory (Braa & Hedberg, 2002; Braa, et al., 2004; Gao, 2007; Heeks & Stanforth, 2007; Sahay, et al., 2009; Walsham & Sahay, 1999). However, there is a call for undertaking more empirical studies to understand how such projects influence the societies (Avgerou, 2003; Boateng, et al., 2008; Heeks, 2008), particularly, in the context of rural and remote communities (Aitkin, 2009; Díaz Andrade & Urquhart, 2009; Heeks & Kanashiro, 2009).

Multiple research methodologies are also introduced in the papers investigated. Both qualitative and quantitative research methods (Kalu, 2007; Kraemer, et al., 2009; Meso, et al., 2009; Walsham & Sahay, 1999) are utilized to understand the local context, and socio-cultural issues. Quantitative methods are used to identify how different factors, such as internal capacity building, enhanced public access to information, and technology infrastructure affects the successful implementation of ICT services. Quantitative techniques are helpful to identify causal relationships, but it may not be sufficient to deliver rich data that are necessary to build theories explaining complicated phenomena, such as interaction process between ICT and social capital and its consequences for development (Urquhart, et al., 2008; Yang, et al., 2009).

Studies appeals for more research required understanding the 'D' part of the ICT4D (Avgerou, 2003; Heeks, 2007; Sein & Harindranath, 2004; Unwin, 2009). Misalignment between development context and the design and implementation of the ICT4D project may lead to project failures (Heeks, 2002b; Prakash & De, 2007) and, consequently, little or no impact on the development of the local communities.

6. EMPIRICAL CASE STUDIES ON RURAL AND REMOTE COMMUNITIES

In order to explore how the capability approach may be used to analyze ICT4D projects, and to learn the context of rural and remote areas more in depth, we examined ten of the research papers more in depth. We employed an evaluative lens based on Sen's theory of capability approach, as discussed earlier the capability approach can be used as a common framework to relate ICT and development. The examination reveals the primary objectives of ICT4D projects, the opportunities (capabilities) they provide to the community, and the conversion factors that hinder achieved functionings. Due to space limitations the analyzes are summarized briefly in table 3, below.

Case	Papers	ICT4D Objectives	Conversion Factors	Capabilities (opportunities)	Achieved Functioning
	(Heeks & Kanashiro, 2009)	To support cultural, economic and social development	Lack of specific execution plan, lack of relevant information as well as assessment ability, lack of transportation and other resources, low self-efficacy in women and older people, lack of technical knowledge and skills, lack of local participation, lack of income generating activities	Provide technical trainings Raise awareness Produce local content Promote tourism Sharing information Extend social network	(Face- to-face communication because of language barriers) Reinforced bonding social ties Facilitated positive information flow
2	(Díaz Andrade & Urquhart, 2009)	To provide timely and useful information to local farmers, businessmen and government agencies to build up capabilities for local development	Lack of physical infrastructure such as roads, electricity, telephones, water, etc., lack of educational opportunities, gender problem, lack of reading habit, lack of income generating activities	Provide opportunity to develop individuals skill and knowledge Sharing information Extend social capital Strengthening institutions	(Priority to farming rather than learning and using computers) Facilitated human capital building process Sharing information Extended social capital Institutional development, such as peasant organization
3	(Donner, 2006)	To develop business and social contacts (micro-entrepreneurs)	Education, higher cost, telecommunication infrastructure, Innovations	Extending and reinforcing existing business and social networks, flexibility of time and space	Micro-entrepreneurs reinforced their social ties and facilitated new contacts with business partners, suppliers, and customers
4	(Jensen, 2007)	To reduce price dispersion and waste (Fishermen)	Lack of information and transportation infrastructure	Improved functioning of markets	Increased earnings and purchasing power
5	(Walsham & Sahay, 1999)	To aid wasteland development using GIS technology	Cultural (e.g. lack of tradition for using maps), political (power dynamics), social (lack of education and technical skills), economical (cost)	Wasteland management, provide platform for analysis and action in the environmental arena	(Cultural ideology, social preferences and security issues in decision making process)
6	(Kumar & Best, 2006)	To provide computer education, e-government services and health services	Age, gender, religion, caste, income, ownership of household assets, educational level, political and institutional support	E-government services such as birth certificates and old age pensions, computer education	(Social norms – women lacks decision making powers, community perception) Information sharing
7	(Duncombe, 2006)	To reduce poverty	Social, human, geographical, financial, political, physical, natural, public and private institutions	Improve information and communication, such as access to training/new knowledge, information about finance, information about technologies, and information about natural resources	Information sharing
8	(Kanungo, 2004a)	To avail social and economic emancipation	Political and social factors, poor information infrastructure, women literacy,	Provide access to capital and support services, foster group action, access to vital information, participation, Training opportunity	(social constraints on women participation) Extended information channel, value-added information, local commerce opportunities, informed about government programs, enhanced participation
9	(Medhi, et al., 2007)	To design text-free user interface for illiterate and semi-literate users	Illiteracy, low income level, language	Job search for domestic laborers, generic map of the city	(cultural, religious and psychological factors) Job search information Provide geographic information
10	(De & Ratan 2009)	To improve field-level microfinance operations	Political issues, technology, human actors	Efficiency enhancements and transparency	(User self-interest and social context influenced the achieved functions), Reduced transaction costs

TABLE 3 RESEARCH FOCUS SUMMARIZED IN ICT4D PAPERS FOCUSING ON ON RURAL AND REMOTE COMMUNITIES

Our analyses identifies how the ICT4D projects were initiated with the objectives of contributing to social, cultural, economic, human, and political problems, like the reinforcement and extension of social ties and building human capital, providing computer education and e-government services and reduce poverty. The projects, however, faced different obstacles (conversion factors), such as illiteracy, poverty, lack of physical infrastructure and political pressures that hinder the relation between ICT (means) and capabilities (freedom to achieve).

Individual preferences, such as priority to farming rather than learning computers and social and cultural ideologies, such as women roles in decision-making process may also affect the achieved functioning. The summary shows that social, cultural, religious, political, and economical context are important while designing ICT4D projects. The common achieved functioning of all the projects is access to information and communication services, which can be helpful in creating social and human capital in remote communities.

7. GAPS IN EXISTING RESEARCH AND FUTURE RESEARCH DIRECTIONS

Based on our analysis we identified six research gaps and, accordingly, six future research directions, summarized in Table 5.

First, there is still a need for more knowledge on the link between ICT and the Development, "D". Even though several researchers emphasize the need to understand this connection (Avgerou, 2003; Nair & Prasad, 2002; Urquhart, et al., 2008) , little is done to address this call. A main reason why this is not addressed so far is the difficulty to identify and isolate factors that explain how ICT contributes to development, since there is an ongoing interplay between ICT and other factors, such as social, cultural, political and economic related issues. Therefore, future research is needed to identify challenges and potential benefits of introducing ICT for development. We argue a stepwise approach is needed to address this call. First, there is a need to understand interaction processes between ICT and social, organizational and economic factors. The understanding of ongoing processes and interaction could be a first step towards better understanding of the outcome of implementing ICT in a developing context. Several research strands and approaches may be introduced to understand the interaction and interplay between various factors. For example, by combining social capital (Urquhart, et al., 2008) and capability approaches (Ibrahim 2006; Zheng & Walsham 2008) with actor network theories (Walsham, 1997; Walsham & Sahay, 1999), we may increase the understanding of social changes and the role of various stakeholders and technologies.

Second, there is a need to clarify and explore the concept of development in the ICT4D research area. We argue there are two major reasons for why this is important. To be able to understand differences and similarities across several research projects, we need to know to what extent these projects shares objectives and aims. So far, the magic "development" part is sometimes introduced like a black box, without considering how various objectives influence projects design, implementation, use or effects (Prakash & De, 2007). Thus it is difficult to compare and learn from one study to another, which is essential to build a cumulative tradition in the research area. Moreover, more research is needed to identify how various views on development influence project outcomes. Future research should also investigate stakeholders' views on development; hence, to what extent they share objectives and visions. Future research may for instance investigate the views of different stakeholders like donors, project owners, developers and project users, may increase our understanding of how various views on development influences project outcomes.

Third, social-cultural issues like de-politicization, corruption, caste structures and context-dependent power structures are so far less investigated in the ICT4D area. Such social-cultural factors may help to explain the failure and successes of such projects.

Fourth, current research in the ICT4D research area is mainly conducted in sub-Saharan countries, India and Latin America. More research is of course still needed from these regions, but since huge areas in the developing world is not investigated, the common understanding of concepts, challenges and opportunities in the ICT4D area may be based only on some few areas, without considering contextual differences between these regions and others, like for instance developing Arabic countries and other countries in Asia, such as e.g. Nepal. More research is needed to understand challenges, opportunities and contextual issues from a wider variety of countries in the developing world. More research is also needed focusing on mountain regions, where one third of the world population resides (Heeks & Kanashiro, 2009).

Fifth, there is a need for more research on digital divide introducing on a broader understanding of the concept. Current research focus mainly on issues related to literacy rate, education and economy. By investigating issues related to e.g. gender and rural versus urban areas, the ICT4D area could gain a more coherent understanding of digital divide related issues, hence increased opportunities to design and implement and organize ICT systems able to address such barriers.

Finally, the ICT4D research literature is so far dominated by case studies. Such studies are clearly needed to explore and explain the complexity in ICT4D projects. The above discussion of research gaps and identified areas for further research do actually call for the use of qualitative research methodologies to gain a broader and wider understanding of issues related issues like digital divide, social-cultural aspect and various view on development. However, to identify causal relation between ICT and Development, our literature review clearly indicates needs for more quantitative research to be able to generalize and compare results to develop a cumulative tradition. Moreover, there is a need to conduct more studies using mix-method approaches, to combine e.g. in-depth understanding of the concept studied and generalization to population investigated (Kaplan & Duchon, 1988; Orlikowski, 1993).

For a research field to progress it is essential to develop a broad understanding of the phenomena studied, and introduce methods and common concept to extend a cumulative tradition. Our analyses, identified research gaps, and suggested areas for further research is a step to guide future research opportunities based on a synthesize of current knowledge.

Identified Research Gaps	**Suggested areas for future research**
Missing understanding of the relationship between ICT and development "D"	Investigate the interaction between these components before focusing on outcomes. Theoretical lens of social capital can be a better interpretive lens
View on development is only implicitly stated, missing knowledge on how various views influence projects.	Clearly state the development perspective, explore views on development from various stakeholders in ICT4D related project
Socio-cultural issues less emphasized	Explore the influence of issues like corruption, de-politicization and caste-systems
Part of the developing world and mountain regions are not included	More research focusing on other part of the developing world and on mountain regions
Only some characteristics related to digital divide are investigated	Broaden the concept of digital divide by including issues like remoteness and gender
Missing diversity concerning research method, theories and frameworks used	Diversify selection of methods, including mix- method approaches and action research; deploy theories and framework to understand causal process of socio-technical interaction and its consequences on socio-economic development.

Table 5. Research gaps and future research directions

8. CONCLUSIONS

Until 1990s researcher were more tended to focus on development and ignore the ICT or isolate the ICT from mainstream development into separate policies and ministries (Heeks, 2008). However, it is apparent in the contemporary society that there is a strong interplay between ICT and society, and it influences the development (Huysman & Wulf, 2006; Johnstone, 2007; Lamb & Kling, 2003; Ngwenyama, et al., 2006). There is a gap in existing literatures of ICT4D domain to denote these issues. Therefore, in this literature review, we aimed to identify the role of ICT in socioeconomic development of developing countries. We reviewed 80 research articles and found that linking ICT to 'D' is a common topic of discussion among development organizations and academia. We propose that Sen's capability approach may be a common approach for both practitioners and researchers to understand the relation between ICT and 'D'. To illustrate the relation, we selected ten papers that discuss empirical case studies and analyzed their development context, based on Sen's model. Finally, based on the overall literature review, we identified six gaps in current research and, accordingly, suggested six areas for future research.

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Demystifying the Possibilities of ICT4D in the Mountain Regions of Nepal

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Abstract

Despite the substantial investments in ICT4D projects in developing countries, the benefits are yet to be realised by the majority of remote communities. Inaccessibility to ICT has widened educational, healthcare, information, and communication gaps between urban and remote communities. This paper focuses on an interpretive case study in Nepal to widen our understanding of how locally-initiated ICT4D projects may help to narrow these gaps. The study utilises the Assets Pentagon Model to identify the strengths and challenges of the Nepal Wireless Networking Project in the mountain areas, and to identify implications for research and practice based on insights from the case.

1. Introduction

Remote communities of mountain regions in developing countries are among the poorest, most inaccessible and most excluded in the world, though they are rich in natural resources [1, 2]. They are facing social, political, and economic exclusion from the key systems of development [1]. The current global information explosion has little impact on development activities and access to practical information for remote communities in developing countries [3]. Despite the massive rate of telecom penetration in the urban areas, IT services still remain far short of meeting total demand and serving these areas. For instance, there are more than 1000 Internet access points all over Nepal, with around 90% of these located in urban areas, whereas only around 15% of the total population lives in such areas[4]. The distribution of ICT services in terms of geographical dispersion has been heavily skewed in favour of urban areas[4, 5].

The availability of Information and Communication Technology ICT in a remote community is significant to facilitate the flow of information and knowledge that provide an opportunity to connect them with the main streamline of development. The implementation of ICT4D projects can facilitate these communities to undertake development activities [6-9]. The reduced cost of installing ICT infrastructure has enhanced the possibility of technology diffusion in these areas. Studies show that ICT intervention can serve community development needs [10, 11]. It is broadly agreed that ICT can play an important role in the development of remote communities [1, 5, 10]. Some of the examples are the Kothmale project in Sri Lanka, the ERTIC project in Peru, and the InfoDes project in northern Peru. The Kothmale project through ICT is helping remote communities to connect with urban communities[3]. Similarly, the ERTIC project in the mountain region of Peru shows that ICT projects can be instrumental in overcoming remoteness and social exclusion problems[1]. Furthermore, Diaz and Urquhart argue that ICT projects such as InfoDes, can be helpful in creating social capital vis-à-vis human capital in remote communities[12].

In the absence of systematic research in these remote places, the actual outcomes of ICT4D projects are unidentified [1, 12]. Few studies have addressed the issues of the opportunities and challenges of ICT4D projects in mountain areas [1, 5, 10, 12]. There is a need to understand the multidimensional opportunities created by the ICT projects [13, 14]. We need to explore both within the communities which are directly affected by the intervention, and within an expanding context surrounding those communities[15]. To contribute to this research context, we conducted an interpretive case study [16, 17] to explore the multidimensional challenges and perspectives of the ICT4D project in the mountain region of Nepal. We deployed the analytical lens of the Assets Pentagon Model [18] to understand the multidimensional possibilities of the Nepal Wireless Networking Project (NWNP) in the Myagdi district of Nepal. This Pentagon model is also useful to explore the inter-relationships between different assets.

The organisation of this paper is as follows: section 2 discusses the theoretical framework; section 3 illustrates the research background, context and methodology; section 4 & 5 discuss the research findings and challenges of the NWNP respectively; and

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section 6 concludes the paper with a discussion and implications.

2. Theoretical Framework

In order to understand the multidimensional potential of the ICT4D project in the Myagdi district of Nepal, we deployed the Assets Pentagon Model[18, 19]. The Assets Pentagon is a core component of the Sustainable Livelihoods Framework [18]. It is composed of five capitals: *financial capital, human capital, physical capital, social capital,* and *political capital* [18, 19]. Research shows that the implementation of ICT4D projects creates multiple opportunities[11, 18, 19]. These opportunities are intertwined and interdependent. Any of the single capital of the Assets Pentagon Model can be a necessary condition for development; however, not a sufficient condition. Therefore, to achieve overall socio-economic development, contribution from the five capitals is a prerequisite. The assets pentagon is also useful to illustrate the inter-relationships between the various assets. Our findings show that political capital, such as government support, political stability, and social inclusion, are core challenges of ICT4D projects. Therefore, we explore the perspective of *political capital* rather than natural capital, in keeping with the argument made by Heeks and Shoba [19].

Social capital is the genre of social resources upon which community people draw in pursuit of their livelihood objectives; mainly conceived as *networks* and relationships based on *trust, reciprocity* and *exchanges*[19, 20]. Social capital influences the other four capitals, for example, by improving the efficiency of economic relations. Social capital can also help increase people's incomes and rates of saving (financial capital). Likewise, by creating bridging social capital, it can facilitate social inclusion, and assist in accessing the collective resources (political capital). It can help community people to maintain shared ICT infrastructure (physical capital). Furthermore, social networks facilitate innovation, the development of knowledge and the sharing of that knowledge. There is, therefore, a close relationship between social and human capital[18].

Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods. Access to information or communication is one essential of physical capital. The opportunity costs associated with poor infrastructure can preclude education, access to health services, and income generation. For example, providing telecom infrastructure can enable the remote communities to access information and communication services; likewise, telemedicine services can provide cheap and time-saving healthcare opportunities. Physical capital can provide the accessibility and shareability choice to create social and human capital.

Human capital represents the skills, knowledge, ability to labour, and good health that together enhance people's capability to pursue different livelihood strategies and achieve their livelihood objectives. For example, improved access to education and training through distance learning programmes, and the potential to transfer digital content to remote locations easily in the form of text, images, video, and radio can help community people in the process of relevant knowledge generation[11]. Human capital is one of the core components of the assets pentagon as it is required to make use of four other capitals[18].

Financial capital denotes the financial resources that community people use to achieve their livelihood; for example, revenue generation through selling agricultural products, eco-Tourism, and remittances using ICT services and at the same time save transaction costs by buying agro products, and getting immediate medical services using the ICT platform. Financial capital is important for the long-term sustainability of ICT4D projects.

Political capital represents the political stability, government support, and pro-poor IT policies for remote community development. Political capital can be formed by including women and marginalised groups in the villages[19]. ICT services such as eGovernment, eCommerce, and telemedicine projects can help to form political capital. The political capital assists the macro-level policies and their effective implementation for development.

3. Research Background, Context, and Methodology

3.1. Nepal

Nepal is a landlocked country situated in South Asia, on the southern slopes of the Himalayan mountain range, between the two giants India and China. The territory comprises three main geographical regions; the Terai (flat river plain of the Ganges, 17%), the central mountain region (64%), and the Himalayan region (19%). Nepal, with its 27 million inhabitants, is divided into five development regions, 14 zones, and 75 districts. Around 4000 village development committees (VDCs) comprise the administrative unit below district. About one third of the total population lives in rural and remote areas. Agriculture and tourism are the key economic sectors of Nepal. About 42% of the population lives below the national poverty line. The literacy rate in Nepal is around 55% in which,

Nepali (national language) is 82% and English is approximately 18%. Computer ownership per 100 inhabitants is 2.80, and telephone lines per 100 inhabitants are 3.5 [21].

3.2 ICT Profile of Nepal

Most of the Internet Service Providers' subscribers and users are concentrated in Kathmandu (capital city). Likewise, tele-density data are less than one per hundred in rural areas, while it is around 15 per hundred in urban areas. Around two-thirds of the telephones are in the Kathmandu valley [22].

The Nepal government formulated an IT policy in 2000, which has been renewed in 2010. The policy offers a vision of putting Nepal onto the global IT map within the next five years[4]. The Nepal government has installed around 300 telecentres all over Nepal as part of the ICT4D projects. However, they are mostly concentrated in the city areas and district headquarters. They are more focused in the eastern and southern parts of Nepal where the density of the population is much higher in comparison to the population density of the north-western part of the country. Most of the remote communities have no internet, email, or IP telephony services. Some remote communities are using internet services; however, they are operated by community initiatives using local VSAT technologies. Even remote places just outside of capital cities are not connected through internet services[23].

3.3. Nepal Wireless Networking Project

The NWNP was initiated in 1997 by educationist and social activist Mahabir Pun. Since 2003, this project has been in full-fledged operation. It is situated in the Myagdi district of Nepal. Despite difficult circumstances, such as lack of government support, lack of funding, lack of technical knowledge, and an unstable political system (Nepal was in fact involved in a civil war between the government and the Maoists when the project started), the project succeeded in providing internet service with minimal wireless technology (meant for private networks), home-made antennas, and relay stations, that had to be hidden in trees at an altitude of 2,700 meters.

