Transitioning Information and Communication Technology for Development (ICTD) Projects from Research to Implementation

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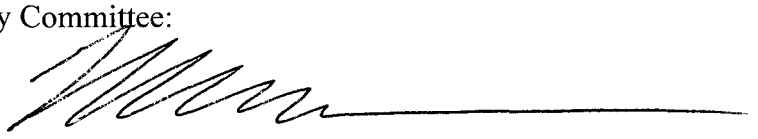

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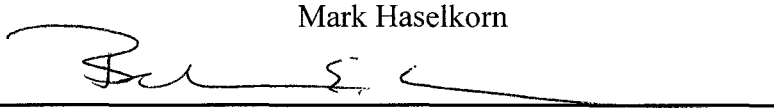

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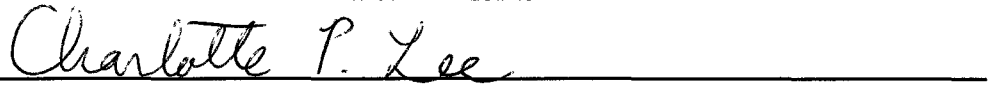

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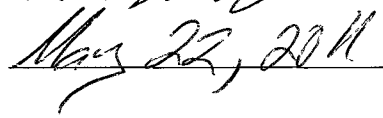
Date 

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Abstract

Transitioning Information and Communication Technology for Development (ICTD) Projects from Research to Implementation

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Since international development emerged at the end of World War II, people have had high expectations that technology and information would play a central role in improving the lives of people in resource-constrained environments. However, we still do not understand how best to design and implement technologies to inform, connect, and empower people in these environments. To address this gap in understanding, this dissertation seeks patterns across seven projects that sought to use information and communication technology (ICT) to support development goals in India. The research is situated within the relatively young, interdisciplinary field of information and communication technology for development (ICTD). Relevant literature includes not only ICTD but also development studies, critical theory, and complex systems literature.

The study examines the transition of seven ICTD projects, addressing the research question, "Which elements are important to transitioning ICTD projects from research to implementation?" All seven projects were led by professional researchers: three projects

by academic researchers at Indian universities, two by academic researchers at U.S. universities, and two by industry researchers at a multi-national corporate research lab. The projects represented a range of development domains, including education, agriculture, and employment. This study presents an analysis of the projects based on four months of onsite data collection, including observation and interviews with project leads, project members, partner organizations, and intended beneficiaries.

Exploring the transition of multiple projects revealed critical patterns related to four broad themes: (1) scope creep, (2) scalability, (3) project management and sustainability, and (4) perceptions and behavior. These patterns not only affected the transition of the seven ICTD projects from research to implementation but also offer important implications for future ICTD researchers, particularly those seeking to transition their findings into development applications in the field. For example, one major takeaway from this study relates to sustainability, a widely held criterion of project success, which posits that more successful ICTD projects continue to exist over time. The findings from this study challenge that somewhat simplistic view of project sustainability by illustrating that ICTD projects live on in a variety of complex ways. Therefore, this research suggests sustainability should be defined much more broadly than it is usually presented in ICTD literature. A second contribution of this research is identifying common surprises and challenges across ICTD projects that were led by seasoned researchers in the field. For example, credibility and trust building played a more significant and far-reaching role throughout the life of ICTD projects than project leaders

expected. A third implication of this study is that ICTD project stakeholders should temper their expectations of ICTD best practices. Examining the transition of seven ICTD projects illustrated not only benefits of ICTD best practices but also drawbacks.

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Thank you all.

Dedication

To my husband, Tony

Chapter 1 – Introduction

Section 1: Major Takeaways

People have long associated development with technology. With development broadly defined as "improving the living conditions of society" (Melkote & Steeves, 2001, p. 34), it makes sense that the tools, manmade objects, and innovations that people use —i.e., technologies—would play a role in development. Some of the most influential and adaptable technologies today are information and communication technologies (ICTs): e.g., mobile phones, web-based tools, and digital media. Information and communication technology for development (ICTD) is a field that uses a particular subset of technologies, ICTs, as a central component of efforts to improve the living conditions of people in resource-constrained environments. These efforts typically focus on core development domains like healthcare (DeRenzi et al., 2008; Luk, Zaharia, Ho, Levine, & Aoki, 2009; Lucas, 2008; Smith, Madon, Anifalaje, Lazarro-Malecela, & Michael, 2008), education (Brunello, 2010; Cervantes, Warschauer, Nardi, & Sambasivan, 2011), and agriculture (Knoche, Sheshagiri Rao, & Huang, 2010; Ramamritham, Bahuman, Duttagupta, Bahuman, & Balasundaram, 2006; Reddy, Ramaraju, & Reddy, 2007), but ICTD has also addressed a variety of other issues, including gender equality (Kuriyan & Kitner, 2007; Morrell & Sterling, 2006), gaming (Kolko & Putnam, 2009), and employment (Garrido, Sullivan, Gordon, & Coward, 2009; Walton, Putnam, Johnson, & Kolko, 2009).

ICTD is a burgeoning research area, growing faster than cognate research areas that focus solely on development or ICT (Heeks, 2010). Arguably beginning in the early 1990s but increasing significantly since the late 1990s, academic researchers began joining this relatively new interdisciplinary field from a variety of backgrounds including computer science, engineering, information science, health informatics, human computer interaction, geography, and others. Because ICTD incorporates researchers from a range of traditional academic disciplines and is a relatively young field, it lacks a cohesive academic identity and well-established theoretical grounding. Much ICTD research describes practical, applied case studies, so there is a dearth of research identifying patterns across case studies to provide widely transferrable knowledge to inform future ICTD projects. Further, the widespread failure of ICTD projects has established the need for a better understanding of ICTD research and implementation (Brand & Schwittay, 2006; Heeks, 2002; Toyama, 2010).

To address this gap, I examined seven ICTD research projects in India, addressing the research question, "What elements are important when transitioning ICTD projects from research to implementation?" I spent four months in India collecting data primarily through semi-structured interviews with project stakeholders. Analyzing this data uncovered four broad themes that emerged across all projects, and I selected two subthemes within each theme to analyze in detail:

- Scope creep: (1) user requests prompted expansions to project scope, (2) scope expanded from providing information to changing established perceptions and ways of doing things
- Scalability: (1) project stakeholders expected that people outside of the project would appropriate aspects of the project for use in other contexts, (2) partnerships were vital to scaling projects
- Project Management and Sustainability: (1) it took years for projects to progress to and through a transition from research to implementation, (2) project stakeholders expected to continue changing their solution or offerings over the long term
- Perceptions and Behavior: (1) trust and credibility influenced a variety of project factors, (2) motivations for long-term project involvement were complex and difficult to maintain

Examining these subthemes in detail illustrates that the elements important in transitioning ICTD projects are themselves complex and interrelated. A major contribution of this study is identifying elements that are *shared* across disparate ICTD projects that differed in areas such as technology type and development domain. These shared elements have important implications for the broader field of ICTD and for specific ICTD researchers and stakeholders involved in future projects:

- The first implication is that ICTD stakeholders should consider sustainability in a broader sense than simply whether the original project continues to exist.

ICTD projects continue to live on in many ways beyond the initial project, and this research identifies several ways that projects are sustained: e.g., by influencing other projects through open source technology or published research.

- The second major takeaway is that, even for experienced ICTD stakeholders, expected challenges manifest in unexpected ways. For example, many project leaders expected trust building and credibility to be relevant to the project, but these leaders still encountered credibility-related barriers to transitioning their projects into long-term implementation. In other words, these leaders understood the broad principle that trust was an important element of ICTD, but that understanding did not enable them to anticipate how that principle would play out in the specific circumstances of their project over time. Thus, being aware of a common challenge to ICTD projects seems insufficient to anticipate how that challenge will affect a particular project. ICTD projects are such complex systems that even expected challenges manifest in unexpected ways.
- The third contribution of this research is to more fully convey the effects of following ICTD best practices—both positive and negative effects. The best practices are not silver bullets; following these practices can directly lead to some negative effects. However, the findings of this study do not *refute* the best practices but instead convey more a balanced and complex picture of

their effects. For example, the data from this study shows that partnering with local stakeholders does lead to a project design that is better suited to those stakeholders' preferences and needs. However, the data also shows that partnering with local stakeholders leads to scope creep. Thus, the data from this study conveys a fuller range of outcomes from applying best practices. In reflecting upon these potential outcomes, complex systems literature provides a useful lens for interpretation.

Section 2: Background

Since international development formally emerged at the end of World War II, people have had high expectations that technology and information would improve the lives of people in resource-constrained environments. However, we still do not understand how best to design technologies to inform, connect, and empower people. While some of this gap relates to technology-centric issues of design and development, much of this gap relates to the people who design those technologies, the people for or with whom those technologies are designed, and the context or surroundings of those intended users. To address this gap in understanding, my research has focused on exploring how human and contextual factors such as stakeholder tasks, individual and organizational goals, and physical environments affect the design and use of information and communication technologies (ICTs) in resource-constrained environments.

Human and contextual factors strongly influence the way that users use and designers design tools that inform and connect people. However, I have found that without rigorous, targeted research, these influences remain tacit and do not explicitly inform the design of information tools or processes. The relationships among human, social, and contextual factors are complex: not only are the factors often tacit, but they also compete and conflict—e.g., creating an environment in which meeting some stakeholders' goals necessitates compromising others'. In the midst of this complexity, my research makes explicit the way that these factors affect ICTD projects and stakeholders.

Previous to this dissertation, my earlier research explored these issues at a case study level. For example, my first ICTD project involved interning with a large international nongovernmental organization (NGO) in Kyrgyzstan for three and a half months. This NGO owned a national-level microfinance organization with 49 regional offices and more than 31,000 customers. I conducted research to guide the microfinance organization in digitizing its information processes. My research focused on the people who gathered and used client information and the processes they currently followed: collecting data through onsite interviews, focus groups, process walkthroughs, and artifact analysis. With this data, I sought to identify aspects of the current processes that should be retained and aspects that should be changed to provide greater value for more stakeholders, producing design requirements for the information technology team who would then build an information system to digitize the process.

Although digitizing a paper-based process may seem straightforward, it was not. The process was situated within a complex system with competing and conflicting factors that had to first be discovered, then considered in relation to each other, and then addressed. For example, microfinance executives wanted to use the information system to access the richly detailed client information that was available at the time only in paper form at local, rural offices. Microloan officers at the local level wanted to retain their current approach of gathering and recording client information onsite at their clients' homes and businesses. The first of these factors I knew from the onset of the project; it was one of the major motivations for digitizing the loan process. The second factor I discovered when talking to loan officers, who identified a conflict between their interests (gathering client information onsite) and those of the microfinance executives (digitally accessing that client information). This conflict arose because the equipment that was initially planned for loan officers to use in recording client information was desktop computers. If loan officers used desktop computers to enter client information into the information system, they would have to either require clients to come into the loan office (a significant barrier for many of these clients, who were poor residents of rural communities with limited and unreliable public transportation) or record data on paper at client homes and workplaces and then enter data again digitally.

Mirroring findings from fields like computer-supported collaborative work (Orlikowski, 1992) and complex systems (Davenport, 1997), we found that the needs of some stakeholders (e.g., executives needing rich information to guide strategic decisions)

conflicted with the needs of other stakeholders (e.g., loan officers needing to accommodate their clients without doubling their own data entry work). This finding had implications not only for organizational processes and ICT selection but also for long-term budgeting, equipment maintenance, policies, and training. I worked with the country director to consider these implications and then collaborated with the information technology team to develop a detailed system description to guide information system development.

Experiences like this research in Kyrgyzstan showed me firsthand the value of viewing ICTD projects as complex systems and focusing on the effects of human and contextual factors on these projects. As I began seeking a dissertation topic, I knew that I would retain this complex systems view of ICTD and the focus on people and their contexts. It was surveying the ICTD literature for gaps that prompted me to analyze multiple projects instead of another single case study. Thus, this dissertation research emerged from a desire to explore complexities across multiple projects, seeking patterns of findings that could inform future ICTD work.

Section 3: Overview

This dissertation is organized into six chapters, following the classic research paper format: introduction, literature review, methodology, findings, and conclusions. Chapter 2 presents major themes from the literature framing this research. Relevant literature includes not only ICTD but also development studies, critical theory, and

complex systems literature. Section 1 contextualizes ICTD within the broader field of development by presenting three major development theories, tracing the history of development from the 1940s to present day, and describing the emergence of ICTD as a field. Section 2 presents ICTD best practices drawn from ICTD literature. It introduces three best practices individually, then describes how they productively combine, and finishes with a discussion of tensions and challenges to employing all three practices. Section 3 draws from a combination of ICTD and complex systems literature to convey the relevance of complex systems principles to the ICTD field. This section presents three major ideas from complex systems literature—taking a holistic approach, managing competing interests, and supporting decision making—tying these ideas to ICTD research and implementation.

Chapter 3 presents the methodology used in this study. Section 1 contextualizes the methods within the broader qualitative tradition. Section 2 explains how projects were selected and participants recruited. Sections 3 and 4 describe data collection and analysis, respectively.

Chapters 4 and 5 convey the findings of the study, using a dual approach to enable the findings to be presented first in the context of each project and then across projects. Chapter 4 includes seven narratives, one for each project, that trace the story of each project from initial idea to research study and beyond. Chapter 5 presents the findings that emerged across projects, describing four broad themes and eight specific subthemes.

Chapter 6 presents conclusions of this work, interpreting the findings and identifying the implications for future research. Section 1 presents three major contributions of the study, and Section 2 describes how future research could build upon this work.

Chapter 2 – Literature Review

The literature review framing this research follows a three-part structure: (1) contextualizing and introducing information and communication technology for development (ICTD), (2) summarizing ICTD best practices, and (3) examining the management of complex systems in the context of ICTD.

