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Sustainability and Technology Diffusion in Small, Isolated Communities in the Developing World: an Applied Ethnographic Study

Research-in-Progress

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ABSTRACT

Developing countries have placed information and communication technologies (ICTs) high on their national development agenda. The assumed model has been one in which ICTs are the means to deliver an "information society," which is itself a means to economic and social development. Anthropologists theorize that small, isolated communities with limited local expertise innovate and adopt more sophisticated technologies as a reaction to perceived survival risk and to enable risk-buffering. We view the adoption and evolution of Information and Communication Technology (ICT) in remote communities in the developing world as a continuation of this anthropologic process. In our Research-in-Progress paper, we describe how we plan to use Applied Ethnography to produce a more granular understanding of the complex social, cultural and political dynamics that constrain or enable ICT interventions within small remote communities in the developing world. We will add to the body of knowledge by investigating how individual's attitudes towards technology are influenced by their prior experience of high profile ICT projects such as One Laptop per Child. Our results will inform the discipline and provide avenues for future research.

KEYWORDS: ICT4D, Sustainability, Technology Transfer, Culture, Applied Ethnography

NATURE OF PROBLEM

While the gap between rich and poor countries has long existed, globalization has led to a new division. A digital divide separates those who have access to, and can use Information and Communications Technologies (ICT), and those who cannot (Figure 1). Although the divide occurs among developed countries, its impact is felt most in the world's poorest countries. According to Kofi Anan, former Secretary General of the United Nations "People lack many things: jobs, shelter, food, health care, and drinkable water. Today, being cut off from basic telecommunications services is a hardship almost as acute as these other deprivations, and may indeed reduce the chances of finding remedies to them" (Anan, 1999).

Developing countries have placed information and communication technologies (ICTs) high on their national development agenda, and high on their list of investment priorities (UNCTAD, 2008). The assumed model has been one in which ICTs are the means to deliver an "information society," which is itself a means to economic and social development.

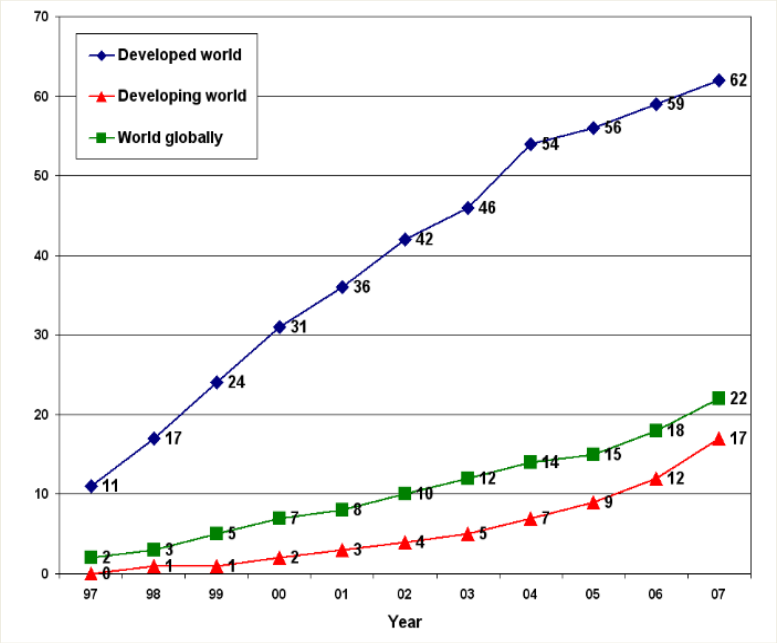

Figure 1: Internet Users per 100 inhabitants 97-07 (Source: ITU)

By 2040 over 70%[1] of the world will have migrated to mega-cities. In developing countries, the remaining 3 billion individuals will remain in isolated, rural communities. Anthropologists theorize that smaller, isolated communities with limited local expertise have more limited toolkits[2] than do their larger counterparts. For example, in Oceania around the time of early European contact, islands with small populations had less complicated marine foraging technology (Kline and Boyd, 2010). Societies innovated and adopted toolkits that were more complex as a reaction to perceived survival risk and to enable risk-buffering (Torrence, 2000; Collard et al., 2005).