The project was initiated to reduce migration from remote areas to urban areas and abroad. After several years working as a social worker in the Myagdi district, Pun identified two major reasons for the migration. First, the health care system is really poor (or non-existent); uneducated "village ladies" are responsible for providing health services in the villages, and there might be several days of walking to get to the nearest doctor. Second, there is no education offered in the mountain areas, and a lack of work for well-educated candidates. Due to lack of decent roads in the mountain areas, lack of trained personnel (such as doctors and nurses) in Nepal, and low status and salaries in the villages, Pun argues that you cannot bring teachers and doctors to villages. Thus, the only opportunity from his point of view is to empower the villages by introducing communication opportunities, to "get service to the people, not people to the services".

The NWNP is working with Open Learning Exchange (OLE) Nepal, an NGO based in the US and Kathmandu, as a partner to develop educational contents for the school children. The contents are based on the government curriculum from grade one through ten. In addition, the NWNP is in the testing phase of using the network for online-based learning. The objective is to provide further education for youngsters living in the villages.

To address the challenges of bringing specialist doctors into the mountain villages, the NWNP has initiated telemedicine services in some villages of the Myagdi district. Every morning, the village ladies (being responsible for health care services in the villages) consult doctors from main hospitals using videoconferencing services, to discuss patients, common diseases or to learn from doctors and village ladies from other communities.

Studies show that for the sustainability of any ICT4D project, income generation activities are important [1, 24]. To generate employment opportunities, the NWNP is working on developing an eCommerce platform in collaboration with Gandaki Software Engineering College, Pokhara. In addition, it is planning to start a remittance service in the remote area because most of the family members from remote communities go to work abroad. Moreover, virtual ATM machine services are being piloted in Ghore Pani (a famous trekking route for tourist), which will be further distributed to other tourist areas.

Pun received the Magsaysay Award in 2007 for implementing this wireless project in the mountain region of Nepal. Currently, the NWNP has built networks in 42 villages of Myagdi and other districts, and has been partially provided financial support by the World Bank and Nepal Telecommunication Authority. The NWNP's vision is to provide all remote villages of Nepal with Internet services to help to contribute to socio-economic development.

3.4. Research Site

The chosen location for this research was the Nangi and Tikot villages in the Myagdi district, located

in western Nepal on the southern flank of the Annapurna and Dhaulagiri ranges of the Himalayas. The total population of these villages is around 2,000 people and the elevation is over 2,000 meters. People have to go to urban areas to procure employment, education, and healthcare services. Tikot is not accessible by road. From Nangi, it takes about four hours by jeep or one day walking to the nearest town of Beni. From Beni, there is another seven-hour bus ride to reach the capital city where there are hospitals and universities. These villages are inhabited predominantly by Magar ethnic communities including other minority castes and social groups [25], and the community people in these villages still practice shamanistic rituals. They are respected as traditional doctors and healers. Most of the villagers are farmers who grow mainly potatoes and other agricultural products. One common employment opportunity is to join the military service in India or the UK because the army service does not require a high level of education. Furthermore, youngsters go abroad to work in, for example, the construction business in neighbouring countries. Thus, the main source of revenue is remittance from family members working outside the villages. Sometimes they also sell agricultural produce such as milk products and potatoes.

3.5. Data Collection

The explorative nature of this research consider that "Research is a continuous process of data collection, followed by analysis and memo writing leading to questions that leads to more data collection"[26]. The research data was collected through interviews, focus group, workshop, note taking, observations, web information, and still and video pictures. Secondary sources of data, such as various reports, were also included. To obtain the primary data, a sample of 40 community people was interviewed from two villages. We interviewed ICT service users, such as teachers (aged 30-40, males), social activists (aged 30-60, males, and females), health workers (aged 30-40, women), students (Standard 11-12, aged 16-18, girls and boys), and non-users, such as drivers, SME workers, retired army personnel, and farmers.

A semi-structured guide was used for the individual interviews, each of which lasted from 15 to 55 minutes and was tape-recorded. Individual interviews helped this study to understand the individual perspective of ICT4D prospects and challenges, at the same time, to understand the collective views, we conducted focus group interviews with teachers, activists, and experts, such as Director of Nepal Telecommunication Authority, Joint Secretary of High Level Commission of Information Technology, and Directors of Borderland Travels and tours, ENRD, OLE Nepal, and Thamel.com. The observation of ICT usage was conducted in schools, telecentres, and village telemedicine clinics. The objective of observation was to understand the pattern of usage and the technical performance of ICT devices, such as wireless services and telemedicine equipments. Pictures and videos were used to portray the socio-cultural context. In addition, supplementary data were obtained from different relevant Internet sites, informal discussions, email exchanges, social networking sites, different websites of ICT4D projects, and a ICT4D workshop in Kathmandu.

The ICT4D workshop attracted around 30 participants, composed by researchers, practitioners, experts, medical doctors, government officials, telecom director, teachers, students, and members of the Nepal Wireless Networking Project. The idea of the workshop was to collect more data and understand the ICT4D possibilities and challenges through the experiences shared by different stakeholders in general, and to synthesize and triangulate our findings from the two villages.

3.6. Data Analysis

We analysed the data collected through interviews, observations, note taking, and workshops. All the interviews were transcribed, summarised, coded and categorised [27] using the nVivo tool with respect to the multidimensional prospects and challenges of the ICT4D project in mountain areas. The analysis started with open coding and categorizing the data. All the coding done by two authors were verified, invalidated and synthesized. Thereafter, based on the relevance of the concepts we created the sub-categories keeping Asset Pentagon as a guiding framework. Furthermore, two core-categorise opportunities and challenges added. The categorization process was based on the iterative process of moving around data, concept, and categories as Klein and Myers suggested[28] in their principle of evaluating interpretive field study.

Finally, we made connection between data and sub-categories, vis-à-vis sub-categories and core-categories. Regular discussions with other researchers and practitioners were attempted throughout the project to check the reliability and validity of interviews and interpretation. Different background of researchers as one of the researchers was from a remote community of Nepal, their knowledge and experience as an insider and outsider helped with understanding the reality of the research context based on critical perspectives.

4. Research Findings

Both the Nangi and Tikot villages have started to use computers actively in schools, and to provide Internet access to other citizens in the afternoons. Further, they are using telemedicine services, and have initiated some income-generating projects utilising the potential brought to them by being connected. We will use the Assets Pentagon Model to further illustrate the potentials of the NWNP in the Nangi and Tikot villages.

4.1. Social Capital

The notion of social capital is to extend the network and relationships based on trust, reciprocity, and exchanges[20, 29]. The NWNP has provided an opportunity to extend their social network. At present, villagers are using the internet for communication purposes. People from the villages who are working abroad are using e-mails to communicate with their families who remain in the villages. Students and teachers are offered web mail accounts through the project, while others are using free web mail accounts such as Yahoo and Gmail. There is a bulletin board for local news, local advertisements, announcements, and urgent messages. While interviewing a school principal, he said:

It [NWNP] has increased the dimension of communication. For non-students, the communication patterns have been somewhat changed, for example, by providing faster communication opportunities. But in the case of students it has been drastically changed. They are using social networking services to make a lot of friends. Likewise, we have a lot of volunteers from other countries with different nationalities and cultures. We can have cultural exchanges, building friendships with them. The dimension of communication has been altered.

Teachers and students are getting access to some educational materials that the NWNP has put on the intranet. Students from high schools are using the network to write e-mails to each other and to their pen-pals abroad. In the past, the students used to send letters to their pe n-pals through "snail mail" which used to take months. Now they can communicate in real time no matter where they are located. A village activist explained:

Regarding the social impact, we are not in a position to say that it has a solid role in development; however, the perspective of the village people regarding the computer and its usage is changing. They are at least using email and chat for sending and receiving message to/from their relatives in foreign countries.

The community people of Nangi are running a cross-breeding project between Yak and Cow. It is situated at the higher altitude of 3,200m from the Nangi village. Due to the internet connection, the management committee of the projects can communicate with each other through NetMeeting in order to make appropriate decisions for the projects.

The health workers from the Nangi and Tikot villages argue that telemedicine assists in the development of trust among village people due to the virtual presence of doctors. A doctor associated with this project said:

Particularly in the villages, people are afraid of diseases. When they see a doctor in front of the camera prescribing them medicines, they feel confident, they feel psychologically confident.

4.2. Physical Capital

The NWNP has facilitated the development of physical capital in these villages, such as Wi-Fi stations, telemedicine centres, and telecentres. Many people living in these villages, including all school children, are able to use computers and, to some extent, utilise online opportunities. Such competence is currently rare in most remote communities in Nepal. One of the teachers expressed his feelings on the matter:

There are a lot of benefits to using computers in this village. There are many places in which children have not seen computers, but in this remote village, children are able to use and feel the new technologies. They are able to read updated news, and some are busy playing games. To enjoy playing games on computer is also a breakthrough achievement for them.

Besides providing communication facilities, the NWNP has set up a telemedicine centre in these villages. Local health workers are communicating with medical doctors in Pokhara or Kathmandu for medical assistance. The village health workers facilitate communication between the doctor and the patient and provide the medicine prescribed by the doctor. A health worker in the Nangi telemedicine centre said that:

Here we have a small clinic where two sisters are working. If they face any difficulties or emergencies, then they connect directly to Kathmandu or four to five other main hospitals and consult with the doctors there.

The team leader of the NWNP project explained about the telemedicine project that:

It is difficult to get specialist doctors to go to remote areas. Thus, we are using telemedicine to get access to hospital doctors for remote places. The people who have not seen doctors can see the doctors

through this technology. These are the main focuses of our project. Whenever we are connecting villages, we are connecting schools and health post stations.

4.3. Human Capital

The NWNP helps school children to utilise online educational resources, as stated by one student:

It helps us in our study. For example, to understand the history the course book is not enough. Now we may download additional information to know more. It's helping me to receive external information related to my studies.

School children and teachers are more motivated to study and learn. One of the teachers expressed his excitement as follows:

It was clearly exciting to get this new technology. Therefore, when the computer arrived in the village, we used to learn computer until midnight. Gradually, the interest to work on the computers was cultivated.

Young people from the village are procuring employment in the project, enhancing their knowledge and skill through the use of ICT. One technician said:

Mahabir Sir taught us at the beginning, [lessons] such as checking radios, operating computers. Later on, I learned through my own experience.

The project facilitated a network between remote and urban hospitals and schools. Local manpower is generated by developing competence for IT teachers, clinic health workers, and network technicians.

4.4. Financial Capital

Some income-generating activities are being initiated but are still in the piloting phase. Examples include the Haat Bazaar initiative and remittance services. On the Haat Baazar websites, villagers may advertise their local products for sale, such as cows, buffaloes, goats, chickens, and cheese. The team leader of the NWNP project explained:

*They can use it (*Haat Baazar) *for advertisements in the village. Thanks to the Internet, we can promote local products such as Doko, Namlo, Nepali spices, mushrooms, and cattles. If anyone wants to sell their products, they may use services like Haat Bazzar on the net. They contact the Internet operator who will put the information online for other people to see and buy that product.*

Remittance services, which are in the testing phase, may become important in the future:

...Remittance services are going to be started soon in this village. By using this service, family and friends in foreign countries and the big cities may transfer money easily, which is clearly beneficial for the community.

By offering cheap communication opportunities, the NWNP facilitates reduced transaction costs. One of the village farmers said:

When there was no internet here, communication was very difficult because we used to go to Beni or Pokhara just to make a phone call. Furthermore, we had to wait for months, not days, to receive our letters from the central offices in Kathmandu. It took many days to send letters abroad. Now communication is very easy and convenient since village people are using the Internet for communication. People here chat and send e-mails to relatives in foreign countries on a daily basis, instead of sending letters. They do chatting [online] instead of telephone calls.

The NWNP is planning to develop e-commerce services related to eco-tourism, and to provide ATM virtual machines. The team leader of the project said:

To make this technology sustainable, we need to introduce eCommerce, so that we can get some economic sustainability.

4.5. Political Capital

One of the notions of political capital is inclusion of marginalised people so that they can access key resources and services. The Myagdi district is found in a very remote area of Nepal. Most of the villagers are still socially, politically, and economically excluded from mainstream development in the cities. The NWNP has provided an opportunity to access information and communication services without any discrimination. One of the interviewees from Tikot village stated the following:

Nangi and this village are pretty similar. There are Magars, Damais, and Kamis (marginalised groups). And, Bahuns (a so-called benefitted group) *came from other districts. However, there is no discrimination among these castes. They are using computers equally.*

A teacher replied with the following, commenting on technology and the inclusiveness of marginalised groups:

This technology is not meant for just a particular caste. I hope it [ICT] will definitely solve this problem (the differences between various castes) *because it is not meant for any particular caste.*

Another element of political capital is empowerment of women. The NWNP provides an opportunity to empower local women and encourage them to participate in the development process. For example, in the telemedicine centre of the Nangi and Tikot villages, local women are given preference with respect to receiving training.

The NWNP has drafted a future plan to introduce eGovernment services in these areas. It will assist in providing government information and services in

remote places via the Internet. The team leader of this project has lobbied the government to put the remote communities on the priority list of IT policy in 2010.

5. Challenges

There are still a number of challenges that need to be addressed in order to realise the benefits of ICT4D projects in remote places. The director of Nepal Telecom Authority articulated the main challenges as follows:

Rural means no affordability, lower literacy rate, everything is below average, and poverty incidence is high. Moreover, the supporting infrastructure, such as electricity, road network, and other supporting infrastructure, is not yet developed in the rural areas.

The Assets Pentagon Model is also useful to identify challenges and obstacles for the NWNP in the Nangi and Tikot villages.

5.1. Social Capital

A main challenge is the literacy rate, which restricts participation, especially of the elderly. A majority of the villagers are using ICT services for communicating with their relatives and friends. It may be helpful to maintain the bonding social capital[30]; however, for the creation of macro level socio-economic development, they need to extend their social network[20]. As mentioned in section 3.2, only 18% of the educated population is English literate. The majority of the people in the Nangi and Tikot villages are lacking with respect to English-oriented ICT services. As previously mentioned, the NWNP has initiated several projects focusing on developing online context based on the Nepalese language.

The participation of the community people is also important for creating social capital. The participation of farmers (the majority of people living in these villages) is still a challenge due to their lack of education, illiteracy rate, and lack of time to participate in training to increase their ICT competence. The VDC chairman of Nangi village, who learned to use computers and the Internet, explains:

In this village, around 50% are retired personnel from the UK's or India's armies. I told them this is an Internet age; we used to send letters using the post office but now, because of the Internet and telecommunication, we can send information to different places easily. Therefore, I asked village elders to come and take computer education, but still, they are not able to understand it.

5.2. Physical Capital

Shortages of power combined with poor infrastructure are still major obstacles for the NWNP. For example, the lack of sophisticated devices has hampered the quality of telemedicine services in the Nangi and Tikot villages. Similarly, the team leader of the NWNP told us that better Internet bandwidth is needed to further generate local content and promote it to outside markets:

The only constraint to making Voice over IP telephone calls to the villages from abroad using the extension number is that they don't have enough Internet bandwidth from the ISP. People are using Skype and Yahoo Voice Chat in the morning or evening when acceptable Internet bandwidth is available.

The poor physical capital in these villages hindered health workers in the use of their capability in the telemedicine project, as expressed by one of the local health workers:

When I went to Kathmandu Model Hospital last time for training, I could use a lot of lab facilities, which are not yet available here. Thus, I'm not able to make full use of my new competence [here].

There is shortage of power in most parts of Nepal in which people face twelve-hour power cuts even in Kathmandu city. In most parts of the country, the power supply is very unreliable. Moreover, due to the mountainous terrain, the NWNP had to locate critical parts of its equipment, for instance, all its relay stations, up in the mountains. Consequently, the NWNP is highly dependent on solar power systems. Solar power is still very expensive (typically amounting to half of overall expenses) and does not function satisfactorily in the rainy seasons.

5.3. Human Capital

A main challenge is the lack of skilled manpower to maintain and further develop the NWNP. For example, in Nangi, there are trained technicians who can solve really basic technical problems. However, most of the technicians are not certified engineers; they are local young people who learned through experience. One technician in Nangi village described this situation:

We are not using the computers for complex tasks; therefore, we don't have problems. But we will face difficulties if we start using them for more complex tasks.

In Tikot, there is tremendous dependence on one technician. One of the teaching staff of the Tikot School said:

If the computers become out of order, there is no one to give support. We have just one technician and he is not perfect. He works according to the

instructions given by Mahabir Pun (the initiator of the NWNP) *by phone. Otherwise, if the problem gets bigger, then Mahabir needs to come.*

Although the NWNP has the support of community members, they are very much dependent on Mahabir Pun, team leader for funding, planning, development, maintenance and action. An involved citizen in Nangi said:

Mahabir has done this entire thing. He is the one who brought the computer and Internet to this village. All the credit goes to him. As long as Mahabir is with us, there is no fear. However, in his absence we are a little doubtful.

One of members of the teaching staff in Tikot village expressed his worries as follows:

It was not possible without him; still, I didn't find any other person who came here to work like Mahabir. For example, there are many people who came from foreign countries to observe the project, but there was no one who said "I will work with Mahabir". Therefore, as long as Mahabir is here, it will function properly; however, in his absence, we need another person like him for the sustainability of this project. Without his presence, this project will not function properly. I am bit worried about it.

5.4. Financial Capital

The NWNP has started different small-scale industries for income generation. So far, most of the income-generating projects are in the testing phase. Sustainable business models should be developed for further extension of the project in order to realise macro level socio-economic benefits. According to the director of the Nepal Telecommunication Authority, private sectors are not interested in remote places because they find no business opportunities there:

The major challenge for the private sector is the lack of a business model in remote places. In the liberal economic system, a business model is very important; we are not able to design the correct sustainable business model.

The lack of financial capital makes it difficult for the NWNP to develop sophisticated devices. Financial capital is required to further develop the network into new villages in other regions. Upgrades and purchases of new devices are difficult due to poor economic conditions. The headmaster of the Tikot school discussed his experience:

There is a lot of development every day. There might be a time when our old computers will not work properly… Therefore, we need to look for funding to buy new equipment, otherwise we will have a problem.

5.5. Political Capital

The NWNP is facing political instability and lack of government support. Ten years of Maoist insurgency, the massacre of the king's family, and the contemporary fragile government are some of the reasons for the unstable political situation. Although the government has embraced liberal policies since 1997, it has drafted IT policies which are still not being implemented in practice. Despite the allocation of an enormous amount of money to the Rural Telecom Development Fund (RTDF), the funds have not been distributed and utilised due to political instability and delayed bureaucratic processes.

Decades of political instability in Nepal have hampered overall socio-economic growth. The head teacher of the Tikot Middle School gave one example of the practical difficulties due to the tense political situation:

We sent our computer teacher to Kathmandu for one month of training in hardware. Due to the Nepal Banda [strike] and other political movements, he got just 15 days of training instead of one month.

Similarly, there is a lack of government support for these kinds of community-based ICT4D projects. A villager from Tikot expressed that:

The District Education Office is not helping us directly, but the education ministry provides around 40-50000 rupies to fund Internet provision to the schools. They sometimes offer us a programme to provide an equal amount of money from the community and from the District Education Office… but that small amount is not enough to contribute to the big change.

6. Discussion

As mentioned in Section 1, remote communities in the mountain regions of developing countries are deprived of socio-economic and political advantages [1, 5, 10]. In this study, we have described the Nepal Wireless Networking Project and explored how this project may help to overcome these shortages. There is a great deal of optimism, exemplified by one villager from Tikot who stated that:

The Internet cannot help us with plowing, sowing, and harvesting. But by using the Internet, we can engage in a lot of other educational and financial development, I believe.

We argue that the NWNP provides a promising opportunity to create social, human, physical, financial, and political capital. People may access data resources and they are offered training to improve their competence. Social networking may also be facilitated. Now they no longer have to travel long hours to make a phone call to their relatives. Due to the NWNP, people living in the villages have better access to

medical competence. Transaction costs are reduced and there are some promising opportunities to empower marginalised groups, especially women, through training programmes.