Each section provides important background information to contextualize the findings identified by my study—for example, by providing the theoretical underpinnings of certain approaches to ICTD or by presenting the best practices which many ICTD projects seek to follow. Section 1 traces the history of development from the 1940s to present day. This historical overview identifies the origins of modern-day development and presents three major development theories. These theories form a foundation for the content not only in the rest of the literature review but the rest of this dissertation. For example, we will see influences of the theory of modernism threading through the ICTD field and the projects in this study. Section 2 presents three ICTD best practices. Using examples from ICTD case studies, we see how productively the three best practices combine and yet how difficult it is to balance them effectively. These best practices are relevant to the findings presented in Chapters 4 and 5, where we see some examples of the best practices implemented in the projects under study. Finally, Section 3 of the literature review presents relevant concepts from complex systems literature. ICTD projects are complex systems with interrelating factors, varied stakeholders, and often-

conflicting goals. Literature from systems theory and information ecology perspectives provides insight into managing complex systems like ICTD projects.

Section 1: Contextualizing and Introducing ICTD

This section draws from literature in development theory, development studies, and ICTD, which culminate to provide a theoretical and historical context for ICTD. The section is divided into three parts: (1) development theories, which introduces and describes modernism, dependency theory, and critical perspectives—the three major theoretical approaches to development; (2) history of development, which traces the emergence, growth, and evolution of international development from the 1940s to the 2000s; and (3) the emergence of ICTD, which describes the birth of ICTD as a field, changes in the field over time, and the field's connection to academia.

2.1.a Development Theories

Although ICTD can be considered a young field (Best, 2010; Heeks, 2010; Parthasarathy & Srinivasan, 2006), it has roots in development, which emerged at the international level at the end of World War II. Situating ICTD within the broader scope of development is a useful way to identify and articulate underlying assumptions in ICTD work. Development has been characterized in many ways: e.g., with goals such as economic growth (Rostow, 1959), individual and community empowerment (Quarry & Ramirez, 2009), or more equitable resource distribution (Feenburg, 2002). Although perspectives on development may contrast in the major area of emphasis (e.g., economic

versus social), most definitions of development do overlap and involve improving societal conditions along some combination of political, structural, social, and economic lines (Melkote & Steeves, 2001). The definition of development is highly influenced by underlying theory. The three major development theories are discussed below: modernism, dependency theory, and critical perspectives.

Modernism is the earliest and arguably still the dominant approach to development (Quarry & Ramirez, 2009; Melkote & Steeves, 2001). This theory of development is highly influenced by quantitative, empirical Western science (Melkote & Steeves, 2001). Fundamentally positivist, classic Western science values efficiency, rationality, and objectivity. Positivists believe that reality exists apart from observers and is experienced by people in the same way; thus, positivist science seeks to produce objective, measurable, observable findings (Denzin & Lincoln, 2008). Considering modernism's foundations in classic Western science, therefore, it is not surprising that modernism operationally defines development as economic growth, a quantifiable factor that is usually measured at the national level by gross national product (GNP) or per capita income (Melkote & Steeves, 2001).

One of the key features of modernism is its view of development as evolutionary: i.e., development is directional (from traditional to modern), cumulative (ever building upon previous technologies and discoveries), predetermined and irreversible (beyond the reach of humans to direct or change), and progressive (moving in a straight line ever toward a more modern society) (Lerner, 1958; Rostow, 1959). This evolutionary

perspective frames the problems in developing countries as "natural" instead of historical, originating from within these nations rather than emerging from a complex international, political, historical context.

To summarize, modernists expect all countries to pass through similar stages and evolve to a common, modern society, as measured by economic growth. Modernists see technology as a key to helping traditional societies develop toward being modern societies. Particularly when traditional societies resist development, modernists view communication as an integral part of development as well. This communication is characterized by one-way, persuasive messages designed to encourage people to abandon traditional ways of life in favor of ways of life that are more evolved or further along the path toward the ideal status of society: modern (Melkote & Steeves, 2001).

Dependency is the second category of development approaches. While modernism is influenced by positivism, dependency theory is influenced by structuralism or neo-Marxism (Servaes, 2008). The dependency perspective was developed in Latin America, arising in direct opposition to modernism. Dependency theorists, or *dependistas*, saw underdevelopment and development as interrelated, with capitalism as the root of both conditions (Baran, 1957; Frank, 1969). Modernism characterizes the underdeveloped conditions of third world countries as natural and internally originating and views the current status of underdeveloped nations as similar to earlier statuses of developed nations. Dependency theory rejects that characterization and instead historicizes national conditions, taking into account the previous colonial status of

underdeveloped nations and these nations' continued dependence upon developed nations.

Dependistas use center-periphery discourse to describe the condition of developed, Western nations as central and developing nations as satellites intentionally kept on the periphery of the economic world (Frank, 1969). Dos Santos (1970) defines this dependent condition as follows:

> Dependence is a conditioning situation in which the economies of one group of countries are conditioned by the development and expansion of others. A relationship of interdependence between two or more economies or between such economies and the world trading system becomes a dependent relationship when some countries can expand through self-impulsion while others, being in a dependent position, can only expand as a reflection of the expansion of the dominant countries.... (p. 231)

Thus, while modernists view an internal resistance to change or a shortage of capital as primary barriers to development, *dependistas* view the international relationship between the center and the periphery, the oppressors and the oppressed, as the primary barrier to development (Servaes, 2008). To overcome this barrier, *dependistas* recommend that peripheral nations withdraw as much as possible from the international market and aim for economic and cultural self-sufficiency. However, this recommendation has not thus far led to successful development outcomes, and some scholars summarize dependency theory's contribution to development thinking as a

useful problem description that lacks useful solutions, or a good diagnosis lacking a cure (Lee, 1980; Unwin, 2009).

Whereas the modernism and dependency theory are diametrically opposed approaches to development, the third major development theory—critical perspectives—is less clear cut. Critical perspectives are more of a category of approaches than a specific theory or movement. What ties together critical development perspectives is the foundational assertion that "there is no universal approach to development, that development must be conceived as an integral, multi-dimensional, and dialectic process which can differ from one society to another" (Servaes, 2008, p. 163). Critical perspectives include, for example, multiplicity, "another development," liberation theology, sustainable development, participatory development, and gender and development. These approaches are distinct in their central issue or area of concern related to development. For example, sustainable development focuses on environmental issues to enable "...development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 43). Liberation theology, another critical perspective on development, stems from religious beliefs, emphasizing the importance of personal and collective empowerment and often addressing issues such as poverty and discrimination (Melkote & Steeves, 2001). But while critical perspectives on development differ in their central issue of focus, they may well overlap or complement one another. To continue the examples above, liberation theology may address environmental issues (from a

stewardship perspective, for example), and sustainable development may encompass spiritual aspects of environmental protection.

Further, many critical perspectives on development share general principles such as an emphasis on meeting basic human needs, both material and non-material; endogenous character, i.e., stemming from local culture and meeting local needs; self-reliance; ecology; participative democracy; and structural changes, particularly in social structures related to power distribution (Servaes, 2008). One important aspect of these critical perspectives is that in acknowledging that there are many ways to "do development," these perspectives allow for greater leeway in epistemological stance and in practical application as compared to other development approaches like modernism and dependency. For example, some development scholars and practitioners claim ideals and beliefs rooted in critical perspectives while acknowledging the necessity of operating according to more modernist principles, depending on the context of a particular development effort (Waisbord, 2007).

2.1.b History of Development

The development theories above introduce concepts and perspectives useful for understanding the information presented in this section: the history of international development. This section traces the history of development by decade from the emergence of development as we know it in the 1940s to the 2000s when ICTD was born.

Concepts associated with development can be traced back to the 17th and 18th centuries and earlier (Bronner, 2004; Unwin, 2009), but what has become known as modern development emerged after World War II when consensus arose in Europe and the U.S. that international financial aid could help promote peace and prevent wars. In 1943, forty-seven nations signed an agreement to provide aid to war-damaged European countries, calling their organization the United Nations Relief and Rehabilitation Administration. In late 1945, representatives from 50 countries met and founded the United Nations (UN), citing four main purposes: "to maintain international peace and security; to develop friendly relations among nations; to cooperate in solving international problems and in promoting respect for human rights; and to be a center for harmonizing the actions of nations" (United Nations Today).

Unlike earlier international organizations like the League of Nations, the UN focused on social and economic cooperation, as opposed to military aims. Although Europe was the main focus of UN aid efforts in the 1940s, attention turned to providing development aid to third world countries in the 1950s and 1960s. Similarly, the U.S.'s aid efforts first focused on Europe with the launch of the Marshall Plan, which provided humanitarian aid and encouraged recipient countries to resist Soviet influences. The Marshall Plan outlined the provision of financial and material assistance to European nations, which used their pre-existing expertise to successfully translate this assistance into improved economic conditions.

In 1949 Truman linked development aid and democracy when he introduced the Third World version of the Marshall Plan, called the Four Points program, in his inaugural address. Points one and two involved strengthening the UN and the world economy, respectively. Point three revealed the intention to oppose Soviet influence in recipient countries: "...strengthen freedom-loving nations against the evils of aggression" (Truman, 1949), and point four shows the influence of what became known as modernism: "embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas" (Truman, 1949). Thus, non-communist Third World nations were qualified to receive development aid in the form of what Truman called "a wider and more vigorous application of modern scientific and technological knowledge" (1949). Truman's description of development aid sounds similar to ICTD, which often seeks to "apply" scientific and technical knowledge to problems such as illiteracy, poverty, etc. Thus, as far back as the 1940s and 50s, the roots of ideas in ICTD can be found in development history.

Continuing the theme of technology as a central component of development, the development focus of the 1960s was straightforward technology transfer. This approach was modeled on the Marshall Plan, which had enabled significant economic growth in European countries after World War II. However, people in Third World countries had different expertise than those in European nations, and aid in the form of money and equipment did not have the same effect. Thus, the focus of international development

expanded to include communication and transfer of technical knowledge as well as technical equipment. It was during this time that President Kennedy expanded the U.S.'s development efforts by founding USAID and the Peace Corps in 1961, and the UN declared the 1960s the United Nations Development Decade (Jackson, 2007).

Three people whose ideas were rooted in modernism and heavily influenced development in the 1950-60s were economist Walt Rostow, sociologist Everett Rogers, and sociologist Daniel Lerner (Melkote & Steeves, 2001; Unwin, 2009). Rostow developed a five-stage model of economic growth in which Third World countries would be classified at stage one and First World countries in the most advanced stage of five. The five stages were (1) traditional society, (2) preconditions for takeoff, (3) take off, (4) drive to maturity, and (5) age of high mass consumption (Rostow, 1959). Technology was one of the most important factors in Rostow's model: it was a crucial precondition for take-off in stage two, and stages three and four both involved increasing technological innovation. Rostow saw technology as a vital component in diversifying and growing every nation's economy. Rostow's model influenced development thinking in the '60s by casting technology transfer as an important way to increase economic growth, which had become all but synonymous with development due to the influence of modernism.

In many ways, Everett Rogers's work dovetailed with Rostow's, sharing a pro-innovation and top-down perspective. Rogers developed the Diffusion of Innovations model to explain how technologies spread across societies (Rogers, 1962). In this model, he proposed that when society members are graphed according to when they begin using

a technology, the data forms a bell curve. Rogers classified people represented in the bell curve into five groups: innovators, early adopters, early majority, late majority, and laggards (1962). His pro-innovation approach called for persuasive communication to convince laggards and late majority members to become modern by adopting new technologies. Rogers's persuasive communication called for both mass media and key individuals to influence people to adopt technologies and thus spread the growth of these innovations across society. Rogers significantly influenced development thinking, later being called the father of development communication (Adhikarya, 2004). Rooted in modernism, development communication is a field that was born to persuade people in Third World nations to abandon their current way of life for one that was more modern. This development approach is summarized by Melkote & Steeves (2001): "...it [development] took upon itself to decide what innovations were best for its clients, followed by campaigns to convince them of the wisdom of its choice" (p. 56).

At about the same time, another sociologist, Daniel Lerner, developed a model to describe how societies transition from traditional to modern (Lerner, 1958). According to Lerner, the phases of modernization included (1) urbanization; (2) literacy and (3) media growth, which he characterized as separate but closely linked; and (4) political participation (1958). Lerner's work influenced development by increasing the domain focus on literacy and geographic focus on rural areas. In addition, his work raised expectations of how mass media communication could be used to influence people's behavior. Development approaches influenced by Lerner sought to move Third World

societies through the phases of modernization and create within Third World nations a climate of acceptance to change—change from a traditional to a modern society, change that was designed and introduced by First World nations which viewed themselves as the ideal to be emulated.

Rostow, Rogers, and Lerner influenced development thinking in a number of ways: emphasizing the role of economic growth; linking technology and economic growth; introducing the concept of persuasive communication to stimulate the spread of technology; and emphasizing the importance of literacy, rural populations, and mass media in the development of societies. These influences can be seen in ICTD as well. ICTD by most definitions seeks to use technologies to improve people's economic (and sometimes social) welfare, and, especially when ICTD was emerging, a relationship between economic growth and technology was assumed. These ideas are discussed in more detail in the next subsection on the emergence and characterization of ICTD.

The 1970s saw some shifts in development scholarship, policy, and practice. It was becoming apparent that the first United Nations Development Decade had not had the intended effects in terms of economic advancement for developing nations. In 1973, the president of the World Bank gave a speech calling for new directions in development, abandoning the previous uncoordinated efforts at rural development and instead launching a broad, unified approach (McNamara, 1973). In this seminal speech, McNamara outlined what became significant focuses for development in the 1970s:

meeting basic needs such as food, water, and shelter and addressing rural poverty, primarily by seeking to increase production of small farms (1973).

At the same time that McNamara was outlining these development goals, Western-educated development studies scholars who were originally from Third World nations began putting forth their own ideas about the barriers to development. These scholars rejected prevailing research that blamed laggards for being unwilling to accept change in the form of a more modern society. Instead their work identified external blocks to modernization such as local people not being involved with development planning, the inability to distribute information and materials due to inadequate infrastructure, and the lack of rural employment opportunities for farmers during the off season (Ashcroft, 1973.). Their work influenced development thinking by shifting the focus from internal barriers to development such as an individual's resistance to change to more external factors inhibiting development. This focus can be seen today in ICTD, which often emphasizes the importance of physical and social context and identifies barriers to development such as inadequate infrastructure.