We view the adoption and evolution of Information and Communication Technology (ICT) in remote communities in the developing world as a continuation of this anthropologic process. Perhaps one of the most visible examples of this technology transfer is the One Laptop per Child Program (OLPC), which has distributed $100 laptops to over 2 million children in some of the poorest, most isolated communities in the world. The following quote from OLPC's Solomon Islands Wiki page (OLPC, 2011) provides insights into OLPC's vision of technology transfer:

> *"The challenges to reach out to remote and rural communities are substantial but the advent of new technologies that are robust, low cost to deploy and operate, portable and that integrate with Internet connectivity provide opportunities that were not previously available."*

The purpose of our research is to investigate the relationships between an infusion of technology and the well-being of small isolated communities in the developing world through a cultural lens. Issues of community size and sustainability will be considered together with questioning whether virtual expertise of the Internet may or may not be sufficient to counter a shortage of local experts in small isolated communities. The study will be framed by examining whether or not prevailing social and media theories of technology apply in small, isolated environments in the developing world.

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[1] From Bruno Di Leo's keynote address to AMCIS2010 Conference, Lima, Peru, August 13, 2010. Mr. Di Leo is General Manager of IBM Growth Markets.

[2] To quantify tool complexity, Oswalt (1976) used *techno-units*: defined as "an integrated, physically distinct and unique structural configuration that contributes to the form of a finished artifact". For example, a stick used for prying shellfish would be one techno-unit; an untended crab trap utilizing a baited lever would be 16 techno-units.

In particular, the focus of our study is to better understand cultural relationships with technology diffusion in the developing world. The following questions will frame our study:

1. What are some of the challenges and opportunities for technology diffusion in the developing world?
2. What are the relationships between culture and technology diffusion in the developing world?

Researchers have not yet fully explored the relationship of isolation and community size and the interplay of individuals, society and technology. To investigate this intriguing issue, we will conduct an applied ethnographic study in a small sample of comparable, under populated, remote locations in the developing world to better understand cultural relationships with technology. We will gather data primarily by observation and interview and also collect site artifacts. The research will be guided by Barzilai-Nahon's theoretical framework for measuring the digital divide (Barzilai-Nahon, 2006), as well as a subset of social and media technology theories, some of which have been applied before in a developing country setting.

LITERATURE REVIEW

Since 1997, the Global Diffusion of the Internet (GDI) project at Princeton has investigated how the Internet has influenced the developing world[3]. Some studies have indicated a positive relationship between ICT adoption and economic growth (Bongo, 2005; Jensen, 2007; Mercer, 2001; Reisman, Roger, & Edge, 2001; UNDP, 2001; The World Bank, 2001). Anecdotal examples include adoption of mobile phones by fishermen in Kerala, India and farmers in Senegal (Jensen, 2007), wireless networking by villages in Robib, Cambodia, and herders in Angola locating their cattle through GPS technology (Samuel, 2005). However, while there are strong signs of ICT investment and diffusion in many developing countries, the actual developmental effect is less clear (Heeks, 2005; Furuholt & Ørvik, 2006). There is growing

[3] See, for example, Wolcott and Goodman, 2000; Foster and Goodman, 2000; Press, 2000; Ein-Dor, 2000; Wolcott, 2001; Cagiltay and Wolcott, 2001; Minges et al, 2001; Press, 2002; Thomasson, 2002; Thielemann, 2003; Wolcott and Goodman, 2003; Foster, 2004; Bernstein et al, 2005; and Wolcott, 2005.

evidence of informational, organizational, and cultural challenges when implementing ICT in developing countries (Avgerou & Walsham, 2000; Walsham, 2001, Heeks, 2002).

Fong (2009a) reported that while adoption rates of telephones, personal computers, and mobile phones in developing countries were linked to Gross National Income per Capita, Internet adoption rate was not a significant factor. Fong (2009b) summarized factors that are critical to the successful adoption and application of ICT in developing economies (Table 1).

Table 1: Critical Success Factors for ICT Diffusion in Developing Countries (Fong, 2009b)

Factors	**Enabling Conditions**
Market condition	Market competition for rational pricing of ICT & access Develop locally relevant content and languages to promote advanced technology uptake Foreign participation through investment to break down monopoly structure
Institutional capacity	Support intellectual capital development Develop stable learning and attractive investment environment Ensure security and stability in the environment Establish an enabling regulatory and legislative framework Economic, social, and political stability
Social/Economic	Ensure equity in digital access Ensure affordability of ICTs access Narrow or erase digital divide
Human capabilities	Improve literacy and computer literacy rate Nurture requisite skills and expertise Continuous investment
Government	Definitive guiding policies Strategic deployment of ICT Initiate coordination and linkages among actors in the system

Stakeholders	Interaction and strategic link among actors in the system Regional and international cooperation and collaboration Identify e-champions and e-leaders to spearhead ICTs investment projects
Utility infrastructure	Electricity, transportation networks, etc.