The NWNP has provided several opportunities to the Nangi and Tikot communities. However, in order to realise the macro level socio-economic impact, the community people should not only be able to access and assess the information; they should also be able to convert it into relevant knowledge, and to make decisions. At the same time, they should be able to generate local content that can be used for revenue generation activities[19].

In the content development and revenue generation programme, this project is still in its infancy. They need to work on local content generation. Although they started local bulletin and eCommerce services, this information is still not exported to the outside community. Access to local data and information by external market is important in order to generate revenue and long-term sustainability [1].

The findings from our NWNP case allow us to identify some implications for practice.

First, there is a need to really understand the context to be able to achieve results by introducing ICT in remote areas of the developing world. Several researchers have identified the lack of contextual understanding as a major explanation for why ICT4D projects have not succeeded (see [14] for a discussion of such issues). Our contribution here is to identify the importance of contextual understanding in a so-far successful ICT4D project in a remote area. The NWNP was initiated without external funding, with only some rare international contacts (a few international students volunteered in the initial phase) and with some clear, community-based objectives on what to achieve, which were clearly not technology-oriented. The objective was (and is) to avoid migration from remote areas by developing health care services, improving education, and developing business opportunities. Everyone interviewed shared exactly the same vision and objectives.

Second, it is important to focus on localised content and develop content providers. The NWNP has initiated collaboration with several content providers in Kathmandu to develop online materials for schools, telemedicine systems, and e-commerce opportunities. It is also of critical importance to develop online content based on the Nepalese language. Mahabir Pun argues that no technology should be distributed before there is a joint understanding of the needs and opportunities, and before there is some content available with which to start up.

Third, the NWNP case study illustrated the critical importance of a champion. Mahabir Pun initiated the project from his uncle's house. The project was illegal, and had to be localised in mountain areas dominated by the Maoists. Pun's importance cannot be overestimated, and based on what he has done with the NWNP, he is currently well-respected at all levels in Nepalese society, which gives him access to all offices, including ministry offices in Kathmandu city. Thus, his network is of critical importance. The importance of one man is a double-edged sword. The project would not exist without him, but the project will also fail if he can no longer manage it. Therefore, the project may face the challenge of being developed from an initial phase in which the champion is of critical importance, to a more mature phase in which it is less dependent on one (or very few) contributor(s).

6.1 Implications for future research

Based on the NWNP case study, we will suggest some implications for future research.

First, the asset pentagon model introduces a holistic view on the Nepal Wireless Networking Project. More research is needed to increase our knowledge of the inter-relationship between the various assets, but our work represents an attempt to start with a holistic view of the implications of introducing ICT4D projects. The holistic view is even more important as long as the project is initiated to overcome social, and not technical, challenges in the Myagdi district.

Second, more research should be done to understand how the contextual characteristics influence the technical design of the NWNP as well as its online content. The NWNP is an excellent candidate for understanding how the design of technology is influenced and influences local societies in remote areas of the developing world. Such knowledge is necessary in order to fully understand how ICT4D projects can succeed under such circumstances.

Third, there is a clear need for more research to develop sustainable business models. So far, the NWNP is highly dependent on donors and some restricted income from the village development committees. Business models should be developed not only to make the NWNP sustainable, but also to generate income for these very poor villages.

The NWNP has created a positive wave in the Nangi and Tikot villages. The extension from what were initially two villages to currently more than forty indicates its importance. Despite some challenges, the NWNP is an important example of an ICT4D project in remote areas in a country which is rarely (if ever) discussed in the ICT4D literature. Conducive government policies, infrastructure development, and public-private partnerships may support the replication of the NWNP across other mountain villages in Nepal.

Further development of business models to attract eco-tourism and to sell cultural and agricultural products through the Internet may generate revenues and further add to the socio-economic development in the long run.

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THE ROLE OF ICT ACTORS AND NETWORKS IN DEVELOPMENT: THE CASE STUDY OF A WIRELESS PROJECT IN NEPAL

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ABSTRACT
The role of ICT actors in the formation and extension of ICT4D projects is important. The actors through their extended network and aligned interest can enhance the effectiveness of the project which in turn enables socioeconomic development opportunities. However, few studies have been conducted to understand the role of these central players. The objective of this paper, therefore, is to address this knowledge gap by conducting a qualitative case study in the Myagdi district in the mountain region of Nepal. In this study we explored the Nepal Wireless Networking Project (NWNP) and examined how an activist started it from one mountain village and gradually extended across more than 150 villages. The formation and extension of information and communication technology for development (ICT4D) projects goes through different phases of identification of relevant ICT actors, roles, negotiations, and their interest alignment. To understand the various phases, we employed Actor-Network Theory (ANT) and explored how a social activist, in the midst of challenges, initiates the wireless project to facilitate educational and healthcare services to the mountain regions. In continuum, the study found how the activist identified relevant actors and enrolled them to form a network of aligned interest. The study also identified several challenges such as high illiteracy rate, over dependency on focal actor, and poor physical infrastructure that may impede the network building process. Furthermore, we identify some implications for research and practice based on insights from the case study.

Keywords: ICT4D, ICT Actors, Actor-Network Theory (ANT), Mountain Region, Development, Nepal.

1. INTRODUCTION

With the increasing interest of academia and development organizations in ICT4D research and practice, the need to understand interplay among various social and technological actors, rather than lopsided explanation to understand implementation process of the project were identified (Hanseth, et al., 1996; Heeks & Stanforth, 2007; Martin, 2000; Stanforth, 2007; UNDP, 2001; Walsham & Sahay, 1999). Similarly, understanding of local socio-cultural context in IS research in general and ICT4D research in particular is mentioned (Mengesha, 2010; Walsham & Sahay, 1999). However, the missing link in the existing literature is to understand the roles of different *ICT actors*[1] in the formation and extension of ICT4D projects. The need of charismatic leaders and champions to bring together and develop commitment among stakeholders is acknowledged (Kleine & Unwin, 2009). The challenge of how to create champions, however, remains a question (Heeks, 2008).

Study suggests that the role of individual actors who enjoyed passing on information and people who had larger networks than their peers is critical in the sharing of computer-mediated information (DíazAndrade & Urquhart, 2010). Similarly, in developing countries

[1] *ICT Actors* in this paper refers to all human and technical actors involved in the formation and extension of ICT4D projects, ICT actors and actors are sometimes used interchangeably in this paper.

low literacy rate, caste, culture, gender, and religious issues create obstacles in getting the benefits of information technology to the vast majority of the population. It creates the information gaps between 'Haves and Have-nots'. Disadvantageous group of people are seldom aware of the information available on the net and even when they are, they have difficulty using it. In this situation, an intermediary role is important to facilitate access to the information (Sein & Furuholt, 2009). However, there is still a need for pursuing further research to understand the role of ICT actors (DíazAndrade & Urquhart, 2010) as a project initiator, champions, and intermediaries, particularly, in the mountain regions of developing countries (Heeks & Kanashiro, 2009).

In this paper, we address this issue. The specific research question was: *How do different ICT actors form and extend ICT4D projects and how do extended networks in turn foster socio-economic development?* To examine the research question, we conducted a case study in the Myagdi district in the mountain region of Nepal and explored the role of ICT actors in establishing the Nepal Wireless Networking Project (NWNP). We found that despite challenges and some negative consequences, the initiative positively influenced development through its extended network. This study employed actor-network theory to understand the formation and extension process of NWNP in their local context. Major focus of the theory when applied in this particular case was to explain the interaction processes between different ICT actors and their roles during the wireless project formation and extension process.

This paper illustrates how a successful network of aligned interests among the ICT actors is created through the enrolment of a sufficient body of allies and translation of their interest, and what roles different ICT actors played to create sufficient body of allies. So that they are willing to participate in particular ways of thinking and acting that maintains the network (Latour, 2005). Literatures on ICT4D provide evidence that qualitative research combined with analytical lens of ANT can be used to enhance the understanding of translation process (Braa, et al., 2007; Díaz Andrade & Urquhart, 2010; Heeks & Stanforth, 2007; Rhodes, 2009; Sarker , et al., 2006; Tatnall & Gilding, 1999; Walsham & Sahay, 1999).

Rest of the paper is organized as follows. Section 2 discusses the theoretical foundation and its relevance to the case study. Section 3 and 4 illustrate research context and methodology. Section 5 illustrates research findings from the case study of NWNP. Finally, Section 6 & 7 concludes the paper with a brief notes on its achievements and some implications.

2. THEORETICAL FOUNDATION

2.1 Actor-Network Theory (ANT)

ANT is developed from the study of sociology and science at the *Ecole des Mines* in Paris (Callon, 1986; Latour, 2005; Law, 1992). The concept was derived from Gabriel Tarde (1893) who argued that division between nature and society is irrelevant for understanding the world of human interactions (cited in Latour, 2002). As summarized in Table 1, the basic concept of ANT includes actors (or actants). Both human beings and non-human (e.g. technical) objects are considered as an actor. Actor-Network is a process of "heterogeneous engineering" in which bits and pieces from the social, the technical, the conceptual, and the textual are fitted together (Callon, 1997). Put simply, actor-network is a heterogeneous network of aligned interests, including people, organizations and standards (Walsham, 1997). According to Latour "ANT is not the empty claim that objects do things 'instead' of human actors; it simply says that no science of the social can even begin if the question of who and what participants in the action is not first of all thoroughly explored, even though it might mean letting elements in which, for lack of a better term, we would call non-humans"(Latour, 2005, p. 72).

Table 1. A Summary of Actor-Network Theory (adapted from (Walsham, 1997))

Actor (or actant)	Both human beings and nonhuman actors such as technological artifacts
Actor-Network	Heterogeneous network of aligned interest, including people, organizations, and standards
Enrolment and Translation	Creating body of allies, human and nonhuman, through a process of translating their interests to be aligned with the actor-network
Delegates and Inscription	Delegates are actors who "stand in and speak for" particular viewpoints which have been inscribed in them, e.g., software as frozen organizational discourse
Irreversibility	The degree to which it is subsequently impossible to go back to point where alternative possibilities exists
Black Box	A frozen network element, often with properties of irreversibility
Immutable mobile	Network element with strong properties of irreversibility, and effects which transcend time and place, e.g., software standards

2.2 Translation Process

The translation process can enhance the deeper understanding of interplay among various ICT actors by providing the details of all the strategies through which an actor identifies other actors and arranges them in relation to each other. This process requires the focus to be on understanding how actor-networks are created, strengthened and weakened, rather than on causes and effects. As depicted in Table 1, the translation process has four phases known as *Problematization*, *Interessement*, *Enrolment*, and *Mobilisation*. These phases are not sequential and can be overlapped.

In the *problematization* phase, different actors define their problems and objectives that need to be solved. As different objectives cannot be attained by the actors individually, they try to identify other relevant actors. After identifying the groups of actors, they select delegates that will represent them. A focal actor, in this phase, tries to convince different actors and define their roles and identities in such a way to establish itself as an obligatory passage point between the other actors and the network. The obligatory passage point, as shown in Figure 1, is defined as a contact point to connect all the actors those involved in the network. "This double movement, which renders him [focal actor] indispensable in the network, is what we call *problematization* (Callon, 1986, p. 101)."

In the *Interessement* phase, the focal actor attempts to negotiate and stabilize the identity of the other actors, which it defines through its *Problematization* process. During the *problematization* we learned how different actors carefully defined their identity, goals and their inclinations of the allies. These identities can be changed based on their own competitive interest. After the *Interessement* phase, the focal actor seeks through physical actions and negotiations to define and coordinate the roles of other actors. It designates the device by which a set of interrelated roles is defined and attributed to actors who accept them. For all the groups involved the device helps create a favourable balance of power, and corner the entities to be enrolled in the network. It attempts to interrupt all potential competing associations and to construct a system of alliances composed of different socio-technical actors (Callon, 1986).

The successful *enrolment* depends on the negotiation and consolidation among actors during the *Interessement* phase. To describe *enrolment* is thus to describe the group of actors with various interests, negotiations among them, and finally synthesize their interests with the common goal.

In the *Mobilisation* phase, the focal actor seeks to ensure that specific representative of all the other actors has been chosen and accepted by their groups. All unions have their delegates or spokesperson; even the IT artefacts have the representation in project blueprint, such as wireless stations, equipments in use, and software. Thereafter, the focal actor is accepted as the main voice or a delegate that speaks on behalf of all the actors in the networks. The state when the actor network gets strong properties of irreversibility, and effects, which transcend time and place, is known as *immutable mobile* (Callon, 1986). However, this consensus and the alliances that it implies can be contested at any moment and the translation can be turned into treason; known as *dissidence* (Callon, 1986). The notion of lack of alignment is simultaneously a timely reminder that agendas and interests may be diverging, in opposition, or competing direction.

Looking at the nature of the qualitative research approach, and the involvement of various ICT actors in forming and extending the Nepal Wireless Networking Project, this study uses ANT as the theoretical lens. More specifically, the theory can provide a lens for deeper understanding into how the processes, controversies and negotiations lead to the formation and extension of the wireless project in the mountain regions of Nepal. Similarly, to understand the differences in the methods and materials that ICT actors deployed to generate the network.

Table 2. Four Phases of Translation Process (Callon, 1986)

Problematization	What is the problem that needs to be solved? Who are the relevant actors? Forming obligatory passage point.
Interessement	After identifying the relevant actors and forming the obligatory passage point, getting the actors interested and negotiating the roles and terms of their involvement. Establishing a device to make power balance.
Enrolment	Actors accept the roles that have been defined for them during *interessement.*
Mobilisation	This phase investigates whether the delegate actors in the network adequately represent the masses.

3. RESEARCH CONTEXT

3.1 Nepal Wireless Networking Project (NWNP)

In 1996, the idea of NWNP was conceived in the mind of Mahabir Pun, a school teacher at Himanchal High School, Nangi in Myagdi district of Nepal. Pun attended his primary education in a village school where getting quality education was difficult. The teachers were not well qualified. It was even difficult to get paper, pencils, and textbooks. His father who was retired army personnel had dream to highly educate his son. Due to the lack of higher educational institutions, it was quite difficult to make the dream come true in his home town. Therefore, Pun's father moved with his family to Narayanghat, a city near southern plain of Nepal. Pun completed his high school from there, and worked as a teacher for about 12 years. In 1989, he received a scholarship to the University of Nebraska at Kearney, from which he graduated in 1996 with a Bachelor's Degree in Science Education.

From the very beginning, he recognized the need of good education and healthcare system in remote areas. The inhabitants in these villages were used to practice shamanistic rituals and shamans were respected as traditional doctors and healers. There were no medical clinics in that region. While in US, he learnt that information technology can provide a platform to provide these services to the remote communities. Out of the realization, after

completing his bachelor's degree from US, Pun returned to teach at a village high school located in Nangi. When he came up with the idea of introducing internet at Nangi there were no telephone lines, no electricity and no computers. At that time, villagers had to walk around five hours down the hill and four hours bus ride to the nearest town (Pokhara) to make phone calls and to check their e-mail from friends abroad. The political situation at that time was unstable as Maoist insurgency was on. It was very difficult to set-up wireless internet stations in the mountain regions because trade policies were restrictive with regard to import wireless technologies. In fact, it was illegal to install wireless stations. However, Pun was never discouraged. As he used to say," It's better to be crazy than to die."

In 2001, Pun wrote an email to the British Broadcasting Corporation (BBC) asking for ideas to connect this remote village to the outside world through internet. The situation changed dramatically when the BBC published his email and received an overwhelming response from all around the world. Within a year, volunteers, especially graduate students from Europe and the United States, began to help him in setting up a wireless connection between Nangi and the base station Pokhara using TV dish antennas mounted in trees. With the partial technical support of World Bank, community people built a micro-level hydro power station at Nangi. Community people also learnt to assemble computer parts received from donations in wooden boxes. Gradually, the success story spread across the World Wide Web, and his social network started extending across to other parts of the world. Volunteers from several countries started donating used computers, computer parts, Wi-Fi equipment, and their skills to these mountain villages.

In 2003, Nepal Wireless Networking Project (NWNP) was formally established. Since then the project has been in full-fledged operation. The project is an example of first grassroots movements to use ICT for mountain regions, in the context of developing countries. It is making every possible effort to adapt modern technologies to the local context. By 2011, NWNP has already build networks in around 150 villages in Myagdi and other districts, and gradually enrolling local, national, and international actors in this formation and extension of the wireless project and its services. Pun was recognized for his initiative to enrol different human and technical actors to extend wireless network across mountain regions. He received many prestigious awards such as Ashoka Fellow (2002), Overall Social Innovations Award (2004), honorary degree as Doctor of Humane Letters (2007), and Magsaysay Award (Known as Asian Nobel Prise) in 2007.

3.2 Research Site

The study took place in Nangi and Tikot villages in the Myagdi district. The district is located in the western Nepal on the southern flank of the Annapurna and Dhaulagiri ranges of the Himalayas. Nangi was the first Himalayan rural village of Nepal where NWNP started its internet services. The Himanchal Higher Secondary School run the wireless project and it coordinates the whole wireless network which covers the different villages of Myagdi, and other districts. The total population of Nangi and Tikot villages is around 2,000.

The majority of villagers are farmers or ex-army personnel. Villagers are growing mainly potatoes and other agricultural products. People from these remote regions have to go to urban areas to procure employment, education, and healthcare services. Many villages in Myagdi district have still no motorable roads. While Nangi is better connected, it still takes about four hours by jeep or one day's walking to the nearest town. These two villages are inhabited predominantly by Magar ethnic communities including other minority castes and social groups. Most of the villages in mountain regions are scattered in small clusters with average populations of less than one thousand. The main source of revenue for the villagers is remittances from people working abroad, and whatever is earned from selling agricultural and dairy products.

4. Research Methodology

The qualitative case study particularly interpretive approach was used to understand the research problem. The philosophical basis of interpretive research inherited from the ethnographic research tradition in anthropology, hermeneutic, and phenomenology (Butler, 1998; Klein & Myers, 1999; Walsham, 1995a). Interpretive approach can better explain the complex socio-technical interaction process using ethnographic interviews, thick case description, and empirical observation.

4.1 Data Collection

This paper has used the interpretive case study method(Walsham, 1995b, 2006) to guide the collection and analysis of data. The initial process of research started with reviewing literature and building a conceptual framework. A series of interviews were conducted with different stakeholders as listed in Appendix (A). To understand the historical background and detail enrolment process, we conducted an ethnographic interview with the team leader of the wireless project *in situ*. In addition, notes taking, observations, still and video pictures were used to capture the socio-cultural and technical context. Different secondary reports were also used. The interviewee selected were teachers, social activist, health workers, students, local users and non-users of the ICT services. Semi-structured guide was used for the individual interviews, each of which lasted from 40 to 60 minutes and was tape-recorded. Appendix (A), illustrates ICT actors interviewed and their objectives for using wireless internet services.

To understand the collective view, focus group interview was conducted in the Schools of Nangi and Tikot villages. Similarly, observation of ICT usage was done in schools, telecenters, and village telemedicine clinics. In addition, supplementary data were obtained from different relevant Internet sites, informal discussions, email exchange, social networking sites, different websites of ICT4D projects, and ICT4D workshop in Kathmandu. The workshop was attended by various ICT actors that were composed of researchers, practitioners, experts, medical doctors, government officials, telecom director, teachers, students, and members of the Nepal Wireless Networking Project.

4.2 Data Analysis

The objective of data analysis was to understand different interpretation of use of technology by actors and their motives to enrol in the wireless network. The data collected through interviews, note taking, workshops, and observations in the field were analyzed using qualitative techniques. All the interviews were transcribed, summarized, coded and categorized keeping actor-network theory as a guiding framework. For example, as shown in Appendix (A), through this analysis process, we identified the interpretation of different ICT actors in enrolling to Nepal Wireless Networking Project.

Throughout the project constant data comparison was used to make connection between different categories and interview codes. Peer review was done by colleagues and other researchers to check the reliability and validity of interview and interpretation. At the same time, ICT4D workshop discussions in Kathmandu provided an opportunity to understand the different perspectives of the participants. The discussion helped to validate our findings. Likewise, author's background and experience from the remote communities of Nepal, helped to understand the reality of the research context with critical perspectives. The whole research process was evaluated according to set of principles for interpretive research in IS (Klein & Myers, 1999). The actor-network theory lens served as a priori guideline for collecting and analyzing data (Walsham, 1995a).