During the 1980s, the emergence of a free market ideology changed development thinking yet again. Deregulation had helped pull the United States and Europe out of the economic crises of the 1970s, so once again, development thinking was guided by the notion that a strategy used in developed nations can be used in developing nations to achieve the same result. This development strategy had three primary emphases to support economic growth: (1) macroeconomic prudence; (2) outward orientation, or what

Unwin calls "openness to the world" (2009, p. 11); and (3) domestic liberalization, or a market economy (Williamson, 1990).

Building on notions of modernization from the 1960s, proponents of the liberal marketplace and international "openness" in the 1980-90s believed Western media, trade, and capitalism to be beneficial modernizing and empowering influences in developing countries. It was expected that being exposed to Western technologies, products, ideas, and media would generate a desire for these things and would prompt developing societies to emulate developed ones. Then when the Soviet Union officially collapsed in 1991, the remaining superpower, the U.S., influenced international development organizations to combine the existing focus on economic growth with an emphasis on liberal democracy. Thus, large development organizations encouraged newly transitioning countries in Central and Eastern Europe to emulate Western nations by establishing a democratic government and a market economy. This development approach was rooted in modernism and continued the theme of using the Western world as an example after which to pattern developing countries. The heavy influence of modernism has propagated what scholars have noted is an increasingly hegemonic approach to development (Unwin, 2009; Melkote & Steeves, 2001; Quarry & Ramirez, 2009). Unwin (2009) summarizes the foundational assumptions of this approach:

> This [hegemonic development approach] is based on the adoption of absolute definitions of poverty, a belief that development is about the elimination of such poverty through economic growth, that this can best be implemented by

> encouraging a free market, and that good governance is an essential precursor for such growth. (p. 14)

It was in this environment that the United Nations adopted the Millennium Development Goals (MDG) in 2000, setting the stage, and funding requirements, for many international development efforts. The emphasis on poverty reduction through economic growth is illustrated throughout the MGDs. For example, the first goal, ending poverty and hunger, has three targets, the first two of which address income and employment and the third addressing hunger directly (United Nations Goal 1). The MDGs also continue a development theme that has been present since the inception of formal international development in the 1940s: the importance of science and technology to development. Goal 8 addresses global partnerships, with Target F specifically calling for ICTs to be made available in developing countries (United Nations Goal 8). Thus, the adoption of the Millennium Development Goals is a significant milestone marking the emergence of ICTD (Heeks, 2008).

2.1.c Emergence of ICTD

Technology and communication have been central to development since before development even existed in its current form. According to ICTD academic Tim Unwin (2009),

> From at least the 17th Century, the use of technology or science has been at the heart of most of the dominant practices and discourses that have been concerned

> with development, from the industrial revolution of the 19th Century to the green revolution of the mid-20th Century. (p. 9)

However, although science and technology have been central to development since development's inception, ICTD as a field is a more recent and narrower "slice" of the whole development "pie": the intersection of socioeconomic development and information and communication technologies. And just as ICTD can be considered a distinct subset of development, ICTD can also be considered a distinct subset of ICT. As Unwin (2009) explains,

> Unlike IT and ICT, where the main focus is on what *is* and what *can* be achieved, ICT4D is about what *should* be done and *how* we should do it. ICT4D therefore has a profoundly moral agenda. It is not primarily about the technologies themselves, but is instead concerned with how they can be used to enable the empowerment of poor and marginalized communities. (p. 33)

ICTD commonly involves technologies such as Internet-connected computers and mobile phones, though a range of other technologies like video, televisions, and radios can also be used. Geographically, ICTD can occur in resource-constrained communities within developed countries, though ICTD more commonly focuses on developing regions, historically concentrated in India and Africa. ICTD often addresses domains like health, education, agriculture, and finance, but it has also been used in areas like gender equality, gaming, and transportation.

From the mid-1990s to the early 2000s, many ICTD efforts were aimed at bridging the "digital divide"—a gap between people who had physical access to ICTs from those who did not. Bridging this divide was expected to make information available that would accrue marginalized people benefits such as improved education and job prospects, a greater voice in government, and access to better healthcare information. Therefore, providing physical access to ICTs was a major focus of early ICTD, as represented by what Heeks identifies as the archetypal technology of this period: the telecenter (2008). The assumption that physical access to ICTs would usher in new economic opportunities was partially based on expectations that people in developing countries would use ICTs in similar ways for similar purposes and following similar usage patterns as people in the developed world. These expectations show the continued influence of modernism, the epistemological stance associated with Rostow, Rogers, and Lerner in the 1950s and 1960s.

In the early to mid-2000s, the hype of ICTD began to flag as projects failed and a wave of reports and publications disseminated the disappointing news of limited, negative, or unintended outcomes (Brand & Schwittay, 2006; Heeks, 2002). Thus, on the heels of these reports, donor organizations and other ICTD stakeholders called for a new focus on criteria for success that would prevent failures in the future. According to critical scholars Quarry and Ramirez (2009), the assumption that these criteria would generalize across ICTD illustrates the influence of modernism and directly conflicts with critical perspectives' foundational emphasis on local context:

> Think about how often donors and governments like to talk about 'best practices.' This thinking reflects an industrial, engineering way of looking at the world.... Our challenge is these recipes do not work. Context matters and solutions need to be designed to fit the local situation. (p. 15)

However, modernism continued as the dominant perspective in ICTD, and two criteria emerged as measures of ICTD success: sustainability and scalability. According to these criteria, a development project centrally involving ICTs would be considered successful if it continued to exist (i.e., was sustainable) and if it spread beyond the initial application area (i.e., was scalable). Underlying these criteria is modernism's emphasis on efficiency. This efficiency-embracing perspective assumes that for ICTD projects to be worth the resources required to plan and implement them, these projects should continue indefinitely or at least the longer the better (i.e., be sustainable). The continued existence of a project is sometimes conflated with continued positive outcomes and benefits. Thus, a project that continues for a longer period of time is often considered more successful just by default compared to a project that exists for a shorter time.

Similarly, modernism underlies the success criterion of scalability. As a criterion for project success, scalability dilutes or eliminates a focus on local context. Scalability assumes that there is at least one approach to an ICTD project that would work (and continue to work, meeting the criterion of sustainability) across contexts. Taken to the extreme, this perspective implies that contexts are similar enough or insignificant enough that if ICTD work is designed successfully, it should be a "plug and play" solution

wherever it is implemented. As Quarry and Ramirez point out, this assumption directly conflicts with critical perspectives of development:

> In international development there is a fascination with best practices and replication. If a pilot project goes well, we make it into a cookie cutter and try to scale it up. Except in the real world this fails because the nature of the beast is not the same. The intense, creative force behind each new initiative is different from the task of multiplication. (p. 62)

Rejecting the criteria of scalability and sustainability, some development scholars and practitioners claim that large-scale focus and detailed goal setting are counter-productive to development efforts (Easterly, 2006). Instead, these scholars and practitioners use language like "planners versus searchers" or orchid metaphors to illustrate the unique, locally focused nature of development success (Easterly, 2006; Quarry and Ramirez, 2009). For example, Quarry and Ramirez's orchid metaphor intentionally eliminates any expectation of sustainability and scalability: orchids bloom only occasionally and only when local conditions are right. Because each project context is unique, dynamic, and complex, no project is expected to last indefinitely or to scale broadly. In other words, critical scholars would consider a project that met the needs of multiple stakeholders within a limited context for a limited time to be a successful project. To summarize, those who are influenced by critical perspectives often emphasize local situatedness, while those in the modernist camp more often seek sustainability and scalability.

The ICTD field involves a variety of stakeholders, such as practitioners, local populations, government organizations, NGOs, and, quite often, academic scholars. Academia has expressed a very enthusiastic, multidisciplinary interest in ICTD, involving disciplines such as computer science, information science, public administration, human-computer interaction, international business, user-centered design, geography, development studies, health informatics, and others. Starting in the late 1990s, academic interest in ICTD became more widespread and formalized. Academic journals, such as *Information Technologies and International Development (ITID)*, and conferences, such the ICTD conference, drew together researchers and practitioners across the field. A few universities even began creating formal academic programs in ICTD. In a February 2010 blog entry, Heeks overviewed the growth of ICTD as an academic field, claiming there was a nearly 2000% increase in ICTD research from 1999 to 2008 (2010). Academic journals and conferences specific to ICTD have increased significantly in the last 10 years, producing 33 journal articles in 1999 and 182 journal articles in 2009. Heeks estimates that worldwide hundreds of academics and thousands of PhD researchers specifically focus on ICTD (2010).

Because ICTD is shared by so many existing academic fields and is relatively young, it lacks a cohesive academic identity and well-established theoretical grounding (Best, 2010). Further, many ICTD articles describe "practical" research such as applied case studies, so there is a dearth of research identifying patterns across case studies to provide meso-level knowledge to inform future ICTD projects (Donner & Toyama,

2009). Recently, ICTD scholars have begun proposing common criteria for high-quality, promising ICTD research (Burrell & Toyama, 2009). Defining research criteria for ICTD is difficult not only because the field is new and cross-disciplinary, but also because it is so broad, encompassing and overlapping with areas like development informatics, communication for development, ICT for international development, and human-computer interaction for development (Ho, Smyth, Kam, & Dearden, 2009).

The breadth of the field can be seen in Burrell and Toyama's characterization of ICTD research: (1) focusing on humans' relation with technology for the purpose of positive socioeconomic change; (2) involving significant differences between researchers and beneficiaries or other stakeholders (e.g., researchers and local beneficiaries often differ in nationality, ethnicity, cultural background, education level, language, and income level); (3) studying interaction of people and technology as it is and as it changes; and (4) including cross-disciplinary topics and approaches (e.g., using information technology, the domain of computer scientists, to support better healthcare, the domain of healthcare professionals). The research criteria the authors mutually advocate include accuracy, transparency and soundness of method, empiricism, novelty, disciplinary relevance, and generalizability.

While Burrell and Toyama seek to distinguish between disagreeing in perspective and approach and conducting inadequate research, points of contention remain: philosophical foundation, reflexivity and bias, differences versus commonality, starting with problems versus values, and different definitions of development (2009). For

example, qualitative researchers treat issues of reflexivity and bias quite differently from quantitative, positivist researchers. Positivists would claims that there is an objective reality and that researchers should convey that reality without bias: i.e., without filtering, coloring, or affecting the reality that they observe and report. In contrast, qualitative researchers claim that reality is always filtered through human perception and that researchers should therefore communicate clearly and thoroughly about themselves and their research methods. Because the ICTD field includes researchers from both traditions, there will continue to be different perspectives on issues such as reflexivity and bias within the ICTD community. Thus, even as ICTD matures as a research area, perspectives and approaches are expected to remain highly inter- and multi-disciplinary (Best, 2010; Burrell & Toyama, 2009).

In formal ICTD academic programs, the curriculum at one school is likely to be quite different from another, and researchers with different areas of expertise, research methods, skill sets, lexicons, and perspectives all claim to perform research in ICTD. For example, the first quarter focus of Stockholm University's Master's in ICTD is computer science core curriculum such as principles of computer security and processes for IT production (2009), while geography is a predominant department in the Royal Holloway, University of London's ICTD PhD program in ICTD (2011).

Among the many universities performing ICTD research, the University of California at Berkeley is a clear leader, with a broad program of research in information, computer science and engineering, economics, business, design, and agriculture. This

university hosted the first ICTD conference, which has arguably become the most influential and respected ICTD-specific conference, and the university draws leading ICTD scholars, such as Kentaro Toyama (lecturer), Tapan Parikh (assistant professor), and Jenna Burrell (assistant professor). Other key universities include the University of Washington; Royal Holloway, University of London, which offers a Master's degree and PhD in ICTD; Carnegie Mellon University; Georgia Tech University; the University of Manchester; several branches of the Indian Institute of Technology; and others. In reviewing this list, one point worth making is that, with the exception of India, universities in developing countries themselves are not taking a strong lead in ICTD research. The data from the study presented in this dissertation suggest some reasons why this might be the case. For example, professors in developing countries often make limited salaries that they supplement with paid consulting work. Unlike corporate-based ICT work, ICTD by definition involves the poor—a client base which cannot pay steep consulting fees. (This point is discussed further in Chapter 5.) Some of the most influential research in ICTD is presented at conferences such as the IEEE/ACM International Conference on Information and Communication Technologies and Development (ICTD) and the International Federation for International Processing (IFIP). However, even conferences such as CHI, WWW, and ISCRAM, which focus on non-ICTD topics, are offering ICTD tracks.

Section 2: ICTD Best Practices

ICTD literature suggests several ways to go about changing existing situations into preferred situations. Unlike the rigid, prescriptive concept of best practices rejected by critical scholars like Quarry and Ramirez, the best practices presented in this section are more like high-level guidelines that can be implemented in different ways, customized for each project. These best practices are presented below:

- Consider the environment or context
- Partner deeply with local stakeholders
- Design appropriate technology

These practices have natural overlaps and connections, as represented in Figure 2.1.

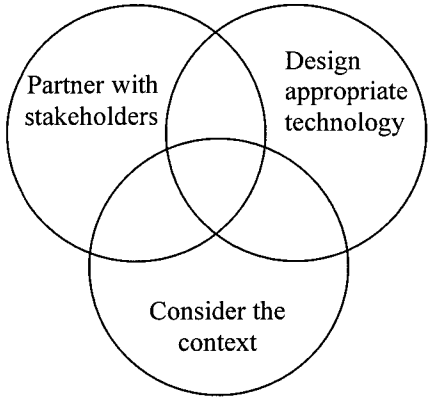

Figure 2.1: Relations of ICTD Best Practices

For clarity, each theme of best practices is introduced individually in the first section, but the themes are not mutually exclusive. Rather, they combine productively, and ICTD projects often suffer if they overemphasize a single best practice. The second

section discusses each possible combination of two themes. In addition to illustrating the benefits of combining the best practices, this section also identifies problems that can result from failing to balance *all three* practices. However, a close reading of the ICTD literature suggests that projects rarely integrate all three practices productively, often due to the constraints on resources such as time and money. The final section elaborates on the difficulties of balancing all three best practices in a single ICTD project.