Jarvenpaa and Lang (2005) found that technology use in developing countries may depend on cultural orientation. Kirlidog and Aydemir (2005) posited that ICT adopters from rural societies in developing countries typically have a high context culture, and rely more on oral communication. Dey (2008) used consumer behavior theories including the expectancy model (Vroom, 1964), and theories of needs based on Maslow's hierarchy (Mazlow, 1943) to analyze the behavioral intentions of Bangladeshi farmers to use technology.

Walsham and Sahay (2005) summarized past ICT research efforts in developing countries in Table 2. They focused on developments to which ICTs contribute, key issues studied, theoretical and methodological stances, and the level and focus of analysis.

Table 2: Examples of MIS studies in Developing Countries (Walsham & Sahay, 2005)

Topic	**Examples in existing literature**	**Future opportunities**
Development to which ICTs contribute	Use of Internet for sustainable development (Madon, 2000) ICT not instrument for development only within market regime (Avgerou, 2003) Institutional theory to analyze ICTs for development in Chile (Silva & Figueroa, 2002)	Draw on wider definitions of development, e.g., Sen (1999) Further work with promising theories, e.g., institutional theory, development economics Make contributions to related disciplines, e.g., development studies, anthropology
Key issues being studied	Local adaptation and cultivation of ICTs (Bada, 2002; Macome, 2003;	Important but neglected topics, e.g., scalability/sustainability

	D'Mello, 2003) Standardization versus localization of technology (Braa & Hedberg, 2002; Thompson, 2002) In-depth studies of GIS technology (Puri & Sahay, 2003; Barrett et al., 2001)	In-depth studies of other technologies: e-government, open-source software Large-scale infrastructure, e.g., telecommunications Society-based critical issues, e.g., information related to HIV/AIDS
Theoretical and methodological stance	Wide range of theories drawn on e.g., globalization, post-colonialism, theories of power (Liu & Westrup, 2003; Adam & Myers, 2003; Silva & Backhouse, 2003) Methodology of interconnected levels and in-depth studies more common than decade earlier (Sayed & Westrup, 2003; Walsham, 2002)	More explicitly critical Need for methodological precision about the nature of interpretive studies More action research and longitudinal studies
Level and focus of analysis	Individual/ group /organization (D'Mello, 2003; Okunoye & Karsten, 2003; Bada 2002) Sectoral/national (Mursu et al., 2003; Silva & Figueroa, 2003) Cross-cultural working (Aman & Nicholson, 2003; Adam & Myers, 2003) Public/private sector (Madon, 2003; Rolland & Monteiro, 2002)	Cross-cultural research teams More individual-level studies, e.g., on identity issues A focus on community in addition to public/private sector Increased geographical coverage, e.g., China More locally based research from developing countries

THEORETICAL FOUNDATION

Diffusion of Knowledge

Anthropology theorists predict that population size influences the diversity and complexity of toolkits owned by small, isolated communities (Kline and Boyd, 2010). They reason that cultural traits are lost when not imitated by others. The rate of loss will be higher in smaller populations as smaller populations have fewer cultural practitioners than larger populations. Additionally, social learning is subject to error with most "students" not attaining the level of expertise of their "teachers". Such a dynamic leads to a constant battle to sustain the current level of cultural expertise. Only those students who surpass their teachers will contribute to cumulative cultural adaptation.

Cultural exchanges with other populations can occur, leading to a greater level of variation in the original cultural trait. Kroeber (1940) introduced the concept of Cultural Diffusion to describe the spread of cultural items—such as ideas, technologies, etc.—between individuals, whether within a single culture or from one culture to another.

Figure 2 represents knowledge as just one of four inter-related aspects of a process. Knowledge, cognition, action, and communication are inseparable (Weick, 1979). In this model, knowledge takes on meaning as the isolated learner interacts with its local environment through communicating with other entities, acting (and thereby changing the environment), and interpreting cues arising from these interactions.

We will extend Weick's Knowledge Transfer model to reflect Kroeber's concept of "Cultural Diffusion" stemming from Internet connectivity. Such a model may reflect the reality of isolated, yet connected communities who manage to escape the developmental limitation of scarce local expertise, by availing themselves of the virtual expertise of the Internet.