5. Research Findings

The following sections will trace the moments of interplay between heterogeneous ICT actors during the wireless project formation and extension process. These moments constitute the different phases of translation process as described below.

5.1 Problematization

As defined in Section 2.2, in this phase, focal actor seeks to define a problem that interests other relevant actors. For example, the problem which focal actor, Pun, the team leader of the wireless project, in this case, wanted to solve was to foster socioeconomic development in the mountain regions through internet connection. Subsequently, the focal actor started finding different relevant actors who, besides having their own interests, can be agreed to collaborate with the wireless project. The brief account of actors discussed in this paper and their *problematization* are formulated as follows. Starting with the team leader, Pun, who stated:

> *One of the reasons I am involved in this project is because I have seen that this has good potential to provide some very basic services to the rural community. Like health and education services…Because there is no way Nepali government is going to build hospital and bring doctors in the rural areas … as it cost so much money to do that… also you can see a lot of good schools and colleges are in the urban areas… students are getting opportunity to get quality education there but students in rural areas are not. So there is a huge education gap…therefore, I think ICT can help to bring this education gap closer. Similarly, to make this project sustainable we have to generate income, that's why we are working in ecommerce project and internet telephony.*

The team leader also plays an important role as a representative or intermediary of the villagers. One of the villagers explained:

> *He[Pun] has a very high contribution for the implementation of these projects, because of that children are very attracted towards the ICT use and education… in fact, implementation of this wireless projects in the village was not possible without his help. He gave us the idea of this project and we are working according to those ideas and plan.*

Pun mentioned that when he initiated this wireless project, there were many challenges, such as human skill, physical infrastructure, political instability, and lack of finance before him. To deal with this problem, he started searching for other set of actors besides community people. His first interaction with outer world to start wireless project was through writing email to British Broadcasting Corporation (BBC). He said "I wrote the BBC about it [NWNP] in 2000. The idea just came into my mind and I wrote them and asked them if there is any person who knows about it then provide me some suggestion." BBC published his article, and he received overwhelming response from all around the world. He said," After that I started getting email responses from many places." Thereafter, he started seeking for other human and technical actors. For example, he started working with Gandaki Boarding School, national and international volunteers, OLE Nepal, Kathmandu Model Hospital, Thamel.com, etc. In addition, technical actor, for instance, the wireless project, was inscribed as a platform to facilitate socioeconomic development.

Another ICT actor, Open Learning Exchange (OLE) Nepal, an NGO based in the US and Kathmandu, as a partner to develop educational contents for the school children. The contents are based on the government curriculum from grade one through ten. The NWNP is in the testing phase of using the wireless network for online learning. The objective of OLE is to provide standard education for youngsters living in the rural and remote villages. The executive director of OLE Nepal expressed:

> *Getting more teachers training, building schools, building classrooms, in spite of this, we are not saying that we should stop it, but in parallel let's start looking into quality. One of the best ways is to introduce computers like OLPC in the classrooms… other thing technology can do is from the communication aspects, it improves the access, so now they can go to school and access lot of quality education materials. Many places every year in remote areas don't even get the textbooks, sometimes the books arrived when the academic year is over, so we are facing lot of these challenges. By introducing technology we can update and send the materials immediately, and easily access the materials. These are the things we can do with technology.*

Kathmandu Model hospital is one of the key ICT actors who are working with the wireless project. To address the challenges of bringing specialist doctors into the mountain villages, NWNP and the hospital have initiated telemedicine services in some villages of the Myagdi district. Every morning, the village ladies (being responsible for health care services in the villages) consult doctors from main hospitals using videoconferencing services, to discuss patients, common diseases or to learn from doctors and village ladies from other communities. One of the doctors *problematize* the telemedicine project as follows:

> *Currently we are in a very initial stage…daily video conference can provide continue training to the health workers in the remote area. And secondly, at the time of emergency, they can bring patients before camera. Our effort is that health workers here in the village become efficient. The people in this village should trust them more, and the ultimately it will benefit village people.*

Another ICT actor, the *thamel.com*, is planning to start a remittance service in the remote area because most of the family members from remote communities go to work abroad. Moreover, virtual ATM machine services are being piloted in Ghore Pani (a famous trekking route for tourist), which will be further distributed to other tourist areas. Director of thamel.com stated his interest as follows:

> *In the rural areas, there is always a misconception that there is no market. What works in urban obviously not work in rural areas, but the thing is all the rural areas have there own socio-economic dynamics. Where we can plug in the technology and create some kind of socio-economic opportunities… people in every village in the mountains like Nangi and Tikot are working somewhere else…So there are people making money and there are people sending money to villages…right now the remittance service in the middle of four or five villages can stop villagers to come down to Beni(district headquarter).*

If we bring that remittance service in the village then they don't have to come down.

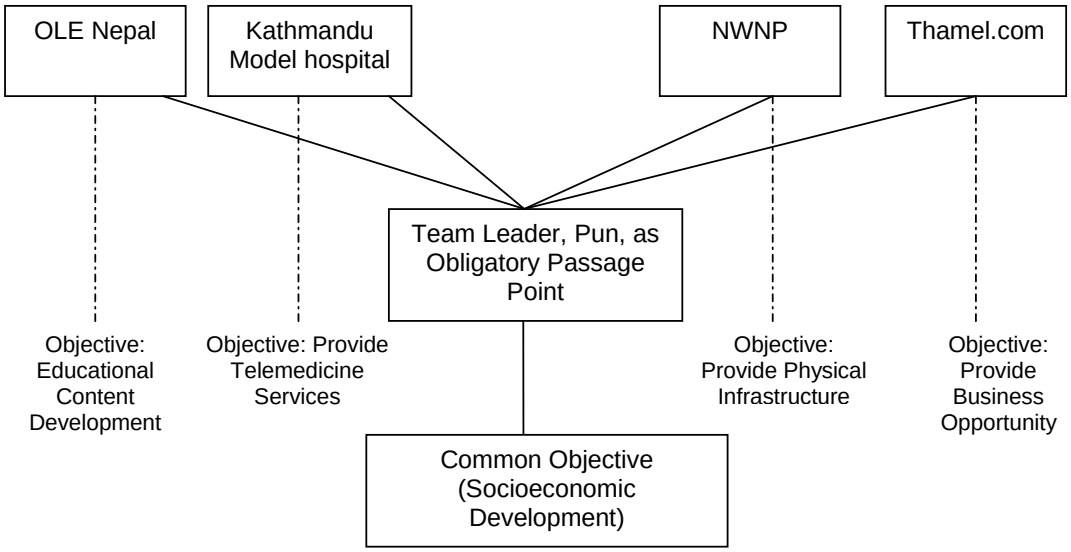

Figure 1. Finding Obligatory Passage Point

5.2 Interessement

As defined in Section 2.2, the *interessement* process explains how the focal actor identifies the threat to different actors and builds an *interessement* (balancing) device which can be placed between them. In this case the wireless project constitutes a representation of the *interessement* device. For example, all actors acknowledged the central role of the wireless project:

"…we can plug in the technology and create some kind of socio-economic opportunities"

"…video conference can provide continue training to the health workers in the remote area"

"…I am involved in this [wireless internet] project because I have seen that this has good potential to provide some very basic services to the rural community"

The Director of OLE Nepal interpreted the wireless service as a platform to provide education. He stated:

"Our goal here is to see how we can improve the quality of education especially in primary level. We get the most return in investment if we can start early and get the kids, if we can impart some quality education into the children then we can have long term benefits and also to improve access to quality education. So those are the two major areas where we believe that ICT can make most impact"

5.3 Enrolment

As defined in Section 2.2, in the enrolment process the focal actor seeks through physical actions and negotiations to define and coordinate the roles of other actors. Physical actions in this case are installation of wireless equipments, such as towers on top of mountains, servers, and software. Likewise, negotiations denotes to arrangement of social and institutional norms among actors. It designates the device (documents) by which a set of interrelated roles is defined and attributed to actors who accept them. For example, the OLE, Nepal explains the reason for partnering with wireless project as follows:

> *Mahabir came three years back to us and said 'contents'. I connect computers and internet it's you have to build contents and then right from the beginning 'content' is our core word. We have 30 people in this organization 15 of them directly involved in developing contents, 2 of them build elibrary, so all our researcher are going into contents implementation part, like I said, we do it through the government resources.*

Another ICT actor, director of thamel.com, explained why they enrol to wireless project:

Because his [Mahabir] dream is to promote education and healthcare, certain percentage of profits goes towards it, and he is such an iconic figure in Nepal. There is a different element of brand he brings into it. It's been wonderful to being around with this somebody like him who is dedicating his entire life selflessly without asking anything for himself. And then but the thing is it's obviously an amazing opportunity for me like I have certain skills he got certain skills, lets pull it together and do something. So now that's what we are trying.

5.4 Mobilisation

As defined in Section 2.2, In the *Mobilisation* phase, as depicted in Figure 2, the focal actor seeks to ensure that specific representative of all the other actors has been chosen and accepted by their groups. All unions have their delegates or spokesperson; even the IT artefacts have the representation in project blueprint such as wireless stations, equipments in use, and software. The focal actor, the team leader, is accepted as the main voice or a delegate that speaks on behalf of all the actors in the networks. As one of the villager expressed:

> *The main credit goes to Mahabir, because it was not possible without him, still I didn't find any other person who came here to work like Mahabir. For example, there are many people from foreign countries who came to observe the project, but there was no one who says that I will work with Mahabir. Therefore, until Mahabir is here it will function properly, however in his absence we need another person like him for the sustainability of this project. Therefore, in his absence this project may not function properly, I am bit worried about it.*

A doctor from telemedicine project mentioned:

> *It is the effort of Mahabir to connect the whole Nepal through wireless technology. There are other 3-4 institutions working along with him, we are one of them to provide health related services. There is another organization called NREN (Nepal research and education network), in*

> *this institute there are 3-4 friends including Mahabir and I. this organization is also helping us, besides that there are other private companies who are working with us. They are also motivated to make this telemedicine project successful. However, Mahabir is the key player in this project.*

The focal actor translates the interest of all the parties resulting in the irreversible black box or actor-network. Although it will take long time to converge the wireless project into a complete black box, it is gradually enrolling local, national, and international ICT actors in this formation and extension of ICT4D project. As the team leader, Pun, expressed:

> *This is a pilot study to learn about future possibilities…right now, we are not doing any big things or magic. What we are trying to do simply is to tell that this [ICT] is very important and necessary for the future. In future, those who will not know ICT will be like a blind man. Therefore, we are trying to open their eyes right now…So we cannot say the result of this project will be seen after one or two years. The impact can be seen after 10 or 20 years…the lesson they learned now will be very useful to them in the long run.*

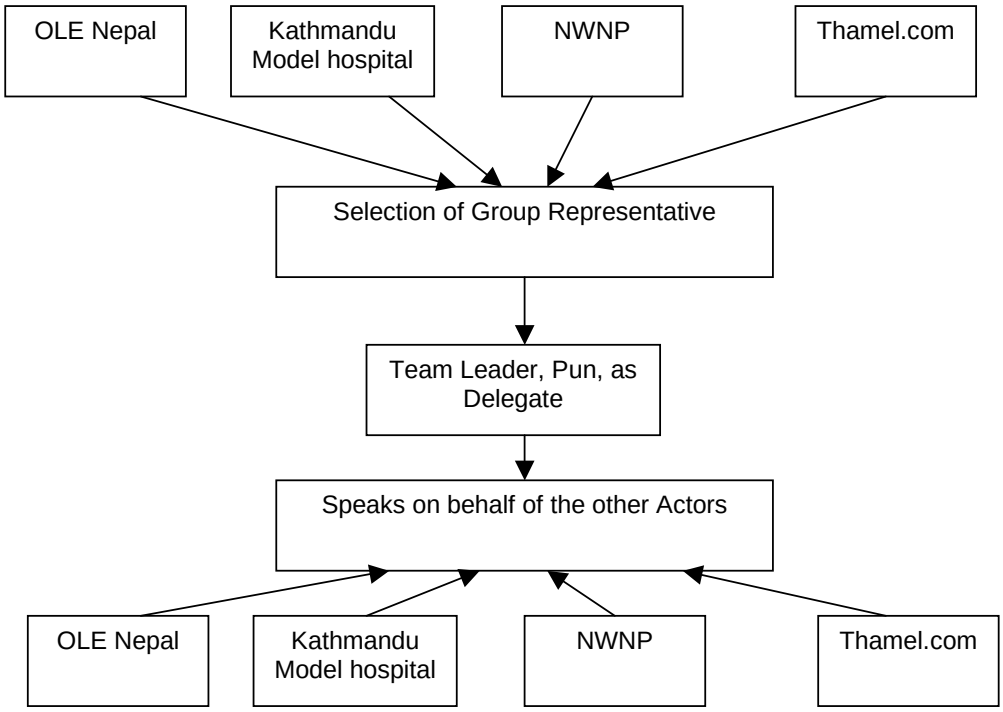

Figure 2. Enrolment and Mobilisation

The project has been extended across more than 150 villages in the mountain region. Different actors are mobilizing together regardless of their physical displacement or distance. They are working in their own, however, heading towards a common goal of socioeconomic development; this togetherness using main representative is known as *Concentration* (Callon, 1986).

5.5 Dissidence

As defined in Section 2.2, the consensus and the alliances that it implies can be contested at any moment and the translation can be turned into treason. There can be lack of alignment between ICT actors, and interests may be diverging, in opposition, or competing direction due to different social, human, physical, economical, and political factors (Thapa & Sæbø, 2011). For instance, the existing challenges such as, lack of physical infrastructure, power shortages, illiteracy, one man dependency, political instability, brain drain, lack of employment opportunities, lack of funding, market competition, and lack of pro-poor government planning may hamper the alliance, consequently, development process in a long run. In this context, director of Nepal telecommunication authority expressed his worries:

> *Rural means no affordability, lower literacy rate, everything is below average, and poverty incidence is high. Moreover, the supporting infrastructure, such as electricity, road network, and other supporting infrastructure, is not yet developed in the rural areas.*

The joint secretary of HLCIT also mentioned the challenges in terms of human skill:

> *We are looking for more technical hands, but still it is quite difficult to get specially IT professional to this government system because they don't get good salary here. Government sector is not like private sector so that is the challenge with the government institutions.*

According to Karmacharya, director of OLE Nepal:

> *Putting computer at schools and connecting internet will not bridge the gap, but we need to produce the useful contents that can be understood… our first and foremost target should be to convince the government organizations because we are not doing this forever. Our role here is more of catalyst…bringing all the stakeholders together to discuss the possible solutions, such as to find different ways of doing it, and to find how best to do it and how best to take this to the mass… involvement of local community is also important. Therefore, the solutions they [government] are employing besides building technical infrastructure are teachers training, capacity building of the government employees, and approaching community leaders.*

6. DISCUSSIONS

This paper highlights the importance of ICT actors, their roles and actions in the formation and extension of ICT4D projects. To enhance this understanding, we conducted a qualitative case study in the Myagdi district in the mountain region of Nepal and studied the Nepal Wireless Networking Project (NWNP) to examine how an activist started this project from one mountain village and gradually extended across more than 150 villages. Using actor-network theory we found that the formation and extension of ICT4D projects goes through different phases of identification of relevant actors, roles, negotiations, and their interest alignment. The study revealed the initiation taken by different actors and community people, in the midst of many challenges, to enable education, healthcare, and economic opportunities in the mountain villages. The roles of different ICT actors and interconnection between technology and society can provide us better lens to understand how ICTs can effectively be used to enhance the livelihoods of poor and marginalised communities (Unwin, 2009).

Theoretically, this paper contributes to the use of actor-network theory for deeper understanding into how the ICT actors play their roles in the formation and extension of ICT4D projects. ANT also enhances the understanding of differences in the methods and materials that actors deploy to achieve their individual as well as common goals. The detail *translation process* describes how at the beginning different actors were separate, and how their interest has unified them. This study through empirical case examined how a focal actor, the team leader of wireless project, enrol different actors, such as social activists, technical experts, community users, doctors, entrepreneurs, national and international volunteers, and researcher through enrolment process, and mobilize the wireless project. The wireless project in turns enables development opportunities in the mountain region of Nepal.

The study has some practical implications. It shows that ICT actors can play a major role in the formation and extension of ICT4D project and foster socioeconomic development through enrolling into common objective. For example, the wireless project provides a promising opportunity to create social, human, physical, financial, and political capital (Thapa & Sæbø, 2011). People may access data resources and they are offered training to improve their competence. People living in the villages have better access to medical competence due to the project. Transaction costs are reduced and there are some promising opportunities to empower marginalized groups, especially women, through training programs. However, at the same time, the challenges like lack of political instability, skilled manpower, and physical infrastructures can perturb the enrolment process and dissolve the network. Using the ANT's translation phases to explain the case adds value, as it breaks up ANT into its temporal elements, showing that ANT can in fact be used as the phases of an ICT project.

The limitations of this study are our data was collected from two remote mountain villages in Nepal is thus highly context dependent. That may restrict the generalization scope. The time frame of the study also raises the possibility that we may not have captured the effects at the right time. Such projects may require a longer period to have a more sustained influence. The researched communities were composed of homogeneous group; result could have been different in other multi ethnic communities. Difficult geographical location, gender issues, and low literacy rates were other obstacles in collecting data.

Finally, the actor-network theory does not consider the macro level effect, such as government policies, and market situation. In practice, macro level factors influence and influenced by the local development context. Likewise, Actor-Network theory is suitable to explore the network formation process; however, it does not explain how this network leads to development. ANT combined with other social theories, for instance, Social Capital can provide a lens to better understand and explain the process of ICT intervention and its consequences on development. Similarly, by combining social capital approaches with actor-network theories, we can increase the understanding of social changes and the role of various stakeholders and technologies in fostering socioeconomic development. These are avenues for future research.

7. CONCLUSIONS

ICT actors can play an important role in the formation and extension of ICT4D projects through their extended network, which in turn enhance the effectiveness of the project, and foster socioeconomic development in the remote communities. However, fewer researches have been done to understand the role of these actors. To contribute to this knowledge gap, this paper illustrated a qualitative case study in the Myagdi district of Nepal. The paper applies actor-network theory to a Nepalese case of ICT intervention (Nepal Wireless Networking Project) in the mountain region of Nepal, and shows how the network of the project's champion gradually grew as he acquired important contacts and got attention to his

project. The paper describes how an activist started a wireless project from one mountain village and gradually extended across more than 150 villages. The paper illustrates how in the midst of challenges he initiated the wireless project to facilitate educational and healthcare services to the mountain regions. The translation process of ANT is used to describe the different phases of the project, showing the importance of connecting to a network of individuals, organizations and technology in these types of project. The paper enhanced the theoretical and practical understanding by thoroughly examining the roles of different ICT actors in formation and extension of ICT4D projects in the context of developing countries. Furthermore, the paper provides insight to academics and practitioners through rich description of the case and its findings vis-à-vis suggests some future research possibilities.