2.2.a Individual Best Practices

The first practice is that ICTD project leaders should pay particular attention to the environment or context in which technologies will be used (see Figure 2.2).

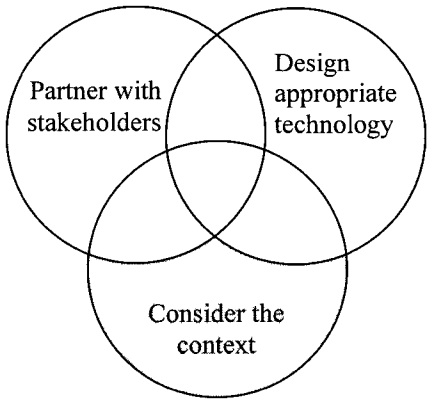

Figure 2.2: ICTD Best Practices: Context

The conception of "context" is multi-faceted, with cultural, physical, infrastructural, political, and other dimensions. This emphasis on context is shared by a number of scholars (Denzin & Lincoln, 2000; Kam et al., 2007; Maunder, Marsden, & Tucker, 2006; Maunder, Marsden, Gruijters, & Blake, 2007; McLuhan & Fiore, 1967; Miller, Friedman, Jancke, & Gill, 2007; Nathan, Friedman, Klasnja, Kane, & Miller,

2008; Spinuzzi, 2005). For example, Denzin and Lincoln claimed that researchers should pursue a deep, nuanced understanding of a situation, developing an awareness of political and social motives and contexts, acknowledging the influence and perspective of the researcher on the designed outcome (2000). McLuhan and Fiore emphasized the importance of being aware of context: "The ground rules, pervasive structure, and over-all patterns of environments elude easy perception" (1967; p. 84-85). Maunder et al. argued for the importance of contextual focus when designing information systems for the developing world, suggesting the use of bridges.org's Real Access/Real Impact criteria to frame contextual thinking (2006, 2007). Kam et al. also focused on designing for the developing world, illustrating the differences in micro-cultures (such as individual schools or hospitals, etc.) and how those differences should affect project design (2007). Some scholars emphasize human context, such as Brand and Schwittay's human-driven design approach (2006). Brand and Schwittay listed four human dimensions of ICT: local practices, socio-cultural contexts, political conditions, and participatory design processes (2006). The first three of these dimensions are contextual. (The final dimension of human-driven design, participatory design process, is related to the second best practice in ICTD project design, partner deeply with local stakeholders, discussed below.) According to Brand and Schwittay, issues such as environmental impact, cultural appropriateness, consumption practices and technological infrastructures all need to be taken into account. For example, computers require IT support to keep them running and help people use them. If an ICTD project provides hardware and software without the

human support, the technology itself is unsustainable—and it creates a dependency on Westerners for continued financial and technical support.

Tongia and Subrahmanian also emphasized the importance of considering contextual factors in ICTD projects (2006). In fact, Tongia and Subrahmanian claimed that one of the major reasons that ICTD projects fail is that project leaders conduct an incomplete assessment of the problem being solved and use inappropriate metrics to evaluate solutions. Like Brand and Schwittay, Tongia and Subrahmanian paired contextual factors and stakeholder participation, claiming that the project must include incorporation of stakeholders, incentive structures, and design participation. The authors believed that too many ICTD projects focus on only one aspect of the ecosystem in which the project will be situated; however, they believed that the only way for an ICTD project to be successful is to aim for understanding the entire ecosystem or at least trying to fully consider it. This type of approach would address issues like identifying direct and indirect stakeholders and their motives, securing long-term funding, identifying relevant regulations, reviewing a variety of technological options, and involving innovators and solution providers. The authors made the point that the digital divide is a symptom of underlying social, educational, political, and economic divides, which cannot be bridged by technology alone. All the typical concerns about ICTD projects—cost, replicability, ruggedness, etc.—are important only in the context of the development effort itself: "The need to balance cost, usability, scalability, maintainability, recyclability and relatively long life cycle of the solution becomes critical in the context of development. Without the

understanding of the overall ecosystems of the product operation, the products will often fail…" (Tongia & Subrahmanian, 2006, p. 245).

A second major theme in ICTD best practices is a call to partner deeply with local stakeholders (see Figure 2.3).

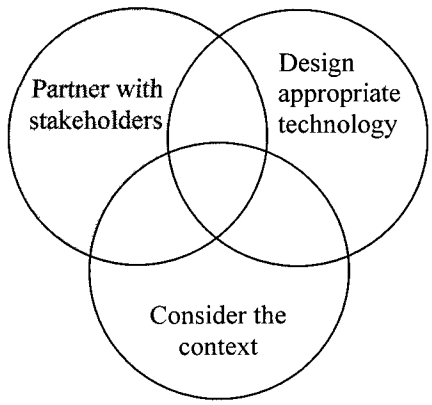

Figure 2.3: ICTD Best Practices: Stakeholders

Many scholars argue that a good system is designed with input from its stakeholders, particularly from direct stakeholders (those who would use the system) but also indirect stakeholders (those who would not use but would be affected by the system) (Friedman, Kahn, & Borning, 2006; Gandhi, Veeraraghavan, Toyama, & Ramprasad, 2007; Greenwood & Levin, 2006; Kam et al., 2007; Miller, Friedman, Jancke, & Gill, 2007; Tacchi, Slater, & Hearn, 2003). However, although the basic premise of local input is consistent, the way that scholars solicit and apply this input varies. For example, Greenwood and Levin advocated for action research, in which researchers and local stakeholders partner from the beginning of the project through the end—joint problem identification through joint evaluation and iteration (2006). Spinuzzi (2005) and Tacchi,

Slater, and Hearn (2003) also advocated this project-long partnership approach. Kam et al. advised researchers/designers to spend time with local stakeholders not only during project-focused activities such as usability testing or interviewing but also for community events such as festivals or everyday social activities like relaxing at the local coffee shop (2007). Gandhi, Veeraraghavan, Toyama, and Ramprasad employed participatory research with heavy input from local stakeholders at the beginning of the process to influence design and evaluation later to gauge whether the design supported the desired outcome (2007).

The Miller (2007) and Friedman (2006) pieces emphasized the importance of considering stakeholder values, beginning a research project with the identification of these values and iteratively testing to ensure the designed systems support these values. Thus, for Miller and Friedman, the values of local stakeholders alone are vital to the design process, whereas action researchers like Greenwood and Levin (2006) also seek to incorporate and support the values of ICTD project team members. Whenever and however this local stakeholder input is solicited, the goal is the same. Crabtree summarizes the goal: "...emphasis in design has been placed on eliciting the tacit local knowledge and skills which characterize work and on supporting local knowledge and skills in a mutual, collective process of learning and design of potential technological solutions" (1998, p. 2).

In ICTD specifically, there is a trend away from what Heeks calls the "propoor" approach (2008). Propoor approaches are innovations designed outside of poor

communities for poor communities; the resulting innovations are often unsuccessful due to the design/reality gap (i.e., the difference between the usage environment and circumstances envisioned by the culturally and geographically distant designer and the actual reality on the ground in developing countries). Instead, trends are moving toward para-poor approaches: innovations designed alongside and in partnership with the poor. For example, Brand and Schwittay claimed that ICTD approaches should incorporate methods of co-design that will highlight local knowledge about the appropriateness of some technologies over others, rather than ICTD being focused on implementing externally designed technology fixes (2006). These authors also claimed that a key to design is immersion in local culture to find out what people want and want to do, which leaves open the possibility that ICTs are not, in fact, the best solution. Thus, Brand and Schwittay (2006) pointed out that attaining and sustaining a locally driven problem identification and solution envisioning process is difficult if the process occurs in the context of a public-private partnership because often the company's products are assumed to be the solution with the process focused on finding a suitable problem:

> Successful projects are always rooted in conditions that enable local initiatives to emerge, and then provide the resources for them to grow. This entails a model of partnership that truly trusts the abilities of local people to know best what they need, rather than being provided for by development agencies, governments, or corporations. (p. 9)

Brand and Schwittay suggested that one role for Western technologists is to lend their expertise to local initiatives in need of technological support. This approach would enable local stakeholders to drive the focus and scope of the project, with ICT brought in to address locally defined problems.

Critical scholars Bakardjieva, Feenberg, and Goldie also called for deep partnerships with stakeholders, though his focus is broader than ICTD, calling for a critical research approach that addresses issues of power, inequality, and exploitation in economic and political institutions and seeks to change institutions to better serve the community (2004). This critical research approach would include an internal analysis, with researchers examining why they are interested in studying a particular topic, who benefits from the research, and how the results will be used. Bakardjieva, Feenberg, and Goldie recommended participatory action research, which seeks not only to partner with participants to conduct research on a topic that is meaningful to them but to equip them with tools to examine, describe, and oppose inequalities of power. The authors called for deep partnerships with research participants based on the belief that a symmetrical power structure is more ethical than what they called the "law model of research," in which researchers alone shape the focus, scope, methods, and desired outcome of a project and in which participants have only the option to participate or not:

> The extent to which participants' interests are recognized and addressed by the goals and techniques of research is a central ethical issue. ...By incorporating the research participant in the very process of formulation of research goals and

designs, the issues that truly concern participants can be addressed" (Bakardjieva, Feenberg, & Goldie, 2004, p. 343).

The third theme in these writings is a focus on appropriate technology design (see Figure 2.4).

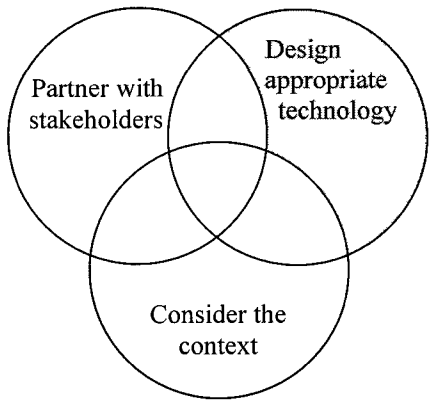

Figure 2.4: ICTD Best Practices: Technology

Developing world contexts and needs can differ significantly from those in the developed world, and technologists involved with ICTD must design technologies appropriate to the environmental constraints, often by taking advantage of resources and behaviors already in place. These technologists also address cultural issues, such as the prevalence of collaborative rather than individualistic problem solving, and human factors, such as widespread illiteracy, in their designs. They seek to meet needs through new technological approaches that are better suited to development environments than commercial off-the-shelf technologies.

For example, Starner described a number of ICTD projects, including DakNet, a project led by the MIT Media Laboratory, that used store-and-forward methods to enable

intermittent email access in rural villages in India (2005). DakNet created mobile ad hoc wireless networks by installing 802.11 mobile access points onto the rural buses that ran established routes from a larger city, through several villages, and back to the city. Computer kiosks in each village could download and upload messages to the hub, which would carry the messages back to the city network. This same idea was used in Cambodia with motorcycles and ox carts due to difficult terrain. These networks used inexpensive WiFi devices (~5$ per chip set when the article was published in 2005) and existing infrastructure (e.g., the rural buses connecting these villages to the city), but the creativity was in how the two are combined to enable intermittent email access that connects these rural areas and enables inexpensive wireless communication. Even better, this technology design was flexible enough to seamlessly upgrade if and when a consistent internet connection became available. For example, if a radio tower were built in a rural village to directly connect to the city network, the system would automatically adapt (Starner, 2005). This ability to not only work in the present but accommodate a dynamic environment and continue to work in the future is vital for ICTD.

Medhi, Sagar, and Toyama also provided an example of appropriate technology design in her initial exploration of interfaces for illiterate users (2007). They noted that computer applications are almost completely inaccessible to illiterate users, but that this does not have to be the case, since computers can use graphics, animation, and audio to convey information. The goal of their research was to design a computer interface that novice illiterate users could use with no intervention or training. After collaboratively

designing two computer applications (interacting with 80 men and women and a few children), the authors tested these applications with other community members (four individuals and two groups of five women) who had not been involved in the design. Testing focused on whether participants could use a regular text-based interface, to what extent participants could use the text-free interface, and which principles of text-free design make the most difference. The researchers found several principles that could guide future interface designs for illiterate users, such as the importance of providing a consistent help feature on all screens and consistently using voice feedback for all interactive elements to respond to the user's actions and confirm the effects of those actions (Medhi, Sagar, & Toyama, 2007).

Medhi, Sagar, and Toyama's research was broader in focus and offered a more nebulous benefit than much ICTD research, which usually seeks to solve an immediate problem by designing a specific solution. None of the local participants involved in Medhi's research had ever used a computer before the project; few had even seen one in person. They did not need specialized device interfaces if they lacked access to the device itself—but that may not always be the case, and it is certainly not the case for all illiterate potential computer users. Thus, Medhi claimed that it is good to know how to design interfaces for illiterate and semi-literate users because the need may arise, and the best solution for a particular problem may be computer based (2007). When that is the case, it will be important to have information about how to develop appropriate interfaces for these applications. Thus, what constitutes appropriate technology is dynamic, and some

researchers explore possibilities for future uses of technology that, while inappropriate for the current context of use, may well become appropriate in the future.

2.2.b Combining Best Practices

The practices introduced above provide only a partial synthesis of the benefits of ICTD best practices if these practices are considered alone. In fact, it is difficult to discuss each practice separately without mentioning the others because there is much overlap in the approaches and benefits of these practices. To get a richer picture of best practices in ICTD and trends that will shape future projects, it is important to examine where the themes connect and even overlap. Below, each combination of best practices is discussed with examples from the literature to illustrate how they overlap in specific projects or according to particular authors' perspectives.

Environmental Constraints Guiding Appropriate Technology Design: A consistent overlap in ICTD best practices occurs when the environmental constraints or contextual factors in a particular location guide appropriate technology design. As suggested by Figure 2.5, most of the examples in this section show the practice "design appropriate technology" in combination with the practice "consider the context." However, a few examples also include the third practice of partnering with stakeholders.