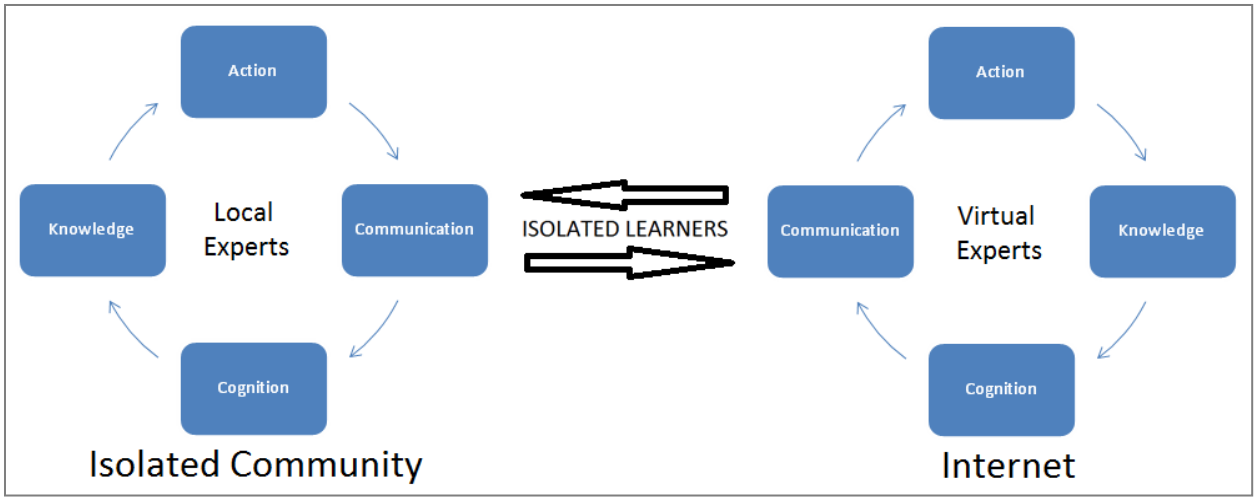

Figure 2: Knowledge Transfer in Geographically Isolated Communities Connected to the Internet (adapted from Weick, 1978; Jin et al, 1998)

Social and Media Technology Theories

Applicability of management theories and practices has been a concern of scholars conducting investigations in developing countries (Hoskisson et al. 2000). In a comprehensive review, Hafsi and Farashahi (2005) reported on the relevance of management theories to developing countries. They concluded that there was widespread applicability of western-based concepts of general management and organizational theories to developing countries.

There are a number of theories, which appear to be relevant to a study of the digital divide in developing countries. We describe some of the more promising social and media technology theories in Figure 3. Social theories address how technology determines social structure or human practice; media theories focus on the social effects of communication media. We briefly describe Actor-Network Theory, Social Construction of Technology, Structuration Theory, Technology Acceptance Model, Social Presence Theory, and Media Naturalness Theory below.

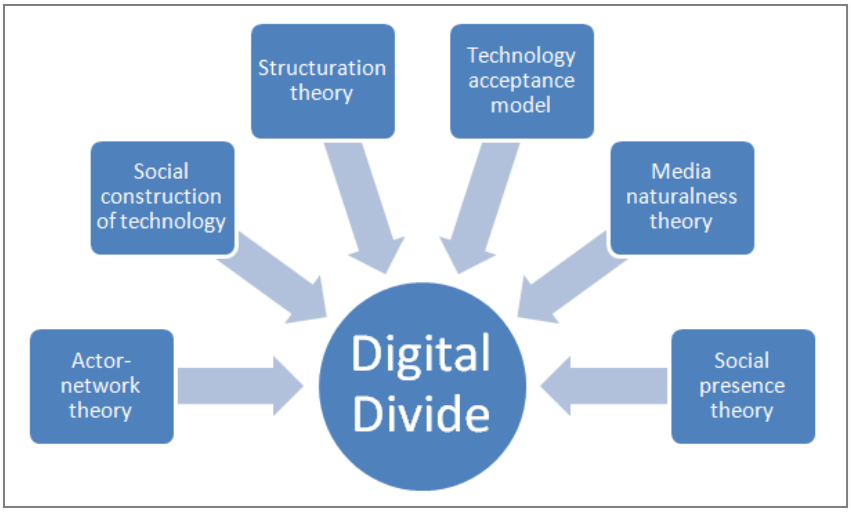

Figure 3: Social and Media Theories

Actor-Network Theory: Nonhumans (i.e. technology) and the humans that interact with them are interrelated equals. Technology is constructed by humans, substitutes for the actions of humans, and shapes human action. Humans anthropomorphize technology, instilling its beliefs, practices, and relations into technology, which in turn becomes like the humans who created it (Latour, 1997; Stanforth, 2006).