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APPENDIX A

ORGANIZATION	POSITION	OBJECTIVES
Nepal Telecommunication Authority	Director	Connecting all the district head quarters to optical fibers
OLE Nepal	Director	Facilitate learning and teaching using computer mediated program
Thamel.com	CEO	Expansion of ecommerce services in remote areas
High Level Commission for Information Technology (HLCIT)	Joint Secretary	Monitoring and evaluation of egovernment services
Kathmandu Model Hospital	Doctor	Install telemedicine services in the mountain regions
Nepal wireless network project	Team Leader	Socioeconomic development of mountain regions
Himanchal Boarding School	Teacher/Technical support	Computer based teaching and learning
Tikot School	Computer teacher	Computer based teaching and learning
VDC Nangi	Chairman	Access information and communication
Kipang VDC	Chairman	Access information and communication
Institute of Engineering (IOE), Tribhuvan University	Asst. Professor	Research, teaching and implementation of ICT4D and eGovernment projects
Madan Puraskar Pustakalaya (MPP)	Director	Localization such as, developing contents in Nepali language
Nangi Health Center	Health worker	Provide better healthcare services to remote communities
Tikot Health Center	Health worker	Provide better healthcare services to remote communities
Tikot School	Principal/activist	Provide better education, and socioeconomic development
NWNP	Technical expert	Provide better internet connection to the village people
BBC	Journalist	Broadcast the socioeconomic development activities in the mountain region through the wireless project

ICT, SOCIAL CAPITAL AND DEVELOPMENT: THE CASE OF A MOUNTAIN REGION IN NEPAL

by

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ABSTRACT

While the role of Information and Communication Technology (ICT) in fostering socio-economic development is generally accepted, the process through which this may happen remain unclear. In this paper, we take a social capital perspective and propose that ICT helps to create or strengthen social capital of communities which in turn leads to development. To illustrate our proposition, we conducted a qualitative case study in the Myagdi district in the mountain region of Nepal. We studied the Nepal Wireless Networking Project (NWNP) and examined its role in building social capital, and the consequences of extended social capital on socio-economic development process. Our findings indicate that the project is enabling the villagers to create, maintain, and extend their bonding, bridging, and linking social capital. Subsequently, this social capital assists them in developing and improving their education, healthcare, communication, and generating economic activities. We also identified several challenges such as, over dependency on single actor, high illiteracy rate, poor physical infrastructure, language, and lack of participation that may impede the social capital building process.

KEYWORDS: ICT4D, Social Capital, Socio-Economic Development, Mountain Region, Nepal.

1. INTRODUCTION

It is broadly agreed that Information and Communication Technology (ICT) [1] can play an important role in the development of developing countries in general and remote communities in particular (Aitkin, 2009; Akhtar & Gregson, 2001; Chapman & Slaymaker, 2002; Heeks & Kanashiro, 2009; Nair & Prasad, 2002; UNDP, 2001). The reduced cost of installing ICT infrastructure has increased the possibility of technology diffusion in these areas. For example, the ERTIC project in the mountain region of Peru demonstrated that ICT projects can be instrumental in overcoming remoteness and social exclusion problems (Heeks & Kanashiro, 2009). Other projects such as InfoDes, can be helpful in creating social capital in addition to human capital in remote communities (Andrade & Urquhart, 2009).

The social capital perspective, focusing on resources embedded in social networks for mutual benefit of parties within the networks (Putnam, 2000) has occasionally been used as a way to explore the effects of ICT intervention in communities (Urquhart, et al., 2008). Therefore, social capital perspective is a promising lens to explore the relationship between ICT4D projects and socio-economic development process Yet, this relationship is not clear (Yang, et al., 2009). Every interaction between socio-technical actors has wide ranging and unpredictable outcomes on the structure of the social capital, and consequently, on development process at various levels.

There are studies that independently measured the impact of ICT on social capital or the impact of social capital on ICT using individual or collective level of analysis (Ellison, et al., 2007; Frank, et al., 2004; Shah, et al., 2001; Simpson, 2005). However, these studies are mostly based on quantitative techniques which are helpful in identifying causal relationships, but are relatively weak in rich analysis necessary to build theories explaining complicated phenomena, such as the interaction between ICT and social capital.(Yang, et al., 2009). A qualitative approach is more suitable to understand the influence of local context, and socio-technical interaction process. This is particularly relevant in studies of ICT in development. Social capital in developing countries, for example in mountain regions of Nepal, may be significantly different in form and substance from that in developed countries. The reasons for this differences are prevailing caste structures, nepotism, multiple languages and difficult geographical setting (Bista, 1991). Consequently, the pattern of interactions between ICT and

[1] Information and communication technology (ICT) is defined in many ways, such as TV, Radio, Mobile Phones, Internet and other digitally stored information(Duncombe, 2006). For the clarity of the research objective, ICT in this paper refers to the wireless Internet services.

social capital and its consequences can be different in developing countries (Yang, et al., 2009).

In this paper, we address this issue. Our specific research question was: *How does ICT create and extend social capital and how does social capital in turn foster socio-economic development?* To examine our research question, we conducted a case study in the Myagdi district in the mountain region of Nepal and explored the role of a specific ICT intervention called the Nepal Wireless Networking Project (NWNP). We found that despite challenges and some negative consequences, the initiative positively influenced development through social capital.

The rest of the paper is organized as follows. Section 2 presents the theoretical foundation of social capital, and related works on ICT and social capital. Section 3 describes the research background, context, and methodology. Section 4 presents and discusses the findings, specifically the role of NWNP in social capital building process; Section 5 illustrates the positive consequences of extended social capital in socio-economic development process. Section 6 highlights challenges that impede social capital building process in the mountain regions. Finally, Section 7 concludes the paper with a discussion of its achievements and future research directions.

2. THEORETICAL FOUNDATION

2.1 SOCIAL CAPITAL

The genus of the concept of social capital can be traced back to the late eighteenth and early nineteenth centuries (Portes, 1998). The idea that involvement and participation in groups can have positive consequences for individuals and communities and as a solution to social instability and self-destruction was raised by scholars such as Tocqueville, Durkheim, Weber, Locke and Marx . The term "social capital" itself was first coined by Hanifan in 1916 (Hyusman & Wulf, 2006). He proposed that it was helpful in building goodwill, fellowship, sympathy, and social interaction among individuals and groups within a social unit. The concept of social capital, therefore, was more focused on positive consequences of sociability while ignoring the less attractive features (Portes, 1998).

Studies of social capital can be categorized into two broad streams based on the level of analysis (Portes, 1998). The first stream, individual social capital studies, focused on individual (human capital) or small groups as unit of analysis (Bourdieu, 1986; Coleman, 1988). It examined benefits accruing to individuals from their relationships with others. The

second stream, collective social capital studies, extended the concept to a community or national level, considering social capital as both individuals' social networks and their moral attitudes, or social norms, which contribute to common good of a community or even a nation (Putnam, 2000; Yang, et al., 2009). Social capital was further categorized into six dimensions; groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and empowerment and political action (Bank, 2006).

Social capital also has negative consequences, an aspect that has received less attention in the literature. As stated by Portes: "The research literature on social capital strongly emphasizes its positive consequences. Indeed it is our sociological bias to see good things emerging out of sociability; bad things are more commonly associated with behavior of homo economics (economic human). However, same mechanisms appropriable by individuals and groups as social capital can have other, less desirable consequences" (Portes, 1998, pp 15). Negative consequences are related to several issues, such as restrictions imposed on actors who do not belong to network, lacking perception of environmental changes outside the network, negative social dynamics within the network and downward spiraling norms, dependency on central actors and their loyalty towards the network, restrictions on autonomy and individuality resulting from demands for conformity, irrational economic behavior due to the feeling of solidarity towards partners in the network, and irrational economic behavior due to personal aversion (Field, 2003; Hyusman & Wulf, 2004).

2.2 FORMS OF SOCIAL CAPITAL

Social capital has different forms: *bonding, bridging,* and *linking* (Healy & Cote, 2001; Putnam, 2000; Woolcook, 2001). As summarized in Table 1, bonding social capital refers to relation amongst homogenous groups such as family members, close friends, ethnic fraternal organizations such as religion based groups. Bridging social capital refers to relation among distant friends, associates and colleagues, as well as institutions such as civil rights movements, and ecumenical religious organizations. Linking social capital refers to relations between individuals and groups in different social strata in a hierarchy where power, social status and wealth are accessed by different groups (Healy & Cote, 2001). The concept of linking social capital is extended to include capacity to leverage resources, ideas and information from formal institutions beyond the community (Woolcook, 2001).

Bonding and bridging social capital have resonance with the ideas of "strong ties" and "weak ties" respectively (Granovetter, 1973). Bonding social capital is good for maintaining existing

relations. However, strong bonding social capital may sometime have adverse impact and serve to exclude and create a context for the growth of reactionary ideology. Bridging social capital is crucial for extending social networks, and it could be an important resource in facilitating mobility. ICT in this context may provide an opportunity to create bridging and linking social capital while at the same time, may help in maintaining existing bonding social capital.

2.3 ICT AND SOCIAL CAPITAL

Despite abundance of research in social capital in fields such as sociology, political science, economics and organization science, the attention from IS scholars has been minimal (Hyusman & Wulf, 2004). This is unfortunate because the interdisciplinary nature of IS research and growth in networks within and between organizations makes research into the relationship between ICT and social capital even more important. Social capital in relation to ICT can be framed at the individual level as connecting and enabling social capital (Yang, et al., 2009), and studies can examine the impacts of ICT on individual's social networks and the possible benefits generated by such networks. At the collective level, research can focus on identifying the role of ICT in social capital building in communities. The study reported in this paper can be categorized as at the collective level and explores how ICT facilitate remote communities to build their social capital.

Research shows that ICT facilitate the building of social capital through increasing flows of information (Adam & Urquhart, 2009). A number of anecdotes indicate that ICT can lead to creation and maintenance of bridging, bonding and linking social capital (DCITA, 2005). This is corroborated by findings from studies that examined the impact of online social networking sites (SNS) on formation and maintenance of social capital (Ellison, et al., 2007). Focusing on both the maintenance of existing social ties and the formation of new connections, they identified a positive relationship between certain kinds of SNS use and the maintenance and creation of social capital. Such studies illustrated the impact of ICT on social capital and vice versa (Frank, et al., 2004; Shah , et al., 2005; Simpson, 2005). Other studies show that ICT promote interactions among community participants that helped to generate and maintain the trust, acceptance, and alignment necessary for successful cooperation (Syrjänen & Kuutti, 2004). A case study on Iranian NGOs found that computer based centers facilitate the building of e-community and extend existing community networking through improved transparency and participation (Rohde, 2004). Our study builds on this stream of research to understand the role of ICT in creating, maintaining, and extending of social capital

in remote communities of a mountainous region in a developing country. Specifically, we studied an ICT initiative, the Nepal Wireless Networking Project (NWNP) in the Myagdi district in Nepal.

Table 1. Forms of Social Capital

Forms of Social Capital	**Description**
Bonding Social Capital	Denotes ties between people in homogenous groups and similar contexts such as immediate family, close friends and neighbors and ethnic fraternal organizations.
Bridging Social Capital	Denotes ties among distant friends and, associates, as well as between institutions such as religious organizations, and civil rights movements.
Linking Social Capital	Denotes ties among unlike people in dissimilar situations, such as those who are entirely outside the community and in different social strata in a hierarchy of power social status and wealth.

3. RESEARCH BACKGROUND, CONTEXT AND METHODOLOGY

3.1 NEPAL

Nepal is a landlocked country situated in South Asia, on the southern slopes of the Himalayan mountain range, and lies between two giants India and China (Figure 1). The total area of Nepal is 147,797 sq km. The country is comprised of three main geographical regions, the Tarai (17% of the total) in the south, the central mountain region (64%), and the Himalayan region (19%) in the North. As shown in Figure 1, Nepal is divided into 5 development regions, 14 zones and 75 districts. The village development committee (VDC) is the administrative unit below district. There are around 3914 VDCs all over the Nepal. The lowest administrative division is the ward. There are around 9 wards on average per VDC. The total population of Nepal is around 27 million, about 75% of whom live in rural and remote areas mainly in mountain regions.

A large proportion of the population lives below the poverty line. The literacy rate in Nepali, the national language, is 82% and in English is approximately 18%. Computer ownership per 100 inhabitants is 2.80, and telephone lines per 100 inhabitants are 3.5 (ENRD, 1997). Human

development report 2004 shows that the mountain region has the lowest human development index (HDI) score amongst the three regions and is also the poorest (UNDP, 2004). The social, political, and economic disparities among regions flared up conflicts among different communities and political institutions. Consequently, it eroded the social capital that existed within communities (the binding elements of trust), and severely disrupted indigenous forms of social networks and institutions (the bridging of the elements). Clearly, the mountain region is the most underdeveloped. It was here that the project we studied, NWNP was initiated. It is situated in the Myagdi district of Nepal which is located at an altitude of 2700 meters above sea level as depicted in Figure 2.

Figure 1. Map of Nepal

Source: www.planetware.com

3.2 NEPAL WIRELESS NETWORKING PROJECT (NWNP)

The Nepal Wireless Networking Project (NWNP) was started in 1997 by educationist and social activist Mahabir Pun (team leader of the project). After completing his Masters degree from US, Pun returned to teach at a village high school located in Nangi in Myagdi district. At that time, villagers had to make two-day trips to the nearest town (Pokhara) to check their e-mail from friends abroad. In 1997, through personal correspondence, Pun succeeded in acquiring four used computers from Australia and began teaching computer classes at the Nangi high school using them. Later, the school received some more donated computers; however, there were no telephone or internet connection in the village.

In 2001, Pun wrote an email to the British Broadcasting Corporation (BBC) asking for ideas to connect this remote village to the outside world through internet. When the BBC published

his email, the response was overwhelming. Within a year, volunteers from Europe and the United States began to help him in setting up a wireless connection between Nangi and other neighboring villages such as Tikot, using TV dish antennas mounted in trees. Gradually, the success story of NWNP spread across the World Wide Web, and his social network started extending across to other parts of the world. Volunteers from several countries started donating computers, parts, Wi-Fi equipments, and perhaps most importantly, their skills to these mountain villages.

Since 2003, this project has been in full-fledged operation. Despite difficult circumstances, such as lack of government support, lack of funding, lack of technical knowledge, and an unstable political system (Nepal was in fact involved in a civil war between the government and the Maoists when the project started), the project succeeded in providing internet service. It uses minimal wireless technology, home-made antennas, and relay stations that had to be hidden in trees. Pun was recognized for his initiative when he received the prestigious Magsaysay Award in 2007. Currently, the NWNP has built networks in around forty villages in Myagdi and other districts, and is partially supported financially by the World Bank and Nepal Telecommunication Authority.

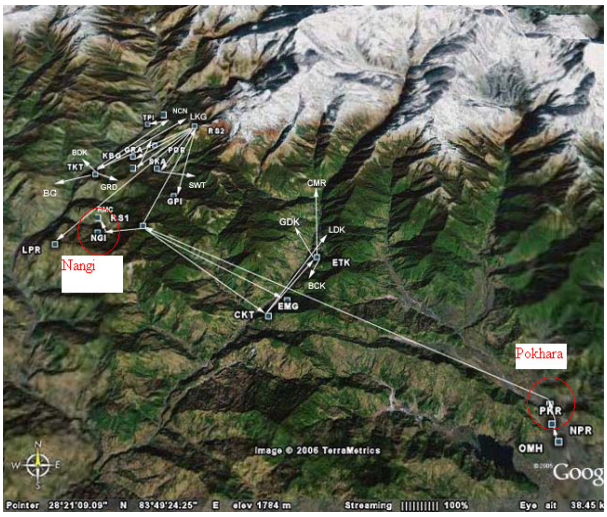
3.3 RESEARCH SITE

The research study was conducted in Nangi and Tikot villages in the Myagdi district, located in western Nepal on the southern flank of the Annapurna and Dhaulagiri ranges of the Himalayas. (Figure 2) We chose Nangi because it was the first Himalayan rural village of Nepal where NWNP provided internet connection. The central office of NWNP Project is the Nangi telecenter which is run by Himanchal Higher Secondary School and it coordinates the whole wireless network which covers the different villages of Myagdi, Parbat and Kaski districts. The center has now started extending its services to several other rural and remote villages of Nepal.

The total population of Nangi and Tikot villages is around 2,000. Villagers from these remote regions have to go to urban areas to procure employment, education, and healthcare services. Tikot is not accessible by road. While Nangi is better connected, it still takes about four hours by jeep or one day's walking to the nearest town of Beni. From Beni, it takes another seven-hour bus ride to reach the capital city of Kathmandu. These two villages are inhabited predominantly by Magar ethnic communities including other minority castes and social groups (Pun, 2006). Most of the villages in mountain regions are scattered in small clusters with average populations of less than one thousand. Before the intervention of ICT through

NWNP, and because of the geo-political exclusion, their social network was limited to strong ties or bonding social capital within their own homogeneous group. Most of the decisions were taken by the communities themselves in the presence of VDC chairpersons.

The inhabitants in these villages still practice shamanistic rituals and shamans are respected as traditional doctors and healers. Medical clinics have only recently been set up. Most of the villagers are farmers growing mainly potatoes and other agricultural products. Young men from these villages prefer to join military service either in India or UK, mainly because a high level of education is not a requirement for enrolling. The main source of revenue for the villagers is not surprisingly remittances of salary from military service, and whatever is earned from selling agricultural and dairy products.



Source: Google map

Source: Picture taken during field visit

Figure 2. Geographical landscape of Nangi village

3.4 DATA COLLECTION

We collected the research data through interviews, notes taking, observations, archival records, physical artifacts, and documents. To obtain primary data, 40 respondents were interviewed from the two communities of Nangi and Tikot. Using the snowball technique, we selected the interviewees from different village development committees (VDCs), IT vendors, policy makers, private investors, and donor agencies. The interviews were mainly semi-structured, lasted between 15 and 55 minutes, and were tape-recorded. To obtain the collective views, we conducted focus group interviews of school children, teachers, and local users and non-users. We also observed ICT usage at schools, telecenters, and village telemedicine clinics. In addition, we gathered supplementary data from different relevant Internet sites, through informal discussions, email exchange, social networking sites, and

different websites of ICT4D projects. We also conducted a workshop on ICT4D in Kathmandu which was attended by various actors involved in NWNP including Mahabir Pun.

3.5 DATA ANALYSIS

All the interviews were transcribed. We then used nVivo tool to summarize, code and categorize the data in accordance with the social capital perspectives. To check the reliability and validity of interviews and interpretation, we held regular discussions with other researchers and practitioners throughout the project. One of the researchers was from a remote community of Nepal, and his knowledge and experience as an insider helped with understanding the reality of the research context.

To insure rigor, we evaluated the research process using the set of principles provided by (Klein & Myers, 1999). For example, we used the Hermeneutic circle to map the codes to the theoretical concepts, such as bonding, bridging, and linking social capitals. Next, we followed an iterative analysis process to connect codes with categories and sub-categories of social capital. It is important to emphasize that we used the theoretical concepts to get a richer understanding of the process as a sensitizing device rather than testing or falsifying hypotheses. The social capital perspective thus served as *a prioi* guideline for collecting and analyzing data (Walsham, 1995).

4. FINDINGS

The wireless project provided an opportunity to the remote communities in Nangi and Tikot to extend their social network. At present, villagers are using the internet for communication purposes. People from the villages who are working abroad are using e-mails to communicate with their families back home. Students and teachers are offered web mail accounts through the project, while others are using free web mail accounts such as Yahoo and Gmail. There is a bulletin board for local news, local advertisements, announcements, and urgent messages. One of the respondents, a school principal said:

It [NWNP] has increased the dimension of communication. For non-students, the communication patterns have been somewhat changed, for example, by providing faster communication opportunities. But in the case of students it has been drastically changed. They are using social networking services to make a lot of friends. Likewise, we have a lot of volunteers from other countries with different nationalities and cultures. We can have cultural exchanges, building friendships with them. The dimension of communication has been altered.

Social capital extends the network and relationships amongst groups and individuals based on trust, reciprocity, and exchanges (Portes, 1998; Woolcock & Narayan, 2000). In the following sections, we describe the role of the wireless project in the creation, maintenance and extension of social capital, specifically, bonding, bridging, and linking social capital.

4.1 BONDING SOCIAL CAPITAL

As defined in Section 2.2, bonding social capital refers to connections within a homogeneous group whose members share some demographic characteristics such as family, kinship or ethnicity. The majority of the inhabitants of Nangi and Tikot villages belongs to the same ethnicity, namely Magar and thus possessed high bonding social capital to begin with. However, they were not able to interact with their relatives and friends who did not live in the immediate vicinity. With the use of the wireless network, Nangi and Tikot village people are able to maintain their bonding social capital. The villagers can now connect with their relatives through email, chat and other social networking sites. Students from high schools are using the network to write e-mails to each other and to their pen-pals abroad. In the past, the villagers used to send letters through post office that used to take months. Now they can communicate in real time no matter where they are located. A village activist explained:

Regarding the social impact, we are not in a position to say that it has a solid role in development; however, the perspective of the village people regarding the computer and its usage is changing. They are at least using email and chat for sending and receiving message to/from their relatives in foreign countries.