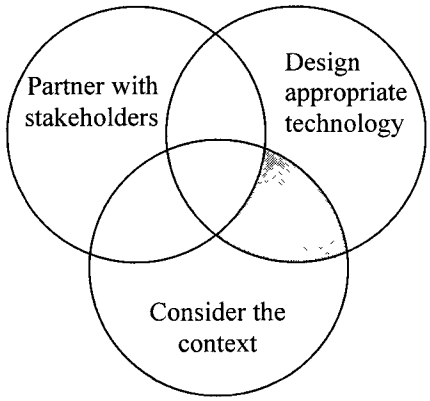

Figure 2.5: ICTD Best Practices: Context and Technology

In fact, both examples in the Appropriate Technology Design theme in the previous section are also related to the Environment and Context theme: e.g., DakNet was designed to capitalize on existing infrastructure (e.g., rural buses) and to circumvent missing infrastructure (e.g., wireless connectivity) (Starner, 2005), and the interface for illiterate users was inspired by local conditions (i.e., widespread illiteracy and the need for job search resources) (Medhi, Sagar, & Toyama, 2007). Existing, off-the-shelf technologies are almost exclusively designed by and for the developed world. However, most ICTD projects implement technologies in the developing world, which has very different environmental constraints that would actually prevent many existing technologies from sustainably operating and therefore should affect technology design for ICTD projects.

In "Designing an Architecture for Delivering Mobile Information Services to the Rural Developing World," Parikh and Lazowska discussed several of these constraints from the perspective of how they affect technology design and performance (2006). For

example, they mentioned environmental challenges such as intermittent power due to unreliable sources and load shedding (planned power outages to save energy) and spatially intermittent internet connectivity. Commonly, Internet connectivity is faster and more reliable the closer it is to an urban area; in developing countries, rural internet connectivity is often slow and poor quality or nonexistent. Some of the less commonly considered environmental factors Parikh and Lazowska mentioned were variable population density and a lack of secure storage. They pointed out that the cost of developing physical infrastructure to support technologies is very different per capita for countries like Bangladesh, with more than 1,000 people per square kilometer, than for areas of Sub-Saharan Africa, where density can be less than 10 people per square kilometer. The population density may well affect the willingness of funders to pay for infrastructure development if the technical approach is expensive and population density is low. This factor calls ICTD technologists to either seek low-cost options at all times or to consider different approaches for different locations. The lack of secure storage for electronic devices is an important consideration, affected by a variety of factors such as type of location (e.g., private home, workplace, school, public building), climate (e.g., extremes of humidity or dust/sand), and cultural norms (e.g., location of devices may affect who has access according to which type of people frequent those locations).

In addition to environmental factors, human factors can also guide appropriate technical design to enable a workable solution or tool. For example, Parikh and Lazowska discussed the effects of limited education, particularly in rural areas of

developing nations (2006). Rural areas are more likely to have agrarian economies, and children may be pulled from school at a younger age to help in the family's fields. Often the few children who do finish school and complete additional training or higher education move to the cities where more jobs are available and salaries are higher. While many people in villages may be illiterate, cultural factors such as prevalent collaboration and close family ties usually provide illiterate members of the village with intermediaries in the form of literate family members (Parikh & Ghosh, 2006).

Certain members of a community may have unique needs that must be considered for technologies to be applicable and available to them. For example, Morrell and Sterling pointed out the discrepancy between, on the one hand, widespread claims that ICTs can raise the status and standards of living for women in developing nations and, on the other hand, the rare and limited attention that gender difference actually receives in technology design and policy reform (2006). Morrell and Sterling claimed that ICTD projects often ignore women's particular design requirements: e.g., lower literacy, physical isolation/limited access, domestic duties, more significant cost constraints. To shift the focus of ICTD from its current, exclusionary course, the authors called for a framework of ICTD efforts that addresses gender issues at the policy and action level, in research and collaboration, through dissemination and communication, through resource development, and in context and culture (2006). Appropriate technology design is required to address the particular needs of women and to make ICTs more applicable and available, particularly to women in rural areas of developing nations.

One interesting example of appropriate technology design in response to contextual factors is Parikh's work on the CAM project (Parikh, 2005; Parikh & Lazowski, 2006). This project developed a particular framework for developing and deploying mobile computing applications for cell phones in the rural developing world. Specifically, Parikh designed an application to streamline paperwork by connecting the paper forms to a cell phone application instead of eliminating paper altogether. The application begins by having the user take a picture of a paper form's initial barcode or enter the associated string of numbers using the phone's key pad. This triggers a stepwise, wizard-like data entry procedure that follows the same order as the paper form. Script can be represented as images to enable non-Latin languages to be represented, and an audio clip reads the form label as well. Most entries are numeric, but text-based entries can be written by hand on paper and photographed or spoken and recorded. To check entries, users can scan the barcode associated with a particular blank on the paper form. The answer would then be shown on the cell phone's screen and an audio clip of the label would be played.

Tying the digital device to a paper form through barcodes encouraged self-help group members to trust the technology by connecting it to processes they already know and are comfortable with. Further, the paper forms showed a global view of the digital data entry process, eliminating the problem of tunnel vision associated with stepwise, wizard-like procedures (Parikh & Lazowski, 2006). Parikh pointed out that paper is very appropriate for hands-on cultures, especially in rural areas with scarce digital resources.

Paper can allow information to be communally viewed, edited, and stored; however, paper is poorly suited for searching, collating, and reporting disparate information. The CAM application allowed paper information to be digitally captured and enabled computers to store, collate, search, and report information, while the paper forms allowed information to be handled, shared, and edited (Parikh, 2005).

Parikh argued that mobile phones were better suited to rural developing areas than many other computing devices such as computers, due to their long battery life, wireless connectivity, solid-state memory, low price and immediate utility, but the authors observed that this appropriate hardware lacked an easy-to-use, easy-to-deploy application framework, thus prompting CAM design. Based on the environmental and user constraints discussed earlier in this section, the authors identified several things to avoid in applications designed for rural developing-world contexts:

- Text: due to prevalent illiteracy and low literacy
- Abstract navigation: because abstract, symbolic thinking is more difficult to convey in low education environments
- Excessive documentation: since devices should ideally be usable based on word-of-mouth instruction
- Personal property: because of India's communal, collaborative culture

Based on these context-based design guidelines, the authors represented information in a number of ways: e.g., audio files (good for illiterate users either to use the application themselves or verify the way an intermediary is using it for them), text as

image (a good way of representing non-Latin languages unsupported by operating systems and incompatible with keyboards), recording a user speaking, enabling a user to take a picture of text/handwriting, and coding text as numbers. Another interesting design feature was the technical approach to address intermittent connectivity. The device first sought wireless internet connectivity and then sent an SMS if no Internet connection was available. Parikh and Lazowski summarized how contextual factors drove the technical design: "Supporting minimal navigation, direct linkage to paper practices and offline multi-media interaction, CAM is uniquely adapted to rural device, user and infrastructure constraints" (2006, p.791).

However, this project applied only two of the three ICTD best practices. Deep partnerships with local stakeholders were not sought, even though the project did involve onsite, ethnographic research with users. The emphasis of this project was very much a propoor application designed to work in the intended environment but with users considered only in terms of their shortcomings and not in terms of what they brought to design. The application was user tested, but the articles focused on describing the technical design and the limitations of users and environments.

Local Partnerships Providing Contextual Insight: Some ICTD projects combined the practices of deep partnerships and an emphasis on environmental or contextual factors. As suggested by Figure 2.6, this section focuses primarily on the overlap of those two practices while including some brief mention of the third practice, designing appropriate technology.

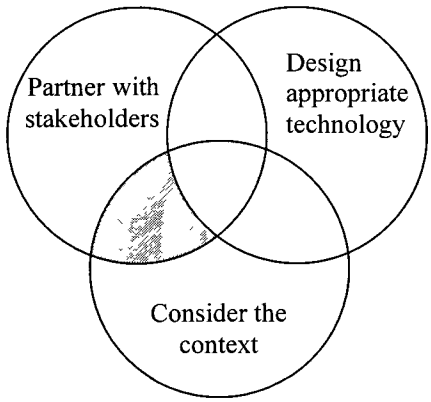

Figure 2.6: ICTD Best Practices: Context and Stakeholders

In this combination, the partnerships with local stakeholders provide insight into the environment, identifying contextual factors and interpreting their relevance to the project design. In their call for critical research, Bakardjieva, Feenberg, and Goldie mentioned contextual insight as a key value of deep partnerships with research participants (2004). Similarly, Crabtree (1998) and Maunder (2007), discussed how a combination of deep partnerships with stakeholders and an understanding of contextual factors can produce the most useful design requirements. In their analysis of the problems associated with the LINCOS project in Costa Rica, Brand and Schwittay showed the poor design results of a process that does not partner with local stakeholders to gain contextual insight to shape design (2006).

Crabtree examined the trend that was emerging more than 12 years ago toward eliciting tacit knowledge and local skills that characterize embedded work practices and on supporting those practices in "...a mutual, collective process of learning and design of potential technological solutions" (1998, p. 2). In this piece, he sought the best way to

design systems for a work environment by combining what participatory design and ethnography have to offer. While participatory design partners users with designers in envisioning different alternatives for their future, ethnography provides a clear and detailed picture of current work practices. In other words, while participatory design emphasizes the design theme of deep partnerships with local stakeholders, ethnography seeks to develop a keen understanding of context, another of the design themes. Used alone, participatory design and ethnography are somewhat incomplete, Crabtree claimed, but used together, these approaches offer a strong methodology to drive system design.

In the last 20 years, several methods have emerged from a participatory design tradition to support user involvement in system design: e.g., future workshops, mock-ups, and scenario construction combined with prototyping to generate design requirements. However, Crabtree pointed out that a risk of using these techniques alone is that the focus on an ideal future can overemphasize technological solutions without deeply exploring and identifying the most appropriate problem spaces—risking a project outcome that generates an excellent solution to the wrong problem. Crabtree linked iterative prototyping in particular to tunnel vision that restricts the focus of the project to a narrow area and potentially ignores relevant contextual factors (1998). Further, the danger in driving design based only on participatory design's exploration methods and not on any direct observation of the workplace is that people describing their practices is not the same as people conducting those practices. Thus, participatory methods like futures workshops, scenarios, and prototyping can lead to solutions focused on problems that are

not central to actual practice. Ethnography, however, focuses on identifying the essential pieces of current practice, which act as constraints that can guide design solutions. These essential pieces of current practice could involve environmental constraints, cultural norms, relevant regulations and policies, etc. Therefore, Crabtree recommended that designers begin their projects with ethnographic methods and continue ethnographic research even as they progress into participatory methods like future workshops (1998). This continuation of ethnographic research can help to ensure that the project focus stays relevant to current practice as researchers/designers and local stakeholders envision and work toward a desired future.

Maunder took a similar stance when examining user-centered design (UCD) practices in the context of ICTD, emphasizing the need for frameworks specifically designed for development contexts to identify relevant contextual factors, motivate local participants toward a deeper and sustained involvement, and frame a progressive participatory design approach (2007). The paper illustrated shortcomings of user-centered design in developing world contexts using two UCD case studies in South Africa which involved good input from local stakeholders about their immediate environments but failed to convey important socio-cultural environmental factors that should also have affected design. Maunder evaluated tools and techniques associated with the first three phases of UCD: 1) understanding and specifying the context of use, 2) specifying the user and organizational requirements, and 3) producing design solutions. Analyzing the ethnographic methods and contextual inquiry used to observe and model current work

practices in both case studies, Maunder claimed that on-the-ground observation and modeling of work practices was essential and that the information gathered by these approaches was important and appropriate (2007). Thus, typical UCD methods seem to be perfectly acceptable and reasonable for a developing world context in the first phase of UCD (understanding and specifying context of use). The breakdown occurs when the observations are translated into design requirements. Maunder claimed that by using the Real Access/Real Impact criteria to drive thinking about design requirements, project leaders can augment UCD methods to add appropriate environmental, infrastructure, organizational, and socio-cultural constraints when considering the design approach, as well as micro (user-centered) and macro (community-centered) factors (2007).

When an ICTD project ignores user-centered and community-centered factors, the results are often disastrous. For example, LINCOS was one of the first telecenter projects, led by a partnership of university and corporate sponsors to bring ICTs to people in rural Costa Rica (Brand & Schwittay, 2006). The LINCOS project designers did not employ any of the suggestions mentioned by Crabtree or Maunder—no ethnographic methods to observe local practice and culture, no futures workshops involving local community members or Real Access/Real Impact analysis to envision possible effects. Instead, these designers were guided primarily by economic and logistical concerns, designing a local computer center installed inside old metal shipping containers, over which large tensile tents were erected. The benefits of this design were that the equipment and tent could be packed into the shipping containers, which are plentiful and cheap, and easily shipped to

many types of locations. Unfortunately, the drawbacks were significant enough to impede the success of the telecenter. As project leaders later learned, local people did not want to go to the telecenter partly because shipping containers were associated with poor people. Further, the tent was difficult to keep up; it quickly fell down and was discarded. The container was poorly designed for local conditions, such as extreme heat and humidity. It flooded during rains, and the metal container became a veritable oven under the hot sun. Because they had never been consulted or involved in the project, community members viewed the telecenter as someone else's project and had little or no investment in its use or success (Brand & Schwittay, 2006). Brand and Schwittay's analysis of this early ICTD project failure highlighted the importance of partnering with local stakeholders and incorporating contextual and environmental factors into design.

Local Partnerships Guiding Appropriate Technology Design: A third combination of best practices is when local partnerships prompt and shape appropriate technology design (See Figure 2.7).

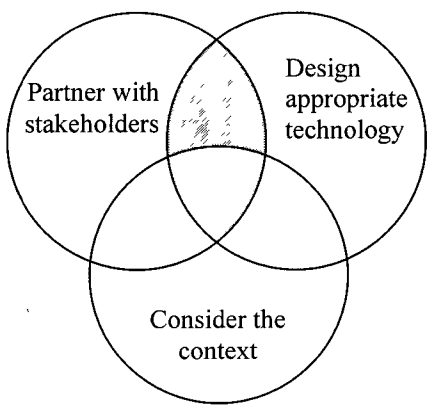

Figure 2.7: ICTD Best Practices: Stakeholders and Technology

This combination is what drives approaches like iterative prototyping in participatory action research. Authors advocating this combination call for deep partnerships with local stakeholders from the beginning of the project design through the envisioning, development, and testing of potential solutions. In this way, local stakeholders can shape the design of technologies in partnership with the designers who create and modify ICTs until these technologies meet people's needs appropriately.