Social Construction of Technology: Technology does not determine human action; human action shapes technology. Groups compete to control the design of technology. Each group has its own needs and own ideas of how the technology should be used that may not be favored by competing groups. Through consensus one social group prevails over the others, so that group's design triumphs and the others are forgotten (Pinch and Bijker, 1992; Kline, 2010; Karanasios, 2010).

Structuration Theory: Groups and organizations use technology for their work, dynamically creating perceptions about the role and utility of the technology, and how it can be applied to their activities. These perceptions influence the way technology is used, thereby allowing technology to act as a mediator between technology, group members, and the groups' outcomes (DeSantis and Poole, 1990 and Orlikowski, 1992).

Technology Acceptance Model: This theory conjectures that perceived ease of use and usefulness determine an individual's intention to use a system. Intention to use serves as a mediator of actual system use. (Davis, 1989, Celik, 2008; and Dey, 2008).

Social Presence Theory: The social impact of a communication medium depends on the social presence it allows communicators to have. Social presence is defined as a property of the medium itself and the degree of acoustic, visual, and physical contact that it allows. The theory assumes that more contact will increase the key components of "presence," namely greater intimacy, immediacy, warmth and inter-personal rapport (Short, et al., 1976).

Media Naturalness Theory: An alternative to media richness theory, media naturalness theory argues that since the Stone Age humans have communicated primarily face-to-face. Evolutionary pressures have led to the development of a brain designed for face-to-face communication. More recent forms of communication involving technology are unlikely to have (yet) created any evolutionary changes, and their use can lead to cognitive obstacles to communication (Kock, 2004).

PROPOSED METHODOLOGY

The conceptual framework for this study will draw on ethnographic principles, with the foundational question: What is the culture of this group of people? Culture has been defined in many ways and is commonly expressed as "the shared knowledge and schemes created by a set of people for perceiving, interpreting, expressing, and responding to the social realities around them" (Lederach, 1995, p. 9), or more simply "the learned and shared behavior of a community of interacting human beings" (Useem & Useem, 1963, p. 169). The importance of understanding culture, especially in relation to change, is the cornerstone of *applied ethnography* as seen in modern society (Chambers, 2000; Patton, 2002). What makes this approach distinct is how the findings are interpreted and applied from a cultural perspective.

As with any research method, ethnography has its benefits and limitations. Markus (1997) and Myers (1999) outline the main benefits and limitations of ethnography in Information Systems research:

> "Ethnographic research is a powerful research tool, providing a unique depth to one's study of a group, culture, organization or society. By inserting oneself into a culture, the researcher is, over time, able to see what people are doing (as well as what they say they are doing), leading to an in-depth

> understanding of not only the observed group but the broader context of the field. Ethnographic research is one of the most intensive research methods available and, due to the intimacy of observation, researchers can glean valuable subject information, motivations, and nuances which would escape a more traditional empirical investigation undertaken from afar.
>
> The main drawback to ethnographic research is that it takes much longer to conduct and complete than other kinds of research. Not only does fieldwork take longer, but analyzing, synthesizing and writing up the results can also be very time consuming. Ethnographic research also often lacks breadth. Though the research is intense the researcher is only studying and/or collecting data from one group or one organization. It may be difficult or inaccurate to draw conclusions and apply them to larger classes of organizations based on the observations of just one group".

Operationalizing the Digital Divide

While monotopical indices are widely available for measuring the digital divide, Barzilai-Nahon (2006) considered the digital divide from a multi-construct perspective, and proposed a set of factors needed to make a comprehensive index operational (Table 3).

Table 3: Proposed Factors and Indicators in Comprehensive Digital Divide Index

Factor	**Indicator**
Infrastructure Access	Communication channels and capacity, Computers per capita, Web sites per capita, Number of ISPs per capita, ISPs: governmental incumbent or private
Affordability (relative to other expenditures and avg. income)	Physical layer (infrastructure), Logical layer (applications and software), Content
Use	Frequency, Time online, Purpose, Users' skills, Autonomy of use
Socio-Demographic Factors	Socio-Economic Status, Gender, Age, Education, Geographic Dispersion, Ethnic Diversity, Race Diversity, Religiosity,

	Language
Social and governmental Constraints/Support	Training, Active help, Support/Suppression/Apathy, Investments and funding
Accessibility	Special populations with physical disabilities

Given Barzilai-Nahon's framework, within one developing country we might expect there to be a digital divide between remote communities that have been exposed to organized technology transfer from One Laptop per Child, and those who have not. On the other hand, we may find that Internet bandwidth alone and the availability of external "Internet Experts" are sufficient to bridge the digital divide.