4.2 BRIDGING SOCIAL CAPITAL

As defined earlier in Section 2.2, bridging social capital refers to relationship among distant groups. The wireless project has enabled Nangi and Tikot villages to connect with forty other villages which have brought together people across diverse social divisions. The project has also facilitated the creation of the bridging level of relationships among various informal and formal institutions which have different functions and are located in different places. For instance, the NWNP is working with Open Learning Exchange (OLE) Nepal, an NGO based in the US and Kathmandu, as a partner to develop educational contents for the school children. The contents are based on the government curriculum from grade one through ten.

In addition, the NWNP is in the testing phase of using the network for online-based learning. The objective is to provide further education for youngsters living in the villages. To meet the challenge of bringing specialist doctors into the mountain region, the NWNP has initiated telemedicine services in some villages of Myagdi. Every morning, the women who are

responsible for health care services in the villages consult doctors from main hospitals using videoconferencing services, to discuss patients, common diseases or to learn from doctors and health care workers from other communities.

Extended bridging capital can be helpful to generate employment opportunities in the villages. For example, NWNP has developed an eCommerce platform in collaboration with an engineering college in Pokhara, the nearest large urban center. In addition, it is planning to start a remittance service because many from these remote communities go to work abroad. Moreover, virtual ATM machine services are being piloted in Ghore Pani (a famous trekking route for tourists), which will be further distributed to other tourist areas. The initial success of NWNP helped these remote communities to create a link between VDCs and local government institutions to replicate similar projects.

4.3 LINKING SOCIAL CAPITAL

Linking social capital pertains to vertical connections to formal institutions mainly at a higher level of hierarchy (Woolcook, 2001). In the context of Nepal, this implies connections with people in powerful and influential positions, whether political or financial. The wireless project not only facilitated relationship between the Nangi and Tikot villagers and local governments, but also assisted in building relationship between these villages and central government. These relationships were also at broader scales for macro level development. Pun successfully lobbied parliament to de-license wireless technology and remove high customs levies on equipment, in order to facilitate its adoption throughout the country. NWNP is helping to develop websites of different mountain villages for e-governance program (Pun, 2009), which may help to extend the linking social capital between community people and central government.

Before the initiation of this project, these mountain villages were almost unknown to the outer world. However, with its extension to several other mountain villages and coverage through different media, such as World Wide Web, radio, magazines, and TV, large number of volunteers, consultants and researchers from all around the world are flocking to these villages. NWNP is currently working on creating a research hub between Japanese, European, Indian, and US Universities and research institutions (ENRD, 1997).

5. LINKING ICT, SOCIO-ECONOMIC DEVELOPMENT AND SOCIAL CAPITAL

In the previous section, we described how the ICT initiative, the NWNP, facilitated the community people in creating, maintaining and extending their bonding, bridging and linking social capitals. The question remains though about how social capital in turn fosters socio-

economic development. One possible link is through social capital's role in developing human capital (Coleman, 1988). It can also be an instrument to access resources embedded in the relational social structure (Bourdieu, 1986). Studies show that social capital leads to civic engagement, better healthcare, and educational improvement (Putnam, 2000). It is further argued that social capital as trust among different institutions and citizens likely leads to economic development (Woolcock & Narayan, 2000). The essence of social capital lies in its ability to secure benefits by virtue of membership in networks and other social structures (Portes, 1998).

The wireless project provided a platform for villagers to use internet services, such as VoIP and social networking sites to build new networks and relationships and extend and strengthen existing ones. This increase in their social capital has possible implications in the socio-economic development process. Table 2 summarizes this link. The citations in the table refer to the sources in the literature that link these processes to development.

Table 2. Social Capital and Socio-Economic Development Process

Social Capital	**Socio-Economic Development Process**
Bonding	- Return migration from urban to rural (Ma, 2002) - Resource sharing within community people(Lin, 1999) - Maintaining trust within community people(Putnam, 2000) - Increasing flow of social and financial remittances(Levitt, 1998) - Job searching(Lin, 1999) - Building human capital(Bourdieu, 1986; Coleman, 1988)
Bridging	- Better healthcare services with telemedicine - Sharing education material with other schools within Nepal - Creating economic opportunities, such as small scale industries - Resource sharing between distant community people(Granovetter, 1973)
Linking	- Sharing educational material with international schools - Accessing better healthcare services through telelink to developed countries - Linking local level community with national level government using eGovernance services(Woolcock & Narayan, 2000) - Facilitating technical information flows (Barr, 2000), research collaboration with national and international institutions - Providing platform for ecoTourism businesses

As we can see from the table, ICT provided the platform to maintain bonding social capital and created a trust between and within the members of the communities. They can share information about their cultural and other activities online. Through extended bridging social capital, village people can enjoy better education and health care facilities. The villagers also started small scale industries like Nepali paper production. The extending of bridging social capital to marketers in Australia resulted in these Nepali paper products being sold in Australia. The linking social capital with different government agencies, tourism sectors and international research institutions has the potential to bring international standard education to these remote villages, which in turns facilitate in building human capital, provide healthcare services and business, and research collaboration opportunities.

In the following sections, we discuss some specific areas to illustrate the link between ICT, and socio-economic development process from the perspective of social capital.

5.1 EDUCATION

Creating and extending bridging social capital enabled school children in the area to search and share information from where other resources were available. Teachers and students are getting access to some educational materials on the intranet. During our focus group interviews some children described their use of the Internet:

It helps us in our study because to understand the history only course book is not enough, therefore, we can download other information to know more. It's helping us in getting external and study related information.

Because of extended social networks, school children are motivated towards learning and teachers are motivated towards teaching. The project has facilitated the building of social capital between schools. It developed local manpower, such as IT teachers, clinic health workers, and network technicians. They are not only providing training to their local people but also to other localities in that region.

5.2 HEALTHCARE

NWNP has set up a telemedicine center between Nangi, Ramche, and Tikot villages. Now, the health workers of these villages can communicate with a medical doctor in the urban center of Pokhara for medical assistance. The village health workers facilitate communication between the doctor and the patient and provide the medicine prescribed by the doctor. A health worker in Nangi telemedicine center said:

Telemedicine means, here we have a small clinic, where two sisters [nurses] are working. If they find any difficulty or some emergency cases then they directly connect to Kathmandu or other 4-5 main hospitals and consult with them.

Team leader of NWNP project described the importance of ICT in creating bridging and linking social capital, especially between remote and urban hospitals, n the following words:

It is difficult to get specialist doctors in remote places; in this situation we are using this technology to access doctors from remote places. The people who have not seen doctors can see the doctors through this technology. These are the main focuses of our project. So wherever we are going we are connecting schools and health post stations.

Health workers from the Nangi and Tikot villages asserted that telemedicine assists in the development of trust, an important element of social capital, among village people due to the virtual presence of doctors. A doctor associated with this project said:

Particularly in the villages, people are afraid of diseases. When they see a doctor in front of the camera prescribing them medicines, they feel confident, they feel psychologically confident.

5.3 ECONOMIC OPPORTUNITIES

The extension of social networks created economic opportunities for the villagers. One example is the cross-breeding project between yak and cow initiated by villagers at Nangi.The project is located at a remote site which is 800 meters above the village. Through internet applications such as NetMeeting, members of the management committee of the project can communicate with each other when making decisions. The wireless project has also initiated income generating activities, though these are still in a test phase. One example is the virtual marketplace called Haat Bazaar where villagers can advertise their local products, such as cows, goats and chicken for sale. The team leader of NWNP project told us:

They can use it for advertisement; now in our village because of this internet we can promote local products, such as Doko, Namlo, Nepali paper, mushrooms, and cattle. If they want to sell their product then they can use our services like Haat Bazzar on the net. They can contact the internet operator where we have installed internet services, and put up the information from there. So that other people can see on the net and buy that product.

He also indicated that new services are being planned:

…remittance services, which are going to be started soon in this village. Because of this [remittance] friends in the foreign country can send their money easily. This is also a benefit to the community.

The youth in the villages are getting employment in the project. They are enhancing their knowledge and skill through the use of ICT. During our interview one of the technicians said:

Mahabir sir taught us at the beginning, such as checking radio, operating computers. And then using by myself I learned it through experience.

For long term sustainability, financial capital plays a vital role. The NWNP is also planning to start eBusiness services (a means of building linking social capital) such as eco-tourism, and ATM virtual machines. Team leader of the project said:

To make this technology sustainable, we need to introduce ecommerce, so that we can get some economic sustainability.

6. CHALLENGES AND NEGATIVE CONSEQUENCES

The NWNP has enabled the villagers of Nangi and Tikot to build and strengthen their social network; however, there are a number of challenges that needs to be addressed. These challenges can create obstacles in social capital formation process; consequently, the benefits of ICT4D projects in the remote communities may not be realized. The Director of Nepal Telecom Authority described these challenges as follows:

Rural means no affordability, lower literacy rate, everything is not good, below average, and poverty incidence is high in rural areas. So all this factors, moreover, the supporting infrastructure such as, electricity, road network, and other supporting infrastructure are not developed in the rural areas.

Below, we briefly elaborate on these challenges.

6.1. ILLITERACY, LANGUAGE, AND LACK OF PARTICIPATION

Our study shows that the main challenges in social capital formation are language and lack of participation from elder generation. For example, the majority of the villagers are using ICT services for communicating with their relatives or friends. While it may be helpful to maintain the bonding social capital, they need to extend their social network for macro level socio-economic development (Granovetter, 1973; Woolcock & Narayan, 2000; Woolcook, 2001). As mentioned earlier, only 18% of the educated population in Nepal is literate in English and the figure is much lower in the mountain region. As a consequence, the majority of the people in Nangi and Tikot villages are less familiar with English-oriented ICT services. However NWNP has initiated several networking projects focusing on developing online context based on the Nepalese language.

The participation of the community people is also important for creating social capital. The participation of farmers (the majority of people living in these villages) is still a challenge due to their lack of education, high illiteracy rate, and lack of time to participate in training to increase their ICT competence. The VDC chairman of Nangi village, who learned to use computers and the Internet, explains:

In this village, around 50% are retired personnel from the UK's or India's armies. I told them this is an Internet age; we used to send letters using the post office but now, because of the Internet and telecommunication, we can send information to different places easily. Therefore, I asked village elders to come and take computer education, but still, they are not able to understand it.

6.2 POOR INFRASTRUCTURE

Power shortage and poor existing infrastructure are general challenges for the mountain regions. The country is currently facing twelve hours of power cut. Solar power is expensive and season dependent, for instance, it is useless during the rainy season. Poor infrastructure may impede the smooth flow of information and communication that may erode social capital in the long run. For example, lack of sophisticated devices has hampered the quality of telemedicine services in Nangi and Tikot villages. Team leader of NWNP told us that to generate local content and promote it to outside market broader Internet bandwidth is needed which is not available in mountain regions:

The only constraint to make VoIP telephone call to the villages from abroad using the extension number is that they don't have enough Internet bandwidth from the ISP. People are using Skype, Yahoo Voice Chatting in the morning or evening because during that time Internet bandwidth is available.

The poor physical infrastructure in these villages also hindered health workers in using their full capability in the telemedicine project. One of our respondents told us:

When I went to Kathmandu Model hospital last time for training, there I could use lot of lab facilities, but it is not available here. Because it requires lot of equipment, therefore, I am not able to use my learning in full.

6.3 POLITICAL INSTABILITY

Nepal's social capital is depleting due to political instability and lack of government intervention policies (UNDP, 2004). Ten years of Maoist insurgency, massacre of the former King's family, and a succession of fragile governments are some of the reasons for this. Decades of political instability in Nepal has hampered the overall socio-economic growth. There is a lack of government support for community based ICT4D projects such as NWNP. During our interview one villager from Tikot complained:

District education office is not helping us directly, but education ministry provide them around 40-50 thousand for the internet provision to the schools. They sometimes offer us a program to provide equal amount of money from the community and from the district education office… but that small amount is not enough to contribute to the big change.

6.4 DEPENDENCY ON CENTRAL ACTOR

Mahabir Pun initiated the project from his uncle's house. The project was illegal at that time, and had to be located in mountain areas dominated by the Maoists. Pun's importance cannot be overestimated, and based on what he has done with the NWNP he is currently well-respected at all levels in Nepalese society. This gives him access to all offices, including ministries in the capital, Kathmandu. Thus, his network is of critical importance. However, this is also a double-edged sword. As Portes (1998) pointed out, over dependency on a central actor can be a negative consequences of social capital. The project would not exist without him, but it will also fail if he can no longer manage it. Therefore, the project may face the challenge in making the transition from its initial phase where the champion is of critical importance, to a more mature phase where it is less dependent on one (or few) contributor(s).

In the case of Tikot village, the one man dependency effects technical support as well. One of the teaching staff in Tikot School told us:

If the computers get out of order, then there is no one to give support. We have just one Tek (technician), he is also not perfect. He does according to the instructions given by Mahabir on phone. Otherwise, if the problem gets bigger than he [Mahabir] needs to come.

Another teacher expressed his worries thus:

It was not possible without him; still I didn't find any other person who came here to work like Mahabir. For example, there are many people who came from foreign countries to observe the project, but there were no one who says that I will work with Mahabir. Therefore, until Mahabir is here, it will function properly, however in his absence, we need another person like him for the sustainability of this project. Therefore, in his absence this project may not function properly, I am bit worried about it.

Although NWNP has the support of community members, they are still over dependent on team leader for funding, planning, and action. A villager from Nangi expressed his concerns thus:

Mahabir has done this entire thing. He is the one who brings computer and internet in this village. All the credit goes to him. As long as Mahabir is with us, there is no fear. However, in his absence we are little doubtful.

7. DISCUSSION

Before proceeding on to a discussion on the research and practical implications of our findings, we point out the limitations of the study. Our data was collected from two remote mountain villages in Nepal and is thus highly context dependent. That limits the extent to

which our findings are generalizable. The time frame of the study also raises the possibility that we may not have captured the effects at the "right" time. Such projects may require a longer period to have a more sustained influence. The researched communities were composed of homogeneous groups; result could have been different in other multi ethnic communities. Difficult geographical location, and low literacy rates were other obstacles in collecting data. Our findings should thus be interpreted in the light of these limitations.

Overall, NWNP has created a positive wave in Nangi and Tikot villages. The expansion of the network from what initially covered just two villages to currently more than forty is in itself an indication of success. Despite some challenges and negative consequences, the project has been sustainable and is an important example of a relatively successful ICT4D project in remote areas in a country such as Nepal which is rarely (if ever) discussed in the literature. Supportive government policies, infrastructure development, and public-private partnerships may support the replication of the NWNP experience across other mountain villages in Nepal, which in turn may inspire similar initiatives in other developing countries.

Theoretically, our research interest was exploring the link between an ICT intervention in a developing country and socio-economic development. We proposed that ICT helps in developing and extending social capital which in turn lead to development. At least in the context of a remote mountainous region, we found support for our proposition. The wireless project led to strengthening of bonding, bridging and linking social capital. It opened up prospects in education, healthcare, communication, and ecommerce despite barriers such as, high illiteracy rate, poor infrastructure, language barrier and lack of participation.

It is tempting to suggest practical implications based on our findings. The obvious one is that ICT initiatives should focus on facilitating bindings within communities (to enhance bonding social capital), between communities (to extend bridging social capital) and with higher levels (to create linking social capital). At the same time, it is vital to not be overly dependent on a central actor or on a small group. Paradoxically, projects such as NWNP succeed in remote regions precisely because of the activist roles of central actors like Pun.

Yet questions remain. The social capital perspective does not tell us how the capital building process happens. Who are the central actors? How do they go about building the social networks? Further research is needed. One possible theoretical lens to examine these issues is Actor-Network Theory which can help explain who the main actors are and how members are enrolled in the networks. However, that raises even more questions. Why do the actors act the way they do? What motivates or drives them? Theories such as Stakeholders or Genres of communication can be useful to examine these issues. These are avenues for future research.

Ultimately though, we may have to accept the very plausible outcome that research may only be able to partially answer the question of how exactly an ICT intervention can lead to development. As one of our respondents in Nangi village said:

"*The Internet cannot help us with plowing, sowing, and harvesting. But by using the Internet, we can engage in a lot of other educational and financial development, I believe*."

The encouraging part was that he was enthusiastic!

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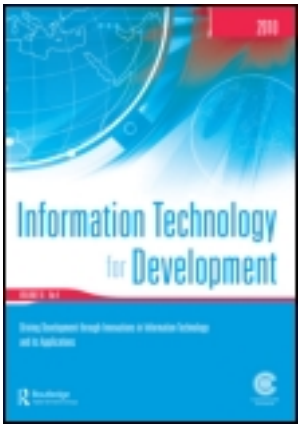

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Building collective capabilities through ICT in a mountain region of Nepal: where social capital leads to collective action

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Building collective capabilities through ICT in a mountain region of Nepal: where social capital leads to collective action[†]

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In this paper, we explore how ICT can lead to development specifically human development in Sen's capability approach. In answering to the critique that Sen views capabilities as the individual, we incorporate the societal level by adding collective capabilities. We propose that ICT helps to create or enhance SC of communities which in turn can lead to development by building collective capabilities through collective action. To illustrate, we conducted a qualitative case study of an ICT initiative in a remote mountain region of Nepal. We found support for our proposition and further that developing collective capabilities also simultaneously enhanced individual capabilities. We contribute to theory building by showing that not just the characteristics of SC, but also its form can promote collective action. We further illustrate that the SC and the capability perspectives are compatible and it is possible to read the two streams both simultaneously and complementarily.

Keywords: ICT4D; human development; capability approach; collective capabilities; collective action; social capital; mountain region; Nepal

1. Introduction

It is broadly agreed that information and communication technology (ICT)[1] can play an important role in the development of developing countries in general and remote communities in particular (Aitkin, 2009; Heeks & Kanashiro, 2009). The reduced cost of ICT has increased the possibility of technology diffusion in these areas. As Amartya Sen himself puts it bluntly, "The availability and the use of this technology is no longer optional."[2]

The question though is how specifically does ICT lead to development? A more fundamental question is what do we mean by development? An extensive review of this much-debated issue is beyond the scope of this paper. We simply affirm that, in keeping with the theme of this special issue, we view development as human development, and concur with Sen's conceptualization of development as freedom (Sen, 2000). While the ICT4D literature has delved into human development to some extent (Avgerou, 2003; Heeks, 2008; Sein & Harindranath, 2004), it has only lately begun to adopt Sen's ideas (Díaz Andrade & Urquhart, 2009; Toboso, 2011; Zheng, 2009). This is encouraging since Sen's capability approach (CA) is a suitable and appropriate lens to investigate how ICT may foster development (Zheng, 2009).

Contrary to the traditional dominant focus on economic decision-making to explain development, Sen's broader view focuses on the social dimension of development (Lehtonen, 2004). The CA proposes that capabilities give an individual the freedom to make decisions

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that can help in achieving the life he or she values and has reason to value (Sen, 2000). The key to development as pointed out by Oxoby (2009) is to build these capabilities through commodities (such as ICT).

The CA emphasizes the development of individual capabilities.[3] This view is echoed in the ICT4D literature. For example, the "enabler" view of ICT (Sein & Harindranath, 2004) essentially relates to enhancing an individual's capability through empowerment and knowledge. It is this individualistic emphasis that leads to the criticism of Sen's concepts. A detailed review of this discourse is beyond the scope of this paper. Instead, we refer the reader elsewhere (Evans, 2002; Ibrahim 2006; Zheng, 2009). The gist of the criticism is that by focussing on the individual, Sen de-emphasizes the role of the collective, considering it as merely instrumentally influencing the development of individual capabilities. Sen in fact rejects the notion of "collective capability." In the context of a developing country, and especially in remote regions, this can be seen as a major weakness. First, building of individual capability presupposes that the individual is not socially excluded (Oxoby, 2009); she has access to resources, such as economic, political or social, that enables her to build her capabilities. Such is seldom the case in poor regions (Evans, 2002). Individuals, however, rely on social networks to make up for lack of individual resources (Díaz Andrade & Urquhart, 2009; Ibrahim 2006; Oxoby, 2009). Second, even when individual capabilities are enhanced, it is not certain that the community as a whole benefits (Ibrahim, 2006).