Several authors advocating this combination of best practices emphasize the need for a variety of stakeholder types to be involved with technology design, or at least to provide feedback and input to shape technology design. For example, Tongia and Subrahmanian called for ICTD partnerships involving development professionals, end users of the ICTs, technologists, end beneficiaries, and others as needed, such as government officials or local nongovernmental organizations (NGOs) (2006). Heeks recommended that future ICTD projects involve researchers/designers from development studies, computer science, and information systems because each contributes a unique and necessary strength to the design process (2008). Computer scientists focus on technologies, developing significant innovations based on an understanding of what is possible with digital technologies. Unfortunately, the human and contextual elements can get left out. Information systems contributes a focus on contextual factors, an emphasis on a holistic approach that balances competing interests, but this field often lacks the expertise to translate contextual findings into technical requirements. Development studies can show where digital technologies fit into development programs and

paradigms—if it does not continue the trend of rejecting technologies on principle. Thus, Heeks called for partnerships of experts across these three areas of expertise—computer science, development studies, and information science—to balance the many areas of expertise to create successful, beneficial, sustainable ICTD projects. When these partnered experts engage deeply with local stakeholders such as end beneficiaries, ICT users, and others, that is when appropriate, useful technology design can flourish (Heeks, 2008, Tongia & Subrahmanian, 2006).

When considering how to engage local participants in appropriate technology design, Maunder made an interesting point about the role of prototypes. Maunder provided an excellent description of the ideal role of prototyping:

> During a typical user-centred design process, designers may present prototypes of varying fidelity to the user. The goal being to ensure that the users' real needs and desires are captured within the design, thereby cultivating an environment conducive to open communication, participation and a shared understanding between the design team and the users. (Maunder, Marsden, Gruijters, & Blake, 2007, p. 325)

However, the authors pointed out that the utility of prototyping is predicated on the assumption that users are (1) familiar enough with technologies to envision how they may interact with and improve their current work practices, (2) familiar enough with the design process to see value in participating, and (3) familiar enough with design abstractions to understand how low-fidelity prototypes may translate into technology

solutions (2007). Unfortunately, these assumptions are often false, as many participants in ICTD projects are not familiar with abstract, symbolic thinking (Maunder, Marsden, Gruijters, & Blake, 2007; Parikh & Lazowski, 2006). To avoid the problems associated with both high- and low-fidelity prototypes, Maunder recommended using technology baselines: i.e., introducing users to an off-the-shelf technology that they can use and respond to, envisioning how it may affect their work practices and what they would like to see changed (2007). This approach has the benefit of concrete experience (versus the abstract thinking associated with low-fidelity prototypes) without the cost of hi-fi prototypes. Demonstrating these off-the-shelf technologies can also be a way to draw interested users into the process or generate interest into the process, thus supporting the development of partnerships with local stakeholders.

One example of a project implementing the advice of Tongia and Subrahmanian (2006) and Heeks (2008) to have local partnerships driving appropriate technology design with multidisciplinary teams is the Digital Green project (Gandhi, Veeraraghavan, Toyama, & Ramprasad, 2007). This project uses digital video to supplement people-based agricultural instruction for subsistence farmers. Project features include (1) a participatory process for content production, (2) a locally generated digital video database, (3) human-mediated instruction for dissemination and training, and (4) regimented sequencing to initiate a new community. Although digital video is a key component of the project, the central and emphasized aspects are people based and social; the whole project was collaboratively designed and implemented with an existing

agriculture extension NGO (2007). As Maunder (2007) and Crabtree (1998) recommend, the methodology involved both ethnography and participatory design:

- Ethnographic observation of more than 200 days in a single year, focusing on existing agriculture extension programs
- Iterative design of video content and screenings with feedback from farmers and extension workers
- A controlled study of 16 villages comparing agriculture extension programs with digital video to classic agriculture extension programs (2007)

By testing several factors and designs of video with farmers in two villages and inviting farmer feedback, researchers determined that the following programmatic elements were best liked by farmers: public screening locations, mediated viewings, videos featuring people most like the farmers themselves, season-appropriate content with short-term benefit, and offering any necessary tools or seeds onsite (Gandhi, Veeraraghavan, Toyama, & Ramprasad, 2007).

Farmers were more likely to use techniques already being used successfully by their neighbors, and farmers were eager to appear in the videos. Therefore, digital video content was produced during extension visits with local farmers, thus requiring three people: a local farmer, extension worker, and videographer (who may be an NGO worker, another extension worker, or a volunteer from the community). Content was produced by a multi-stakeholder team that further influenced technology design and

content. Content was stored in a digital database and required editing by a trained video editor to produce usable videos; content was then stored online and burned onto DVDs. Each village received a minimum of one TV and DVD player, and the agriculture extension NGO hired a local person to mediate discussion during video screenings to build local capacity and to raise the credibility of the techniques.

Hiring a local community member to mediate the discussion of techniques shown in the videos had the additional benefit of building human capacity in improved farming techniques, as this person often became the village "expert" on farming and was also usually the first to implement the new approaches. Digital video screenings were shown three times per week in different locations with attendance recorded and impact followed up on by extension officers. In the eight Digital Green villages, seven times more farmers adopted a new technique than in the control villages; local farmers who appeared on the videos and mediators (who often were the first adopters of the featured techniques) became the most effective proponents of new techniques. Though the research built on existing agricultural extension programs, and not from ideas generated by local farmers, the design was driven by input from local farmers, and the outcome was measured according to how many farmers determined the practices to be relevant and potentially beneficial enough to implement them. Thus, this project illustrates the benefits from combining design themes, as recommended by several authors in the literature: e.g., Feenberg's, Heeks' and Tongia's calls for partnerships among multiple stakeholder

groups and Maunder and Crabtree's recommendations to combine ethnography with participatory design.

2.2.c Tensions and Challenges

This review has described three ICTD best practices: appropriate technology design, deep partnerships with local stakeholders, and emphasis on contextual factors. Although the practices do combine productively—indeed, problems arise if a single theme is underemphasized—in practice these practices are often in tension. Tension arises not because the themes directly contradict or impede each other but because the practices often compete for limited resources in terms of time and money.

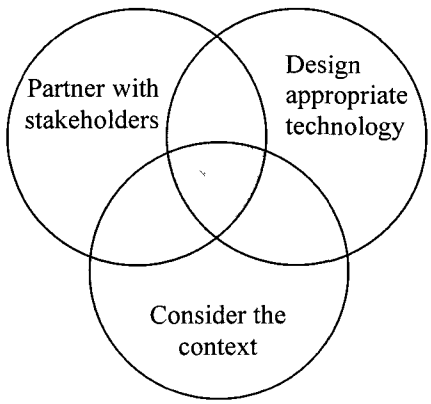

Figure 2.8: ICTD Best Practices: Tensions in Balancing All Three

ICTD project leaders are often technologists who live and work in developed nations. Of the three best practices, creative technology design is often the practice with which they have the most experience. These project leaders often expect creative technology design to require significant money (for high-technology equipment and possibly for technical expertise) and time (for design, testing, and implementation). Thus,

this practice is often prioritized. In seeking to stretch limited time and funding, ICTD project leaders may conduct secondary research into the local context and project environment. Literature reviews can contribute to an understanding of at least some relevant contextual factors and can springboard ICTD project efforts for minimal time and money.

It is often the best practice of deep partnerships with local stakeholders that is sacrificed in the face of limited resources. ICTD project leaders often live and work literally around the world from the local stakeholders who comprise the intended users. Most local stakeholders have little or no access to technologies, such as web cams and voiceover internet protocols, that could support long-distance collaboration with offsite project members. Further, these stakeholders are unlikely to be familiar and comfortable enough in using these technologies to enable a beneficial long-distance collaboration, and the cultures in many developing areas, such as in Africa and India, emphasize the importance of face-to-face communication for relationship building. Thus, building a deep collaborative partnership with local stakeholders very often means traveling to their community to build relationships and learn together. It can require significant time together to enable ICTD project leaders to listen, observe, understand, and show respect for the desires and lifestyles of local stakeholders. To project leads facing time and budget constraints, that may not seem possible. In many ICTD projects, therefore, this practice is the one to be sacrificed.

However, Tongia and Subrahmanian made a persuasive argument for partnering deeply with stakeholders early in the project development—identifying not only design benefits, but cost benefits of this practice. Tongia and Subrahmanian claimed that the design of a product locks in approximately 70 percent of its cost but that the design process itself is only about 5 percent of the product development cost (2006). Thus, there is a great incentive to do design right: e.g., to spend enough time and money drawing users into the design process earlier and deeper, since getting the design right is vital to—not just the major goal of development— but also to constraining costs. Making design changes early in the design process prevents more costly changes later—or worse, a final design that does not solve the intended problem.

Failing to consider one of these best practices (whether from oversight or from prioritization due to constraints) can result in a project design that actively conflicts with the principles associated with the unaddressed theme. For example, Javid and Parikh described the current supply chain for a healthcare product distribution company in rural India, identifying pain points in the supply chain where information and materials do not flow efficiently (2006). The authors pointed out that companies need information from their customers to better anticipate customer demand and therefore manufacture and distribute the proper amount of products. Necessary information includes what (which products), where (where is the demand for which products), and when (when do customers want these products); thus, product flows down and information flows up the supply chain. Because flowing information up the supply chain to decision makers is

difficult with manual systems, Javid and Parikh advocated for a digital mobile information system. This focus sounds innocuous so far: Javid and Parikh were clearly addressing the creative technology design theme and combining it with an analysis of some contextual factors such as cell coverage levels in rural India. One could even propose that, at a limited level, Javid and Parikh addressed partnership with stakeholders, since the motivation for design was supporting decision makers in the healthcare distribution company.

However, further analysis of the mobile information system suggests that some very important stakeholders were not considered, and that oversight could well affect the success of the information system. Javid and Parikh claimed that centralized, executive management should be able to track the whereabouts of traveling sales people to ensure that the sales people are not lying about their location or selling the healthcare products close to home to avoid traveling (2006). This emphasis on increasing profit and efficiency through distrust and surveillance seems to offer little benefit for the actual end users of the information system: the traveling sales force. Thus, this paper provides an example of a computer science-focused effort of the sort that Heeks criticized (2008). The problem was described in terms of concern for surveillance and efficiency, and the methods focused solely on identifying what is possible with technology (not what is desired by the users themselves). Thus, the solution seems unlikely to be well received and faithfully used. Interestingly, Javid and Parikh's project has much in common with another ICTD-related surveillance system, which Maunder mentioned when discussing

the relevance of sociocultural issues to system design and user concerns (Maunder, Marsden, Gruijters, & Blake, 2007). The authors described the CyberTracker system—which users disabled because they believed their bosses used the system to monitor their productivity. Monitoring productivity was one of the primary uses of the supply chain solution proposed in the Javid and Parikh article. Thus, Javid and Parikh's article (2006) provides an example of how an overemphasis on one practice—creative technology design—can produce a solution that actively conflicts with the other best practices and may well lead to project failure.

The literature reviewed in this section highlights not only the importance of individual best practices but of strategically balancing all three practices, even in the context of limited time and financial resources. Over the course of a project, researchers and designers must iteratively assess the emphasis on each best practice, re-allocating time and attention to enable a balanced focus. Although the best practices complement and support each other, this balance can be difficult to achieve due in part to the complexity of ICTD projects and the contexts in which they are situated. The final section of the literature review discusses this complexity and strategies for managing complex systems.

Section 3: Managing Complex Systems in the Context of ICTD

Although we are approximately 50 years into what some have characterized as an information age or technology revolution (Castells, 1996), ICTs have not fulfilled high

expectations of supporting development through better access, understanding, and use of information. We do not fully understand how best to develop and manage complex ICTs that could fulfill the great potential of an information age. As Davenport (1997) described information environments more than a decade ago, "...forty years of failure is forty of failure" (p.8), and he was referring to the *developed* world. However, trends illustrated in the literature of information systems (Davenport, 1997), management science (Churchman, 1968), systems theory (Vicente, 1998), and information and communication for development (Braa & Hedberg, 2002; Maiers, Reynods, & Haselkorn, 2005; Piotti, Chilundo, & Sahay, 2006; Smith, Madon, Anifalaje, Lazarro-Malecela, & Michael, 2008; Williamson & Stoops, 2001) suggest that we are starting to improve and could be expected to do a better job of understanding the factors that affect ICTD project success in the future. This optimism stems less from recent examples of success as from a more nuanced, intentional approach to managing complex information ecologies, an approach that addresses infrastructural factors such as policies and social/political factors, as well as human factors at an individual level.

Ecology-inspired approaches to information technology often characterize communication differently than earlier approaches to IT. Communication models underlying early ICT design (including ICTD) represented communication as transactional, with senders transmitting a message to receivers. These models greatly privilege the senders in providing the information that they deem appropriate, and, in developing world contexts, receivers are usually ill-equipped to provide feedback

(Melkote & Steeves, 2001). However, alternative views of communication emphasize shared meaning and the relationship between communication and culture: "Communication is the maintenance, modification, and creation of culture" (Melkote & Steeves, 2001, p. 31). This more complex and nuanced view of communication is well suited to an ecological view of ICTs, which seeks to avoid the weaknesses of earlier, one-dimensional approaches. And while it is easier in the short term to attempt complex systems management (including ICTD project management) from a simpler, single-faceted standpoint, it is also less effective—usually disastrously so. In looking across the literature, at least three themes emerge to suggest what makes ICTD projects more effective and how to achieve the development and management of these projects in the future: take a holistic approach, balance conflicting "goods," and support decision making.

2.3.a Taking a Holistic Approach

One of the major themes regarding managing complex systems is the importance of taking a holistic approach, as opposed to a fragmented or, worse, a narrow management approach. A holistic approach to information systems identifies and addresses a wide variety of factors that affect the acceptance and workability of these information systems, factors such as

- Environmental factors related to culture, physical infrastructure, policy, and social norms (A connection between ICTD and complex systems

literature is apparent here, as environmental factors as also emphasized in ICTD best practices.)