Selection of Study Setting

Discourse on the digital divide typically focuses on the international or national level, comparing developing world to modernized world, or comparing country-to-country (Barzilai-Nahon, 2006). Yet the impact of the digital divide can vary depending on the level of observation (e.g. region, organization, work group, or individual (Straub et al., 2002). Studying the digital divide at a micro level can be more revealing, leading to a deeper understanding of the problems and opportunities for technology diffusion in the developing world (Larson, 2003).

In the proposed research project, we will be using applied ethnography to conduct our study over a three-year period in eight comparable small, isolated communities within four English-speaking developing countries. At this stage, we have established contacts in Oceania (Pulao, Cook Islands), and Africa (Ghana and Kenya). We will identify two similarly sized and remote villages in each country, one of which has had One Laptop Per Child support. Interviews and observation will draw on applied ethnographic principles and the digital divide framework described above, together with the social and media theories discussed earlier, to try to make sense of the interplay of the data about society, individuals, and technology.

Data Collection

We will use Purposive Sampling (Patton, 1990) to ensure rich and balanced data sources about groups connected to rural communities, including elders, family units, business owners, religious leaders, and officials, who may not physically reside in the community. Our study will be

strengthened through data triangulation (Patton, 2002) as we will be collecting multiple data types: in-depth interviews, direct observations and reviews of related archival materials.

We will interview children, adults, business owners, and officials to elicit rich narratives offering insight to respondents' beliefs about technology availability, adoption, application, and perceived individual and community benefits. We will conduct interviews in English at a location convenient to the respondent. The goal is to structure interviews as lengthy conversations, therefore an ordered list of questions will not be used (Bernard 2006; Briggs 1986; Lofland et al 2006; Schatzman and Strauss 1973).

Concurrent with the interviews, we will conduct extended periods of direct observation at schools, community centers and businesses. This method will provide insight into the community's structural context: the daily practices of locals, the physical infrastructure of technology delivery, and the interaction between individuals, groups, and technology. Observation will allow for contrast between what interviewees actually do and what they may say they do (Bernard 2006).

We will review archived materials at government institutions, local and international NGOs, research centers and regional universities within the host countries. We will continuously review data from interviews and field notes from direct observation throughout the data collection period in order to identify salient themes, topics, and issues to refine and redirect interview questions as necessary (Corbin and Strauss 2008).

To acknowledge the inductive process in the research design, the researcher must be continually looking for, and open to, new ways of aligning and shifting to the interpretive meanings of data, that is to see different ways of looking at what is happening in the setting (Patton, 2002; Schwandt, 2001). To support this process, a research journal, capturing both methodological and reflective ideas, and a series of design, analytical and methodological memos (Kaczynski, Jackson, & Richards, 2004) will document and create an audit trail of any design changes and shifts that impact the overall study. Analytic memos will help to identify and articulate emerging themes, systematic patterns and theoretical implications. We will use the memos to develop codes, definitions, and examples that will inform the write-up process (Bernard 2006). The analysis will pay particular attention to demographic variation in perspectives among

respondents in order to explore the power relations that influence the delivery and use of technology services (Schatzman and Strauss 1973).

OUTCOMES OF THIS STUDY

Although there has been considerable interest in the role of ICTs in development, many IS researchers have focused on the macro level (Barzilai-Nahon, 2006; Chen and Wellman, 2003; Fong, 2009). There appears to be a gap in qualitative knowledge relating to ICTs and development at the micro level. Using an Applied Ethnography approach, our research will follow the example of Miller et al (2005) to produce a more granular description of the social, cultural and political dynamics that constrain or enable ICT interventions within small remote communities in the developing world.

We will add to the body of knowledge by investigating how individual's attitudes towards technology are influenced by their prior experience of high profile ICT projects such as One Laptop Per Child. We will explore whether ICT implementations in one domain such as teaching can influence projects in other domain, such as telemedicine. Our results will inform the discipline and provide avenues for future research.

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