Yet, even his critics concede that the CA is a powerful lens to study human development. It is termed as suitable, but insufficient (Ibrahim, 2006) and incomplete, but a good foundation to build upon (Zheng, 2009). We agree. Following Evans (2002), we propose that Sen's CA can be complemented by incorporating theoretical and conceptual premises that emphasize the collective and the society. Adding *collective capabilities* to individual capabilities gives us a sharper and more powerful analytical framework to examine how ICT can lead to human development.

Collective capability is not merely the sum of individual capabilities (Ibrahim, 2006). Rather, these are properties of a group (e.g. a trade union) which an "individual alone would neither have nor be able to achieve if he/she did not join a collectivity" (Ibrahim, 2006, p. 404). Developing such capabilities require (and is influenced by) *collective action* where individuals act together as a group to achieve common goals. In spite of its intuitive appeal, collective action is not easy to achieve. The main challenge is the potential tension between the individual agency and group goals (Gilbert, 2006; Ostrom, 2000). Hence, a conceptual framework that seeks to link any initiative (e.g. ICT) to human development by building collective capabilities needs to include a mechanism to foster collective action.

One such possible mechanism is social capital (SC) (Ostrom, 2000; Ostrom & Ahn, 2003). SC focuses on "the norms and networks that facilitate collective action" (Woolcook, 2001, p. 70). By emphasizing the resources embedded in social networks, it is an appropriate perspective in general to explore the collective or social level of development (Ibrahim, 2006; Lehtonen, 2004; Oxoby, 2009; Putnam, 2000), and in particular the effect of ICT intervention in rural areas of a developing country (Díaz Andrade & Urquhart, 2009). However, this relationship is not clear (Yang, Lee, & Kurnia, 2009). Every interaction between socio-technical actors has wide ranging and unpredictable outcomes on the structure and development process of SC.

This is particularly relevant in ICT4D research. SC in developing countries may be influenced by such contextual issues as the prevailing caste structures, nepotism, multiple languages and difficult geographical setting (Bista, 1991). Consequently, the pattern of interactions between ICT and SC and its consequences may be different from those in more developed countries.

We address these issues in this paper. Our specific research question is: How does ICT create and extend SC and how does SC in turn foster the collective action that enables the building of collective capabilities? Through a case study in the mountain region of Nepal, we explored the role of an ICT intervention called the Nepal Wireless Networking Project (NWNP). We found that despite challenges, the initiative positively influenced development through SC.

The rest of the paper is organized as follows. Section 2 presents the theoretical premises on which we build our arguments. In Section 3, we describe the research background, context, and method and we present our findings in Section 4. Finally, in Section 5, we discuss the theoretical and practical implications of our findings, and offer suggestions on future research directions.

2. Theoretical premises

In this section, we elaborate on the theoretical concepts that form the basis of our arguments in this paper. First, we discuss collective capabilities and collective action and the challenges to achieving collective action. We then discuss SC, which we suggest as a means of meeting this challenge.

2.1 *Collective capabilities and collective action*

Collective capabilities can be defined as "the freedom of a group of individual agents to perform a set of agentially distinct actions in combination" (Carter, 1999, in Ibrahim, 2006, p. 404). Such capabilities are distinct ones that an individual can only attain as a member of a group. Thus, trade unions are able to achieve bargaining power that individual members are unlikely to attain by acting alone. Referred to also as "social capabilities" (Comim & Carey, 2001), these incorporate variables such as norms and mutual trust that are only meaningful at a collective level and are characterized by joint participation (Comim & Carey, 2001).

Collective capabilities result from social interaction through the individual's engagement in collective actions (Evans, 2002; Ibrahim, 2006). Defined as "doing something together or acting together" (Gilbert, 2006, p. 4), collective action can act as an engine for collective capabilities in poor communities for various reasons (Ibrahim, 2006). First, it can promote income generation and resource sharing, and encourage poor people to participate in local decision-making. Second, it can influence the formulation of values and beliefs, as an outcome of a social context. Third, collective action and collective freedom are mutually reinforcing, where freedom widens the possibilities for collective actions, which again allows individuals to exercise their freedom (Ibrahim, 2006). A more forceful argument for collective action in a poor country is that organized collectives are fundamental in expansion and exercise of individuals' freedoms especially when powerful forces oppose them (Evans, 2002).

2.1.1 *Achieving collective action*

Collective action requires a joint commitment which binds group members through a shared and persisting reason to commit and oblige them to act as agreed upon (Gilbert, 2006). Such commitments are often implicit and voluntary. This leads to the central question of why individuals should take part in collective action. The core of Olsen's "zero contribution thesis" is that in the absence of external forces such as coercion, no rational individual will take part in actions to achieve a group goal (Ostrom, 2000). Yet, empirical evidence shows otherwise: the potential conflict between individual agency and collective goal does get resolved.

How does this happen? Findings in experimental economics, especially the work of Elinor Ostrom, another Nobel Laureate, provide several pointers. Here, we list a few aspects that are germane to our arguments. Individuals learn to cooperate, a behavior that is reinforced over a period of time, especially if they work in the same group and members actually contribute (free riders are absent or are censured). Open communication between members fosters cooperation. Groups are more effective and act in more amity if they are locally organized, self-governing and external mandates are nominal or absent altogether.

The finding that is most relevant here is that social norms play a vital part in fostering collective action. Individuals bring in their own set of values and norms that emphasize cooperation (Ostrom, 2000). History influences how individuals gel into a group and how the group evolves. Group heterogeneity further influences collective action. Since such action is in most cases voluntary, the ties that bind heavily rely on the goodwill, fellowship and social interactions among individuals of a social unit. In other words, it depends on the "level of social capital" (Ostrom, 2000, p. 148). Next, we examine the concept of SC in depth.

2.2. *Social capital*

2.3.1 *Basics and forms of SC*

Scholars, such as Tocqueville, raised the idea that involvement and participation in groups can have positive consequences for individuals and communities. The term "SC" was coined by Hanifan in 1916 (Huysman & Wulf, 2004), who proposed that it was helpful in building goodwill, fellowship, sympathy, and social interaction among individuals and groups within a social unit. SC can be categorized into individual or collective (Portes, 1998) and further into six dimensions; groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and empowerment and political action (WorldBank, 2006).

SC may have undesirable consequences such as restrictions imposed on actors who do not belong to a network. Within the networks too, negative characteristics may prevail. These include negative social dynamics within the network and downward spiraling norms, dependency on central actors and their loyalty towards the network, restrictions on autonomy and irrational economic behavior (Field, 2003; Huysman & Wulf, 2004).

SC has three different forms: bonding, bridging, and linking (Field, 2003). The characteristics of these forms are summarized in Table 1. Bonding and bridging SC have resonance with the ideas of "strong ties" and "weak ties," respectively, (Granovetter, 1973). Bonding SC is important for maintaining existing relations. Bridging SC is crucial for extending social networks, and could be an important resource for facilitating mobility. Linking SC includes

Table 1. Forms of SC.

Forms of SC	Description
Bonding SC	Denotes ties between people in homogenous groups and similar contexts such as immediate family, close friends and neighbors and ethnic fraternal organizations
Bridging SC	Denotes ties among distant friends and, associates, as well as between institutions such as religious organizations, and civil rights movements
Linking SC	Denotes ties among unlike people in dissimilar situations, such as those who are entirely outside the community and in different social strata in a hierarchy of power social status and wealth

capacity to leverage resources, ideas and information from formal institutions beyond the community (Woolcook, 2001). ICT in this context may provide an opportunity to create bridging and linking SC while at the same time helping to maintain existing bonding SC.

2.3.2 *ICT and SC*

Despite abundance of research in SC in fields such as sociology and economics, the attention from IS scholars has been minimal (Huysman & Wulf, 2004). This is unfortunate because the interdisciplinary nature of IS research and growth in networks within and between organizations makes research into the relationship between ICT and SC even more important. ICT can be framed at the individual level as connecting and enabling SC (Yang et al., 2009), while, at the collective level, research can focus on identifying the role of ICT in SC building in communities. Our study is one such example.

ICT can facilitate the building of SC through increasing flows of information (Adam & Urquhart, 2009) and can lead to the creation and maintenance of bridging, bonding and linking SC (DCITA, 2005). This is corroborated by findings from studies that identified a positive relationship between certain kinds of Social Networking Site use and the maintenance and creation of SC (Ellison, Steinfield, & Lampe, 2007). Other studies show that ICT promotes interactions among community participants that helped to generate and maintain the trust, acceptance, and alignment necessary for successful cooperation (Syrjänen & Kuutti, 2004) and extend existing community networking through improved transparency and participation (Rohde, 2004). Such studies illustrate the impact of ICT on SC and vice versa (Frank, Zhao, & Borman, 2004; Simpson, 2005).

2.3 *Summarizing the theoretical premises*

To summarize up to this point, development in Sen's conceptualization is enlargement of freedoms through the enhancement of individual capabilities. However, this is an appropriate, but insufficient view: in addition, social or collective capabilities need to be added not only because such capabilities in of themselves can foster development, but also because they influence the enhancement and exercise of individual capabilities. Developing collective capabilities require collective actions, the impetus for which can lie in the strength and level of SC in groups. ICT can be a catalyst in building, developing and enhancing different forms of SC. Our conceptual framework is depicted in Figure 1.

To empirically examine our framework, we conducted a case study which is described next.

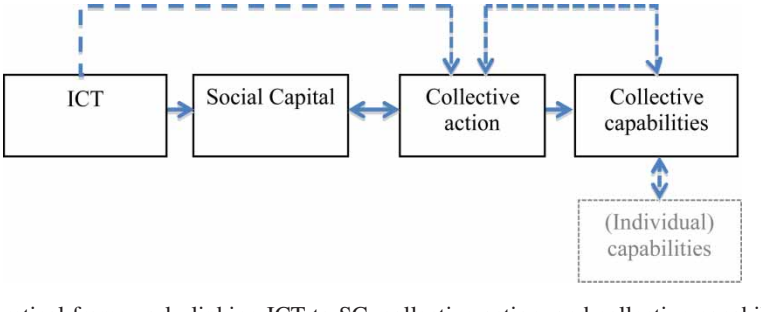

Figure 1. Theoretical framework: linking ICT to SC, collective action, and collective capabilities.

3. Research background, context and method

3.1 *Nepal*

Nepal is a landlocked country of 27 million people situated on the southern slopes of the Himalayas and lies between two giants India and China. Its total area is 147,797 km^2 and consists of three main geographical regions: the Tarai in the south, the central mountain region, and the Himalayan region in the North. Nepal is divided into 5 development regions, 14 zones, 75 districts and 3914 village development committees (VDC) which are the lowest administrative units. About 75% of the population lives in rural and remote areas, mainly in the mountain regions.

A large proportion of the population lives below the poverty line. The literacy rate in Nepali is 82% and in English is approximately 18%. Computer ownership per 100 inhabitants is 2.80, and telephone lines per 100 inhabitants are 3.5 (ENRD, 2009). The mountain region, where the NWNP was initiated, has the lowest human development index score among the three regions and is also the poorest (UNDP, 2004). The social, political, and economic disparities among regions flared up conflicts among different communities and political institutions. Consequently, it eroded the SC that existed within communities (the binding elements of trust), and severely disrupted indigenous forms of social networks and institutions (the bridging of the elements).

3.2 *Nepal Wireless Networking Project*

NWNP was initiated by educationist and social activist Mahabir Pun (team leader of the project). After completing his studies in USA, Pun returned to teach at the Nanga village high school. At that time, villagers had to make two-day trips to the nearest town (Pokhara) to make a phone call or check e-mails. In 1997, through personal correspondence, Pun acquired four used computers from Australia and began teaching computer classes at his school. Some more donated computers followed; however, there were no telephone or Internet connection in the village.

In 2001, Pun wrote an email to the British Broadcasting Corporation (BBC) asking for ideas to connect this remote village to the outside world through the Internet. When the BBC broadcast his email, the response was overwhelming. Within a year, volunteers from Europe and the USA began to pour in and helped him set up a wireless connection between Nangi and neighboring villages, using TV dish antennas mounted on trees. Gradually, the story of the NWNP spread across the Internet and his social network started extending across to other parts of the world. Volunteers from several countries started donating computers, parts, Wi-Fi equipment and their time to these mountain villages.

Since 2003, the NWNP has been in full-fledged operation. Despite difficult circumstances, such as lack of government support, and technical knowledge, and, an unstable political system (Nepal was involved in a civil war between the government and Maoists when the project started), the project succeeded in providing Internet services to some villages in the Myagdi district. As recognition for his initiative, Pun received the prestigious Magsaysay Award in 2007. Currently, the NWNP has built networks in around 150 villages, and is partially supported financially by the World Bank and Nepal Telecommunication Authority.

3.3 *Research site*

The study was conducted in Nangi and Tikot villages, located in western Nepal on the southern flank of the Annapurna and Dhaulagiri ranges of the Himalayas (GoogleMap, 2011). Nangi was the first village where the NWNP provided the Internet connection and its telecenter coordinates the project.

The total population of the two villages is around 2000. Tikot is not accessible by road. While Nangi is better connected, it still takes about 4 h by jeep or a one-day walk to the nearest town, from where it is another 7 h bus ride to the capital, Kathmandu. The inhabitants of the two villages are predominantly of the Magar ethnic community and other minority groups. Most of the villages in these regions are scattered in small clusters with average populations of less than one thousand. Because of the geo-political exclusion, their social network is traditionally limited to strong ties within homogeneous groups in their own and nearby villages. The communities make most of the local decisions in the presence of the VDC chairperson.

The villagers still practice shamanistic rituals and shamans are respected as traditional doctors and healers. Medical clinics have only recently been set up. Most of the villagers are farmers growing mainly potatoes. The youth prefer to join military service either in India or UK (forming the legendary Gurkha battalions), mainly because a high level of education is not a requirement for enlisting. The main source of revenue for the villagers is salary remittances from military personnel, and whatever is earned from selling agricultural and dairy products.

3.4 *Data collection*

We used a qualitative approach in our study and collected data through interviews (40 respondents), notes taking, observations, still pictures and videos, and relevant documents. Using a snowball technique, we selected the interviewees from different social groups and institutions. The interviewees were service users, such as teachers (aged 30–40, males), social activists (aged 30–60, male, and females), health workers (aged 30–40, females, students (Standard 11–12, aged 16–18, girls and boys), as well as non-users. The interviews were mainly semi-structured and lasted between 15 and 60 minutes. (see the appendix for examples of questions asked). We visited different collective projects started by the villagers, observed how they interacted with each other and listened to their reflections on their experiences with working together.

To obtain collective views, we conducted three focus group interviews of school children, teachers, doctors, and local users and non-users. We also observed ICT usage at schools, telecenters, and village telemedicine clinics. In addition, we gathered supplementary data from different relevant Internet sites, through informal discussions, email exchange, social networking sites, and different websites of ICT4D projects. Finally, to supplement our data collection, we conducted a workshop on ICT4D in Kathmandu, which was attended by various actors involved in the NWNP.

3.5 *Data analysis*

All the interviews were transcribed, summarized, coded and categorized in accordance with the proposed framework. For instance, initial codes about different groups in the community, their communication pattern, their expectations, and achievements of NWNP in education, healthcare, and business were drawn from the data. The code further grouped these into categories and sub-categories, such as collective action, collective capabilities, and bonding, bridging, and linking SCs. To check the reliability and validity of interviews and interpretation, we held regular discussions with other researchers and practitioners throughout the project. Two of the authors collected the data. One was from a remote community of Nepal, and his knowledge and experience as an insider helped with understanding the research context. The other author had an outsider's view on the context. In addition, we also used the ICT4D workshop to validate our research findings.

To insure rigor, we used the set of principles developed by Klein and Myers (1999). For example, we used the Hermeneutic circle to map the codes to the theoretical concepts and

followed an iterative analysis process to connect codes with categories and sub-categories. We used the theoretical concepts to get a richer understanding of the process as a sensitizing device rather than testing or falsifying hypotheses. Thus, our theoretical framework served as *a priori* guideline for collecting and analyzing data (Walsham, 1995).

4. Findings

The wireless project basically provided the remote villages the ability to communicate. Villagers working abroad are using e-mails to communicate with their families back home. Students and teachers are offered web-mail accounts through the project or use free web-mail accounts such as Yahoo and Gmail. There is a bulletin board for local news, local advertisements, announcements, and urgent messages. One of the respondents, a school principal said:

> It (NWNP) has increased the dimension of communication. For non-students, the communication patterns have been somewhat changed, for example, by providing faster communication opportunities. But in the case of students it has been drastically changed. They are using social networking services to make a lot of friends. Likewise, we have a lot of volunteers from other countries with different nationalities and cultures. We can have cultural exchanges, building friendships with them. The dimension of communication has been altered.

The following sections present detailed findings of our study: first the role of the NWNP in SC building, next the role of SC on fostering collective action, and then the role of collective action on collective capabilities, before listing challenges that may impede this process.

4.1 *NWNP and SC*

4.1.1 *Bonding SC*

Bonding SC refers to connections within a homogeneous group. The majority of the inhabitants belongs to the same ethnicity (Magar) and thus possessed a high bonding SC to begin with. However, they were not able to interact with their relatives and friends who did not live in the immediate vicinity. Through the NWNP, they are able to maintain and enhance their bonding SC, by connecting with their relatives through email, chat, and other social networking sites. Students are using the network to send e-mails to each other and to their pen-pals abroad. In the past, the villagers used to send letters through the post office that used to take months. Now they can communicate in real-time. A village activist explained:

> Regarding the social impact, we are not in a position to say that it has a solid role in development; however, the perspective of the village people regarding the computer and its usage is changing. They are at least using email and chat for sending and receiving message to/from their relatives in foreign countries.

4.1.2 *Bridging SC*

Bridging SC refers to relationship among distant groups. The NWNP has enabled the villages to connect with 150 other villages bringing together people across diverse social divisions. The project has also facilitated the creation of bridging relationships among various informal and formal institutions. For instance, the NWNP is working with open learning exchange (OLE) Nepal, an NGO based in the USA and Kathmandu, as a partner to develop educational contents for school children.

To meet the challenge of improving the healthcare systems in the mountain region, the NWNP has initiated telemedicine services in some villages. Every morning a virtual meeting is held using video-conferencing in which the local women who are responsible for healthcare

services in the villages virtually meet with healthcare personnel from various fields of medicine. These include doctors from national hospitals and their peers from other villages. They discuss patients, common diseases or learn from the doctors and healthcare workers from other communities. The peer-to-peer communication strengthens bridging the SC.

Setting up of a virtual marketplace called Haat Bazaar also provides a means of enhancing the bridging of SC. Villagers can advertise their products, such as cows, goats and chicken for sale and thus build relations with other groups such as vendors and buyers from other areas. In addition, the NWNP is piloting a remittance service because many from these remote communities work abroad. Virtual ATM machine services are being piloted in popular tourist areas with plans to distribute further. The initial success of the NWNP helped these remote communities to create a link between VDCs and local government institutions to replicate similar projects.

The NWNP enhanced the bridging of SC in education through providing schools access to external networks to search and share information and resources. Teachers and students get access to educational materials on the Internet. Some children described their use of the Internet:

> It helps us in our study because to understand the history only course book is not enough, therefore, we can download other information to know more. It's helping us in getting external and study related information.

4.1.3 *Linking SC*

Linking SC pertains to vertical connections to formal institutions mainly at a higher level of hierarchy. In Nepal, this implies connections with people in powerful and influential positions, whether political or financial. The telemedicine project not only enhances bridging SC, but also linking SC; it puts the local health-workers in the villages, who have limited formal education, in touch with doctors from national hospitals. The linking is also at the institutional level because primary healthcare centers of the village get connected to the national hospitals of the country. The NWNP also assisted in building a relationship between these villages and the central government. It successfully lobbied parliament to de-license wireless technology and remove high customs levies on equipment, in order to facilitate its adoption throughout the country. Furthermore, the NWNP develops websites where the mountain villagers get access to government information and e-government services, which may help to extend the linking of SC between the communities and the central government.