- Resources including financial and temporal resources, as well as human resources such as the skills and tacit knowledge of stakeholders
- Objectives, both the narrower, short-term objectives of stakeholders and the broader, overarching objectives of organizations and institutions

To better understand ICTD projects, it is vital to broadly survey relevant information and synthesize this information into a more holistic view. As Davenport (1997) pointed out, it can be confusing to begin a holistic approach, since there are so many factors involved and, therefore, so many potential starting places. However, because complex systems are comprised of interrelated components, the analysis of one factor will often lead to the next and so on. Therefore, it is more important to embark upon ICTD projects with a holistic focus that seeks to identify these areas of overlap than to start with a particular area. In focusing broadly and identifying overlaps, a holistic approach to ICTD projects contrasts with two other common approaches: narrow and fragmented.

Narrow approach: In a narrow approach to complex systems management, only some elements are considered while others are ignored or consistently given a lower priority. For example, regarding the complex system of business information, Davenport described a management approach that consistently focuses on technologies while ignoring system elements such as the information needs of people (1997). This narrow

approach wastes significant amounts of time and money and results in computer systems that are unused and information needs that are unmet. An example more closely related to my research interests in information and communication technology for development (ICTD) is an ambitious and rigorously designed—yet narrowly focused— research project by Heffernan and Yu (2007). Heffernan and Yu's team wanted to develop a "neutral" tool to support decision makers such as policy makers, development practitioners, and researchers who work with poor livestock keepers in developing countries by providing these decision makers with information about what factors are most likely to increase livestock keepers' income.

Heffernan and Yu began by identifying large geographical areas within the country where livestock keeping was common. They then interviewed government, academic, and NGO sources to identify key communities of livestock keepers and put together focus groups of a range of livestock keepers in the selected communities. These focus groups helped to map where all of the community's livestock keepers lived, and community mobilizers then invited each livestock keeper to be interviewed about his or her demographics; finances; and livestock type, health, treatment, and activities. The researchers emphasized the "neutrality" of their design by training interviewers to ensure that the same narrow selection of questions was asked of every participant and that the data was "cleaned" by removing all information beyond the bounds of the questions (2007). Researchers then compiled this clean data into a database that allowed users to select certain indicators—such as married males ages 25-35 in Bolivia with a goat herd of

xx size. The program then selected individuals in the database who met those criteria, determined their average income, and plotted it against the national poverty line: "...and in this manner, allowing the complex reality faced by the poor to be directly understood by the livestock development actor involved" (Heffernan & Yu, 2007, p. 252). But it does not, really. This approach to understanding income-affecting factors for livestock keepers sounds very rigorous, yet the system elements on which researchers focused were quite narrow: demographics, finances, and livestock. The software tool does not allow policy makers to understand the complex reality of these people's lives or to rationally predict the lifestyle changes that would best increase income because life, poverty, and people are too complex and messy to be reduced to narrowly selected data points and rationally predicted.

Davenport claims that strategy should be both planned and emergent, allowing people to respond to dynamic environments (1997). Heffernan and Yu's neutral tool was too rigid and too narrowly focused to support emergent strategies that respond to changes in circumstances. The tool could not enable development decision makers to advise poor livestock keepers of the best way to increase their income for at least two reasons. First, the focus of the tool was far too narrow to address many of the factors affecting poverty level. What if a livestock keeper is deep in debt? What if the livestock keeper's family is suffering from health problems that are draining their income and restricting their ability to perform new income-producing activities? What if a livestock keeper has many daughters and no sons and must hire help because it is not culturally appropriate for

women to handle livestock? The list of hypothetical factors could continue indefinitely, while the point remains the same: many factors outside the scope of finances and income-generating livestock activities affect poverty level. Further, the kinds of data that can be quantified and easily recorded in a computer are far too simplified to address the contexts—cultural, financial, political, social—that encompass this data and give it meaning and purpose (Brand & Schwittay, 2006; Davenport, 1997; Maunder, 2007). The second reason this tool would not be useful in practice is that it was too rigid; it assumed a fixed reality in which the activities that produced the most income in the past will continue to be the highest income-producing activities in the future. It assumed that demographics that were beneficial in the past will be beneficial in the future. However, societies are continuously changing, and it is highly likely that the model Heffernan and Yu's tool represented was out of date before it was even accessible to development decision makers. Instead, as Davenport suggests, plans and strategies, including those to reduce poverty, should be flexible to account for changing, complex circumstances (1997).

Lucas (2008) provided another example of how a narrow approach to system design can impact not only its immediate success but also its ability to expand and sustain operation. In a case study of Satellife's work developing a health information network in Uganda, Lucas described what sounds like a resounding success: a pilot effort that resulted in near 100-percent reporting levels for the health information in the pilot district (2008). Unfortunately, as Lucas also pointed out, this project had a narrow focus in terms

of time, funding, and geography that prevented its success from being sustained or from expanding nationally. The annual equipment costs to nationally expand the project were nearly triple that of the existing system. The pilot project was not planned holistically as a component of a national rollout plan. The design was too expensive, and funding was neither planned nor available to support the expansion. The narrow design approach resulted in a brief success that failed to continue or expand (Lucas, 2008).

Fragmented approach: Also ineffective is a fragmented approach to system management, an approach which considers a wider range of system elements—but only in isolation without considering overlaps, relationships, and conflicts among pieces of the system (including human elements such as system users and stakeholders) and environmental factors. Churchman (1968) discussed the difficulty of maintaining a holistic focus to organizing and evaluating complex systems. Complex systems often operate within organizations that are organized by functional department, not by activity. Thus, major activities of a complex system necessarily cross departmental boundaries. Unfortunately, budgets, incentives, organization charts, and evaluation structures are almost always segmented by department—not activity—making it difficult to manage systems holistically. Maiers, Reynolds, and Haselkorn (2005) discussed the drawbacks of a fragmented approach to complex systems management in planning and executing disaster response by international humanitarian organizations. The authors called for cross-departmental planning—not planning that considers each department's concerns but that includes and coordinates inputs from disparate departments in a joint effort that

would encompass ties, overlaps, and conflicts between the departments' perspectives as well. This joint effort could drive an information strategy that is vital to a holistic approach to managing complex systems: "One of the most important reasons for developing a common information strategy is to allow diverse experiences from all over the world to fuel the institutional knowledge of an organization" (Maiers, Reynolds, & Haselkorn, 2005, p. 86).

Another call for moving away from fragmented approaches to systems management was made by the University of Cambridge and IBM in a paper about service science (2007). This paper described service systems as combinations and configurations of resources, such as people, technology, organizations, and information, that share a goal to meet people's needs better than other available alternatives (2007). With such a broad definition, examples of service systems include something as large as the global economy and as small as an individual person. The scale and complexity of service systems—as well as the interrelationships among their parts—are affected by technology developments, economic institutions, demographics, and trends in globalizations. The authors' vision for service science was discovering value propositions that interconnect and sustain complex service systems, but to achieve this vision, the various fields involved in service science need to resolve their knowledge fragmentation through shared language and frameworks (2007). A fragmented approach to service systems management would be neither effective nor enlightening, as each field brings a different perspective and area of expertise to the analysis. It is only by combining these fields

through a holistic framework that such a complex and varied type of system could be understood and managed.

In summary, fragmented management is ineffective because, by definition, complex systems comprise a whole that exceeds the sum of its parts. Each element of a complex system affects and is affected by other elements, thus requiring, if possible, a simultaneous evaluation of multiple elements of the system, and if not simultaneous, then at least an iterative and systematically shifting focus to ensure that each system element is addressed and the overall management is balanced. In contrast to narrow and fragmented approaches, a holistic approach to managing complex systems considers elements of the system and environmental factors as interrelated pieces of a whole, much like an ecology is comprised of multiple elements and contexts that are interrelated and interdependent (Davenport, 1997).

Environment, system, and a holistic approach: Yet however appealing and potentially effective a holistic approach may be, it is difficult to do well for a number of reasons. As Churchman (1968) discussed, merely defining the boundaries of a complex system is difficult, since a complex system is interrelated with elements of the environment. Churchman gave the example of determining the boundaries of a factory when the business organization owning the factory includes distributed offices and, more subtly, when managers of the factory have political affiliations that allow them to exert pressure affecting the regulatory environment in which the factory operates (1968). If the offices are part of the same business as the factory, are they not a part of the factory's

system? And if the political organizations influenced by factory managers affect the regulations that constrain factory operations, are political ties not a part of the factory's system? With complex systems, the lines are rarely clear. Therefore, those who design or manage these systems often overlook important systemic influences in the environment.

For example, Piotti, Chilundo, and Sahay discussed the influence of both formal and informal institutions on implementing health information systems to support health sector reform (2006). According to institutional theory, institutions create the environment that affects how organizations can and do operate. Specifically, institutions help frame the behavior of individuals through incentive structures, facilitate social action, and reduce the uncertainty of social interaction by providing a framework for acting and understanding the actions of others. The many organizations involved in health sector reform operate according to both formal institutions, such as laws and regulations, and informal institutions, such as social networks and typical patterns of behavior. It is vital to the success of complex system management to consider both formal and informal institutions that comprise the environment—particularly when the complex systems operate in developing nations with limited overlap between formal and informal institutions. One of the major impediments to successful ICTD implementation and management is when formal and informal institutions barely overlap and the incentives and enforcement of formal institutions is weak or nonexistent (Piotti, Chilundo, & Sahay, 2006). In these cases, the system environment often prevents

effective system management because managers rarely evaluate the potential impacts of informal institutions such as personal social networks (2006).

Working in a developing world context, it can be difficult to translate some of the environmental and systemic factors into design or management guidelines. In "Designing interactive systems for the developing world: Reflections on user-centred design," Maunder, Marsden, Gruijters, and Blake focused on designing ICTD solutions, but their points are applicable to understanding and managing complex systems as well (2007). The authors claimed that bridges.org's Real Access/Real Impact (RA/RI) criteria provide a useful framework for keeping people at the center of focus and evaluating technology through a human-centric lens (2007). (Davenport would agree that this is an appropriate approach to complex systems management.) The RA/RI criteria are a useful framework not only for retaining a human-centric focus but also for ensuring a holistic focus that includes cultural, social, and infrastructural factors that affect complex systems.

2.3.b Managing Competing and Conflicting Interests

Another major theme in managing complex systems is balancing competing interests and conflicting "goods." Balancing these competing interests is one necessary element of taking a holistic approach because a holistic approach to managing complex systems will necessarily reveal conflicts that must be resolved, if possible, or at least balanced. These conflicts can be framed in a number of ways: conflicts between stakeholders, values, or goals. The literature discusses the challenges involved in managing conflicting or competing interests, suggesting ways of balancing conflicts,

ways of identifying conflicts, and the importance of expecting to encounter conflict when managing complex systems.

Competing interests: Churchman (1968) addresses the idea of competing interests in exploring the difference between stated and actual goals. Whereas stated goals may be more high-minded or idealistic, actual goals are the ones that win out when goals come into conflict. Layman (2003) provides an example of real and stated goals of the Medicaid program. Two stated goals of Medicaid are to protect the privacy of its beneficiaries and to be accountable for the benefits it offers. However, when Medicaid posts on an unprotected website the specific benefits it has provided by county, this posting includes enough information to identify individuals and the healthcare they received and to extrapolate medical conditions (Layman, 2003). Thus, when privacy and accountability come into conflict, accountability emerges as an actual goal, whereas privacy is only a stated goal. Examples like this one emphasize the importance of holistic management, since it is possible that the managers of the complex Medicaid reporting system do not even realize that these goals are in conflict and that the fulfillment of one (accountability) has compromised the other (privacy).

Sometimes the management of competing or conflicting interests must occur at a broad, philosophical level to provide a framework for understanding conflicts at a more detailed level (Ratan & Bailur, 2007). For example, Ratan and Bailur discussed the commonly conflicting interpretations of "development" in ICTD: whereas donors seek to improve wellbeing through ICTs, recipients are often more interested in increasing

agency, or the ability to make one's own decisions and act upon them. Stated so broadly, this conflict may not seem problematic: it seems reasonable to assume that recipients would be interested in improving their own wellbeing and that donors would want recipients to be able to make their own decisions. However, the conflict in this philosophical split becomes evident—and highly problematic—when ICTD projects are implemented without anticipating or managing the conflict. Unaddressed conflict may play out, for example, with donors providing a telecenter with free internet access intended for uses that improve wellbeing such as improving English, seeking job information, engaging in online education, or looking up crop prices, and with recipients exercising increased agency by choosing to use Internet access to watch videos on YouTube, look at adult content, and download music. Potential conflicts between how recipients choose to apply their increased agency and how donors intend ICTs to be used must be addressed rather than ignored or naively unanticipated. Ratan and Bailur suggested that donors should seek to increase agency as a primary goal, with improving welfare as a secondary goal, since it is much more difficult to prove ties between ICTs and improved wellbeing and easier to show how ICTs can increase agency (2007); Ratan and Bailur also claimed that this position (prioritizing agency above wellbeing) eliminates any potential for conflict between donors and recipients regarding use of ICTs (2007). While the authors' claims may be true, they are not the only potential solution for managers of complex ICTD systems. Other possibilities include implementing more application-specific ICTs that are appropriate only for wellbeing-improving activities,

taking a more holistic approach to the ICT introduction and training to illustrate how ICTs can improve wellbeing, or designating specific times and contexts for the wellbeing-improving applications of ICTs and other times and contexts for the agency-increased usage in which recipients have free reign.

When people seek to optimize performance of a complex system at the local level, they are likely to find that local system performance requires a balancing of conflicts between the local and global levels. For example, Braa and Hedberg developed a district-level health information system for use in South Africa immediately after apartheid (2002). Under apartheid, the country had 14 national health departments, with resources and services inequitably distributed and the politics of exclusion and segregation inscribed even into data collection and reporting practices. Thus, major goals for the new health information system included establishing standardized data collection and reporting that would enable national decision makers to ensure that resources and services were equitably distributed and to pinpoint areas where further efforts were needed (Braa & Hedberg, 2002). Braa and Hedberg began with several pilot districts to enable iterative design and in-depth participation with local health workers. However, Braa and Hedberg (2002) found that this local focus illuminated a tension between standardization and localization:

> It is difficult to create and nearly impossible to maintain isolated 'democratic islands' of localized information systems. Local health units are part of, and

> dependent on, the larger health system and will therefore need to interact with the higher level health system by way of standards for data collection. (p. 114).