An important part of the project is the development and collaboration with other organizations to develop localized online educational material in Nepali. Traditionally, rural teachers are often retired military personnel and are poorly educated. Thus, it is important to educate and support them and include them in professional networks with other teachers. By connecting local teachers and central resource centers in Kathmandu, the NWNP provides teaching material and educational opportunities for the teachers. The NWNP is currently working on creating a research hub between Japanese, European, Indian, and US universities and research institutions (ENRD, 2009).

4.2. *Relating SC and collective action*

In the previous sub-section, we described how the NWNP facilitated bonding, bridging, and linking SCs. Here, we examine how these in turn fostered collective actions, i.e. the joint activities taking place to achieve common goals.

SC builds trust between the members of the communities, which encourages the community to take collective action through formal and informal groups. We identified a number of such groups. *Aama Samoh* is a motherś group that works to increase awareness among villagers

about healthcare, education, and particularly women's role in community development. Members of this group are the active health-workers and they build trust toward the telemedicine project and the use of computers in schools by talking to the parents of school children in the villages. Their activities exemplify both bonding SC (connections between members of their families and their ethnic groups) and bridging SC (connection between various ethnic groups and between healthcare-workers in neighboring villages).

Another group, the *Yuva Samoh* (Youth club) runs the sanitation programs, cultural, and social activities, and works to bridge a knowledge gap between younger and older generations. They use the bulletin board services provided by the NWNP to organize cultural events. Other groups such as the *Associations of ex- British and Indian army personnel* and the *cooperatives societies* work collectively to raise and invest funds to build the physical infrastructure of villages such as schools, public toilets, and motorable roads. In these activities, their strong bonding and bridging SC play a vital part.

These groups are active users of the services provided by the NWNP. This enables them to extend their social networks by bringing in more people from their own and neighboring villages. The increased SC provides a springboard to take collective actions. These actions in turn strengthen the bond within these groups and between groups thus mutually reinforcing a virtuous cycle.

The telemedicine project is another example of how SC enables collective action. The daily virtual meetings enable consultative medical care where expert knowledge from doctors in national hospitals combines with the contextual knowledge of local primary healthcare workers. A health worker said:

> Telemedicine means, here we have a small clinic, where two sisters [nurses] are working. If they find any difficulty or some emergency cases then they directly connect to Kathmandu or other 4–5 main hospitals and consult with them.

These collective actions are dependent on the technical services provided by the NWNP. However, to succeed, these actions require ties between local health workers (bonding SC) and ties between local health workers and national doctors (linking SC). These extended networks of health workers are based on common norms, trust, and objectives. A doctor involved in the telemedicine project stated:

> It (NWNP) is the effort of Mahabir to connect the whole Nepal through wireless technology. There are 3–4 other institutions working along with NWNP, we [Kathmandu Model Hospital] are one of them to provide health related services. There is another organization called NREN (Nepal research and education network) helping us. Besides that there are other private companies. . . also motivated to make this telemedicine project successful.

The villagers have initiated several collective projects to generate income. For example, cooperative societies are running yak farming projects that produce milk and dairy products. These are located at a remote site 800 meters above the village. Through the NWNP-provided Internet services, members of the project management committee work together and make joint decisions without making long trips. The communication services also result in better planning, ordering of supplies and management of the projects. The yak project is dependent on extended social networks (bridging SC) to engender participation by various groups and villages. The OLE project mentioned earlier is another example of collective action. It brings together such diverse, but complementary groups as teachers, content developers, vendors, and the government (through the education ministry).

These examples illustrate how the NWNP has provided a platform for the villagers to take collective actions through extended SC and exercise their capabilities to participate in the various community development programs.

4.3. *Relating collective action and collective capabilities*

So far, we have described how the NWNP enabled collective actions in these villages through building and extending SC. In the following, we describe how this process created collective capabilities in healthcare, income generation, and education while simultaneously enhancing individual capabilities.

4.3.1 *Healthcare*

An important achievement of the NWNP is the telemedicine project. Through new networks, it has increased the villages' collective capabilities on healthcare facilities. The team leader of the NWNP described how it brought doctors to the villages:

> It is difficult to get specialist doctors in remote places; in this situation we are using this technology to access doctors from remote places. The people who have not seen doctors can see the doctors through this technology. These are the main focuses of our project. So wherever we are going we are connecting schools and health post stations.

The daily videoconferencing that brings together health care providers of different groups (primary care providers, nurses, doctors) from different facilities (primary health stations, national hospitals) and different regions (villages, urban areas, Kathmandu) is a good illustration of collective action. Through this, the remote villages can now offer comprehensive healthcare and consultative services to its inhabitants which are examples of collective capabilities. Essentially, the quality of the healthcare service is higher than before and trust is enhanced between villagers and the local health workers due to the virtual presence of doctors. A doctor associated with this project said:

> Particularly in the villages, people are afraid of diseases. When they see a doctor in front of the camera prescribing them medicines, they feel confident, they feel psychologically confident.

Participation in the telemedicine project also enhances individual capabilities of the local healthcare providers through distance training and education programs. This illustrates the mutual reinforcement between individual and collective capabilities. A health worker said:

> [The] objective [of telemedicine service] was to involve and empower women, for example, health workers. Therefore, this [telemedicine] clinic was not only for treatment purpose, but it also provides training to the village women. They also trained health workers from other villages, who are women.

4.3.2 *Income generation*

Collective actions such as the yak project and Haat Bazaar increase collective capabilities for economic opportunities and participatory decision-making. While it is too early to assess the impact of these relatively recent projects, they have generated optimism among the villagers. The team leader of the NWNP told us:

> They can use it for advertisement; now in our village because of this Internet we can promote local products, such as Doko, Namlo, Nepali paper, mushrooms, and cattle. If they want to sell their product then they can use our services like Haat Bazaar on the net.

The yak project is an example of collective capability that resulted from collective action. It would be quite impossible for individuals to start and run such a project. The project participants have learnt about veterinary aspects and how to run cooperative projects, and, thus simultaneously, enhanced their own capabilities. Haat Bazaar, the virtual marketplace, belongs to the community as a whole and thus illustrates another collective capability. The NWNP is planning to start new eBusiness services run by the local communities in such areas as eco-tourism and remittances. These income generation activities also enhance the individual capabilities of

the youth in the villages. They are able to explore employment opportunities by enhancing their knowledge and skill through using ICT. A technician told us:

> Mahabir sir taught us at the beginning, such as checking radio, operating computers. And then using by myself I learned it through experience.

4.3.3 *Education*

The increase in SC based on educational activities has just begun to promote collective action. We gave the example of OLE as one such action, where the initial stages of the development of collective capabilities can be detected. New projects are underway to bring school teachers together in a network to improve teaching in resource poor schools in remote villages. Multicasting systems will support online teaching based on collaboration and joint teaching activities between schools in the villages and schools in urban and rural areas. It is intended to scale them up for collaboration with schools and universities outside Nepal. These networks will also help teachers to learn from one another. In addition, online educational material is being developed to specifically increase the competence of individual teachers.

4.4 *Challenges*

The NWNP faces a number of challenges that may hamper its success in the long run, which we discuss below.

4.4.1 *Challenges to maintain and develop SC*

Illiteracy rate and the lack of participation from elderly people are two main barriers to SC formation. Illiterate and elderly people tend to be less active. When they do participate in collective action, they mostly maintain existing bonding SC, and do not extend their social network by developing bridging and linking SC. The vast majority of the villagers do not know English. While online content is being developed in Nepali, a huge proportion of useful information and services is still only available in English.

Farmers form the majority of the inhabitants, and their participation is important for creating SC. This is a challenge as they do not understand the need to participate, are mostly uneducated, and have little time to attend training. The VDC chairman of Nangi, who learned to use computers and the Internet, explains:

> In this village, around 50% are retired personnel from the UK's or India's armies. I told them this is an Internet age; we used to send letters using the post office but now, because of the Internet and telecommunication, we can send information to different places easily. Therefore, I asked village elders to come and take computer education, but still, they are not able to understand it.

4.4.2 *Challenges to maintain and develop collective action*

Power shortage (cuts up to 12 h a day) and poor infrastructure are common challenges in the mountain regions, which is a major problem for the NWNP in general, and for collective actions more specifically. For example, the telemedicine project is dependent on reliable synchronous services. The lack of required equipment such as lab facilities adds to the problem.

The caste system and political differences are still barriers to develop collective actions in these villages despite the fact that the NWNP has been able to initiate cross-caste services to address low-caste and poor citizen-groups in these villages. One of the villagers stated:

> Majority of people support the idea of eliminating caste system. But, especially older generation still follow the caste discrimination.

4.4.3 *Challenges to maintain and develop collective capabilities*

Political instability and lack of faith in politicians are major challenges for maintaining and developing collective capabilities in these villages. Ten years of Maoist insurgency and a succession of fragile governments are reasons why Nepal has not succeeded in developing stable and robust government institutions. Increased collective capabilities are important for social inclusion of poor societies in the decisions-making process (Ibrahim, 2006; Oxoby, 2009). The prevailing situation is, therefore, a huge challenge. There is a lack of government support for community-based projects such as the NWNP. A villager from Tikot complained:

> District education office is not helping us directly, but education ministry provide them around 40–50 thousand for the Internet provision to the schools. They sometimes offer us a program to provide equal amount of money from the community and from the district education office . . . but that small amount is not enough to contribute to the big change.

4.4.4 *Challenges due to dependency on central actor*

Although the NWNP has the support of the community, it is overly dependent on the team leader for literally every aspect. Mahabir Puńs importance cannot be overestimated, and based on what he has done with the NWNP, is currently well respected at all levels in Nepalese society. This gives him access to the corridors of power, including the ministries in Kathmandu. At the same time, he is still maintaining and managing the whole network, by buying, installing and maintaining the equipment such as servers, which are still located in his private house.

Pun's importance for the whole project can be a double-edged sword. Over-dependency on a central actor can be a negative consequence of SC (Portes, 1998). The project would not have existed without him, but it will also likely fail if he can no longer manage it. It faces the challenge in making the transition from its initial phase where the champion is of critical importance, to a more mature phase where it is less dependent on one (or few) contributor(s). A villager expressed his worries:

> Mahabir has done this entire thing. He is the one who brings computer and internet in this village. All the credit goes to him. As long as Mahabir is with us, there is no fear. However, in his absence we are little doubtful.

4.5. *Summarizing the findings*

Figure 2 summarizes our findings. Overall, the indications are that the NWNP can be considered a successful initiative. While, as we discuss in the next section, the success of the NWNP can be understood through the interlocking lens of SC, collective action, and collective capabilities, there are other influencing factors. Communication itself promotes collaborative collective action (Ostrom, 2000); providing communication is the raison d'être of the NWNP. The project and the different group initiatives it fostered were also in accordance with the design rules proposed by Ostrom (2000) that need to be followed to sustain collection action. The groups, such as the members of the telemedicine project, were self-regulating and had local participation. The NWNP itself had a local leadership in the person of Mahabir Pun. They followed local norms and were only nominally governed by external regulations. Finally, the various forms of SC represented societal structures that the members could build and modify as they deemed appropriate.

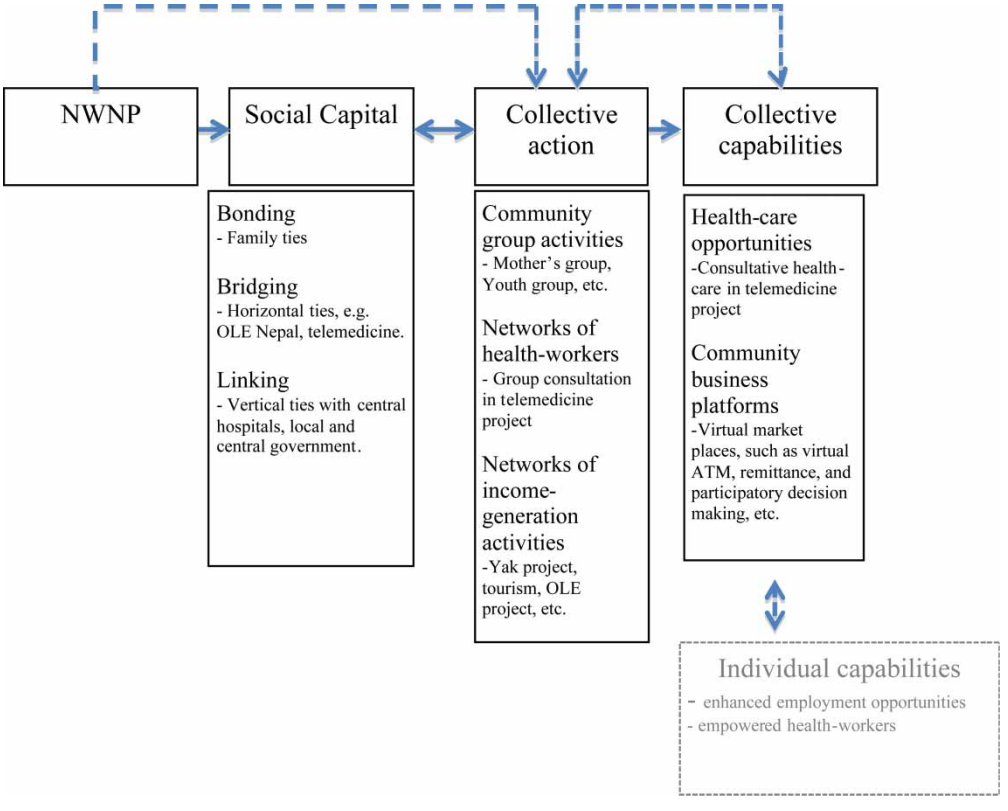

Figure 2. Empirical summary: linking ICT to SC, collective action, and collective capabilities.

5. Discussion

Before discussing the theoretical and practical implications of our findings, we point out the limitations of the study. It is context dependent since we collected data from two remote mountain villages in Nepal. The researched communities were composed of homogeneous groups and results may have been different in more multi-ethnic communities. The time frame of the study raises the possibility that we may not have captured the effects at the "right" time. Such projects may require a longer period to have a more sustained influence and hence a longitudinal study would have been more appropriate. Our findings should be interpreted in the light of these limitations.

Theoretically, our research interest was to explore the link between an ICT intervention in a developing country and human development. Following Sen (2000), we viewed human development in terms of the CA. However, we also subscribed to the view that because it emphasizes individual capabilities, the CA while an appropriate perspective of human development, is also "insufficient" (Ibrahim, 2006) and "incomplete" (Zheng, 2009). We, therefore, extended Sen's view and incorporated Collective Capabilities. To quote Evans (2002:59), we viewed Sen's approach as "... a foundation to build on, not simply admired."

Our findings reveal an intricate and mutually reinforcing relationship between the two forms of capabilities. Through the same mechanism of SC and collective action, the NWNP was able to enhance both individual and collective capabilities in each of the three areas: healthcare, income generation, and education. Consider the telemedicine project. By interacting with national

doctors and peers from neighboring villages through the daily virtual conferences, the knowledge and skills of the local health workers were enhanced. These skills are portable and give them the freedom to use them in settings outside the project or their communities. This is in keeping with Sen's view that social arrangements, resulting from the collective approach play a constitutive and instrumental role in enhancing the capabilities of an individual. Sen states that interactions with others help individuals to understand their needs and values. At the same time, and perhaps more important for development, the telemedicine project developed a collective capability: providing consultative medical service to these remote villages through combining the clinical expertise of national doctors and the contextual knowledge of local health workers. Such collective capabilities are not simply instrumental in influencing individual capabilities but have intrinsic value in themselves (Comim & Carey, 2001; Evans, 2002).

In bringing SC and the CA together to the same interpretive lens, we enter into the discourse on their compatibility (see Comim and Carey (2001) for a fuller discussion). The crux of the debate is that they come from completely different theoretical roots. While SC's philosophical base of coordinating action by social structures comes from sociology and political science, CA's intellectual base is moral philosophy and economics. The former is essentially a theory of social arrangements while the latter is a lens to evaluate such arrangements. In resolving this debate, we followed Comim and Carey's postulation that SC can actually be considered as the "social capability," i.e. a form of collective capability. In the context of our case, we found this to be tenable. We were able to read both streams simultaneously and complementarily supporting Comim and Carey's conclusion that the two are "compatible bedfellows."

As a study of an ICT intervention, we also address another of the criticisms of Sen's approach that it lacks a discussion on technology and its interaction with the social process (Zheng, 2009). At least in the case of the NWNP, we found that such an intervention can lead to the strengthening of SC, which can foster collective action and can lead to the development of individual and collective capabilities. This opened up prospects in areas such as healthcare, and income generation despite barriers such as high illiteracy rate and poor infrastructure.

Our findings lend support to the propositions of economists (Ostrom, 2000; Ostrom & Ahn, 2003) and policy-making bodies (WorldBank, 2006) that SC and collective action have a mutually reinforcing relationship. On one hand, SC concepts such as norms and trust can foster collective action. In return, collective action can strengthen SC. A further contribution is our conceptualization of SC not only in its characteristics (norms and trust), but also in its forms (bonding, bridging, and linking). Prior work in ICT for development has examined characteristics in an instrumental way (Díaz Andrade & Urquhart, 2009). By contrast, we delve into the structural aspects; the forms of SC represent structures that are resources in themselves and as such, are collective capabilities (Comim & Carey, 2001).

Based on our findings, it is tempting to suggest implications for practice. The obvious one is that ICT initiatives should focus on facilitating bindings within communities (to enhance bonding SC), between communities (to extend bridging SC) and with higher levels (to create linking SC), while not being overly dependent on a central actor or a small group. Paradoxically, projects such as the NWNP succeeded in remote regions precisely because of the active roles of central and local actors like Pun. His knowledge of the real needs, the social constructs, and cultural aspects were clearly instrumental in the project's success.

Yet questions remain. The SC perspective does not reveal how the capability building process happens. While our findings shed some light on the role of collective action, what is unanswered is the role of the central actors in building social networks. One possible theoretical lens to examine these issues is Actor-Network Theory, which may help explain who the main actors are and how members are enrolled in the networks. However, that raises even more

questions. What motivates or drives the actors to act the way they do? Theories such as Agency theory, Stakeholders or Genres of communication can be useful to examine these issues. These are avenues for future research.

Ultimately though, we may have to accept the plausible outcome that research may only partially answer the question of how exactly an ICT intervention lead to development. As one of our respondents in Nangi said:

> The Internet cannot help us with plowing, sowing, and harvesting. But by using the Internet, we can engage in a lot of other educational and financial development, I believe.

His emphasis on "us" and on the future possibilities that he sees within reach, clearly points to both "collective" and "capability." What was even more encouraging was that he was enthusiastic!

Notes

1. While ICT is defined in many ways, such as TV, radio, mobile phones, Internet and other digitally stored information, here we refer to wireless Internet services.
2. Comment at Harvard forum on ICT and Poverty Reduction (http://www.idrc.ca/uploads/user-S/10787612051Harvard_Forum_2003_-_Summary.pdf).
3. A second concept of the CA is *functionings* which though related, is distinct from capabilities. Functionings refers to achievements already realized. We will not discuss functioning in detail here because our focus is more on the potential of ICT in enhancing freedom of choice. Hence whether an individual actually uses ICT is irrelevant as long as she has the freedom and choice to use or not.

Notes on contributors

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Appendix. Examples of interview questions

To understand the local context

1. Could you please tell me something about the history, technological change, and development of this village?
2. Do you think the telecenter can help in social development?

To understand SC

3. How many types of groups are there in this village?
4. Do you have any exchange with other communities outside this village?
5. How is the relationship among these groups?

To understand collective action

6. How do different NGOs, activist (Champions), funding agencies (public, private), telecom authorities, political actors, academician, ISPs, IT consultants, community groups, and IT vendors work together?

To understand collective and individual capabilities

7. How do the community people realize the benefits of ICT availability?
8. How do you visualize the future impacts of ICT availability in remote communities?
9. What is your opinion about the NWNP? Do women benefit from it?

To understand the challenges

10. What are the main challenges of villagers in general, and the NWNP in particular