Thus, there is a tension between standardization, which allows for coordinating information and activities, and flexibility, which allows standardized information to be applied locally. This local/global tension is not unique to Braa and Hedberg's experience. Complex systems, including ICTD projects, include a variety of stakeholders, operate in a variety of locations, and support a variety of activities; thus, managing complex systems consistently requires identifying and balancing tensions among levels of operation and location.

Competing stakeholders & values: Managing tensions or conflicts can also be considered in terms of competing stakeholders or of competing values. For example, when considering what kinds of ICT tools to purchase and implement in an international humanitarian organization, field office employees may be more concerned with supporting the local economy by purchasing locally created solutions, while headquarters employees may be more concerned with cost-effectiveness or organizational compatibility (Maiers, Reynolds, & Haselkorn, 2005). This same conflict can be considered in terms of autonomy (particularly in the field) versus coordination (with headquarters and other field offices). Different schools of thought offer different ways of considering these conflicts: e.g., value-sensitive design frames system concerns and elements in terms of values foregrounded and supported (Friedman, Kahn, & Borning, 2006), whereas ecological systems design considers interrelationships in a system

according a biological ecology metaphor (Davenport, 1997). Either of these perspectives could be useful; the important thing is to intentionally address conflicts in perspective when managing complex systems.

As illustrated by the example above, managing conflicts is hard to do because often both values or perspectives are good, but only one can take precedence. Interestingly, two articles provided the same example of competing "goods" in reference to health information systems implemented in Mozambique (Piotti, Chilundo, & Sahay, 2006) and Tanzania (Smith, Madon, Anifalaje, Lazarro-Malecela, & Michael, 2008). In the context of rising numbers of patients, drastically understaffed health centers, and little-to-no incentives or enforcement to properly record data, health workers prioritized patient care above recording data—often estimating at the end of the day the numbers of patients treated, type of treatment provided, and other vital data. Patient care is important, but so is recording the data associated with patient care, as it is this data that enables decision makers at higher levels to allocate appropriate resources and plan for better patient care. Perhaps partly because health worker training did not encompass a holistic view that emphasizes the overlaps among perspectives, health workers and strategic decision makers had competing views of the health workers' jobs. And because the complex system of healthcare was not managed holistically and in a way that intentionally addressed conflict, accurate record keeping was sacrificed to, rather than balanced with, patient care (Piotti, Chilundo, & Sahay, 2006; Smith, Madon, Anifalaje, Lazarro-Malecela, & Michael, 2008). The fact that this conflict was documented by

different researchers in different countries with different information systems shows the prevalence of this problem, both specifically—accurate data recording and reporting is sacrificed to immediate patient care—and generally—competing goods are not being balanced but rather are unanticipated and unaddressed.

2.3.c Supporting Decision Making

A third theme in applying complex systems principles to ICTD projects is focusing on supporting decision making. Historically, this key to effective management has been consistently overlooked, which is extremely concerning in the context of ICTs, since one major purpose of information systems is to support decision making with relevant information: "...the systems approach entails the construction of 'management information systems' that will record the relevant information for decision-making purposes..." (Churchman, 1968, p. 39). As Davenport (1997), Layman (2003), Lucas (2008), and others insist, the process of managing information should address people first and centrally and technology last and peripherally. Thus, ICTs—especially in a low-resource context like ICTD—should exist to help people to make better decisions, plan strategically, and respond to a dynamic environment.

Yet the solutions and services offered by ICTD projects rarely do this effectively, partly because expectations of these projects are unreasonably high and focused on the short term. For example, people sometimes expect that access to technology is sufficient for improved wellbeing (Piotti, Chilundo, & Sahay, 2006) or that ICTD solutions need to be designed and developed once and will forever after support decision making

(Davenport, 1997) or that technological systems will save both time and money while improving productivity or effectiveness (Layman, 2003; Lucas, 2008), but as Piotti, Davenport, Lucas, and Layman discussed, these expectations are unreasonable or at least incomplete. Often when organizations developing and managing complex systems realize this, they abandon the effort, halt training, and redirect resources previously allocated to the system.

In fact, fickle funding can halt even very promising complex systems projects. For example, Braa and Hedberg described the process by which their pilot project for a district health information system was rolled out nationally (2002). One of the major factors was the failure of several more expensive, more complex health information systems, right as their successful pilot project wrapped up. Braa and Hedberg presented results to the South African Ministry of Health, expecting their project to end, and the Ministry of Health offered support (policy and interest-level support, not financial support) to expand the system nationally (2002). Even after this unexpected level of success, the pilot funders opted not to continue funding, and the project might have ended had not other funders stepped in (Braa & Hedberg, 2002). Managing complex systems in a way that supports decision making requires sustained, reliable resources—financial and human—to enable the development and training required for people to be able to use systems to support their work: i.e., managing complex systems to support decision making takes time.

Greenwood and Levin (2006) discussed the need for a more long-term mindset when conducting action research, which is one approach to planning, developing, implementing, and evaluating complex systems. Action research is "...a long-term, open-ended process that is never completely and seamlessly finished. The problem definition and scope are expected to shift during the process, as the knowledge generated is expected to clarify and affect priorities and approaches" (Greenwood & Levin, 2006, p. 121). Clearly, the emphasis is on assessing and acting within a dynamic environment, letting go of expectations that detailed plans for complex systems management could or should be created and followed. Davenport (1997) echoed this emphasis on developing system tools that support critical, strategic thinking more than they rigorously follow a detailed plan. One of the key values of this long-term and flexible focus is that it is appropriate for helping people turn data into information and information into knowledge. Although these terms are often used interchangeably, Davenport (1997) distinguished between them, defining data as raw facts, information as data with a purpose, and knowledge as information that is contextualized and, I would add, supports action. While technology can more easily handle data, it is less suited to information and knowledge, which require a human element to create meaning. This is the juncture where complex systems begin to support human decision making. What this means is that for complex systems to support decision making, both the system and the users have to be actively involved.

Involving the users of ICTD solutions is one of the key ways to increase the chances that these solutions will support decision making. Even a minimal amount of input from users can have some significant effects on the future utility of the system. For example, an information system for health workers in Tanzania was designed in English when even perfunctory involvement of users early in the process would have revealed that they spoke Swahili and did not have the English skills to use an English-based interface (Smith, Madon, Anifalaje, Lazarro-Malecela, & Michael, 2008). Deeper involvement of users throughout the process can have greater effects on the ability to support decision making. In describing outcomes of the health information systems implemented in Tanzania, Smith et al. found that the information system was considered significantly more successful by stakeholders at all levels (international, national, local) in one particular district that had been the focus of an intervention based on the participatory action approach (2008). Tellingly, in this district, local stakeholders helped to select the information to be recorded and determined how to apply it (Smith, Madon, Anifalaje, Lazarro-Malecela, & Michael, 2008).

Action researchers Greenwood and Levin also advocated for user involvement throughout the process of identifying and prioritizing problems, developing and implementing solutions, and evaluating the outcomes (2006). In fact, they claimed that the results of action research should be judged according to workability of the solutions generated: whether the collective social judgment of participants (including the researcher) is that the solutions do resolve the initial problem (2006). This focus on local

perceptions and action-based outcomes is an important consideration in managing complex systems to support decision making because, although user involvement is vital, it is not a magic bullet that will ensure decision making support.

Williamson and Stoops's experience with the health information system in South Africa (2001) illustrates the importance of additional factors in managing complex systems to support decision making. As Braa and Hedberg (2002) describe, local input was vital in indentifying the indicators to record and track. Further, involvement was coordinated at great pains from the district level up to the national level to ensure that the system would record only those indicators that health workers and decision makers would actually use to support the public health system (Williamson & Stoops, 2001). Williamson and Stoops described the training that health workers received in how to enter the data to determine these health indicators and the enthusiasm with which they welcomed the system. Yet even with all these promising efforts, the system did not affect quality of healthcare on the ground because although health workers knew how to use the system (i.e., enter data) they did not know how to apply the data to support decision making (i.e., transform data into knowledge) (2001). They believed that information was important but did not know how to apply it. Further, the population data they needed was unavailable in a form that corresponded with the calculations they needed to perform, so health workers at lower levels would create reports for decision makers at higher levels based on the number of people treated, for example, instead of the more useful coverage rates based on local population (Williamson & Stoops, 2001). Because one of the major

goals of this health information system was to monitor equity of health service post-apartheid, reporting analyzed versus raw data was vital to supporting decision making. Unfortunately, the system fell short of meeting this goal because of

- Environmental factors: population data unavailable in forms compatible with the necessary calculations; formal institutions provided insufficient enforcement and incentives to more deeply understand the connection between health indicator numbers and how to improve healthcare
- Technical factors: the system did not convert available population data into usable forms
- Human capacity factors: health workers lacked the math skills and deep understanding of what the numbers mean to create reports with actionable information to support more equitable care
- Financial factors: budget allocation was insufficient to identify and change or work around the other impeding factors (Williamson & Stoops, 2001)

In summary, the solutions and services developed in ICTD projects rarely support people in accessing, understanding, and using information, but analysis of failures from the first 50 years of the information age can improve the design of future ICTD projects. This analysis suggests at least three ways that ICTD project stakeholders can improve their understanding and performance: take a holistic approach, balance conflicting "goods," and support decision making. As discussed in Chapter 6, considering these concepts from complex systems literature can lead to a more nuanced understanding of

ICTD project outcomes. For example, the findings presented in Chapters 4 and 5 will illustrate not only positive effects of following ICTD best practices but also some negative effects as well, offering a more balanced and complex understanding of the ICTD best practices discussed earlier in this chapter. Viewing these outcomes through the lens of complex systems literature helps to make sense of this complexity.

Chapter 3 – Methodology

The methodology chapter follows a four-part structure: (1) qualitative traditions informing the methodology, (2) project selection and participant recruitment procedures, (3) data collection methods, and (4) data analysis methods. This chapter conveys the validity of my research design and methodology through detailed process descriptions.

Section 1: Qualitative Traditions

Methods are the ways that researchers explore questions, and researchers' exploration are contextualized and affected by a variety of factors beyond just gaps in knowledge. For example, the setting, the context, the researcher, and the goals all help to clarify which methods are appropriate and potentially useful (Denzin & Lincoln, 2000). One important key when selecting methods is to triangulate; i.e., to combine several types of methods (Denzin & Lincoln, 2000; Crabtree, 1998, Friedman, Kahn, & Borning, 2006, Gandhi, Veeraraghavan, Toyama, & Ramprasad, 2007; Greenwood & Levin, 2006; Maunder, Marsden, Guijters, & Blake, 2007; Tacchi, Slater, & Hearn, 2003). Qualitative research in particular typically involves several methods to triangulate results and provide a richer, deeper, more nuanced picture (Denzin & Lincoln, 2000). Qualitative researchers believe that reality cannot be fully or objectively known and that the best approach to gathering information is to gather many perspectives of reality's representations, considering what these perspectives suggest when considered simultaneously:

> No single method can grasp all of the subtle variations in ongoing human experience. Consequently, qualitative researchers deploy a wide range of interconnected interpretive methods, always seeking better ways to make more understandable the worlds of experience they have studied. (Denzin & Lincoln, 2000, p. 19)

This emphasis on multiple perspectives and appropriateness for local context is key in qualitative research, especially in research across cultures and involving people with widely disparate power distributions. My research study is informed by the broad qualitative tradition, which includes a variety of specific research approaches that are relevant to ICTD and that advocate triangulation as an effective strategy for more richly representing a complex reality. For example, Batya Friedman, one of the founders of value-sensitive design (VSD), concurs that researchers should triangulate to identify multiple perspectives (Friedman, Kahn, & Borning, 2006). Friedman encourages researchers applying the VSD approach to use multiple methods in empirical investigations to explore how best to support stakeholders and their values through technical design (2006). Action researchers Greenwood and Levin also recommend using any variety of social science research methods that are appropriate for the participants and problems of the particular situation (2006). They claim that any number of qualitative or quantitative methods may be appropriate to an action research approach: interviews, surveys, statistical analysis, focus groups, ethnographies, document/artifact analysis. The

driving factors are that methods should be selected to address the problem at hand, to generate knowledge, and to support democratic action (Greenwood & Levin, 2006).

The research reported in this dissertation comes from an exploratory, qualitative study, in which I gathered data as an intern with the Technology for Emerging Markets research group at Microsoft Research India. Findings are based on four months of qualitative data collection, with the primary method of data collection being onsite interviews with project leads, project members, partner organizations, and intended beneficiaries. The sections below describe the methodology for project selection and recruitment, data collection, and data analysis.

Section 2: Project Selection and Participant Recruitment

ICTD is an interdisciplinary field in which people use ICTs as a central component of projects that support development goals. The practical, outcome-focused nature of this field means that much of ICTD literature reports on applied case studies. Thus, as detailed in Chapter 2, ICTD literature is heavy on case studies. The less common research pieces that examine multiple projects tend to select these projects using inclusion criteria such as technology type or development domain. For example, much of Jonathan Donner's work explores the use of mobile phones in developing world contexts. Other research explores how ICTs are being used within a particular development domain, such as healthcare or education. In this study, I wanted to foreground neither a particular technology nor domain. Instead, I wanted to foreground research. Thus, I

selected ICTD projects using the following inclusion criteria: (1) project was led by a professional researcher; (2) project began as exploratory research with the intention to transition successful findings into implementation; (3) project took place in India.

I identified ICTD projects that met these criteria through reviews of ICTD literature, particularly the proceedings of the ICTD conferences from 2007-2009 and journals such as *Information Technology and International Development (ITID)*, followed by conversations with my mentor at Microsoft Research, Kentaro Toyama. In these discussions, we identified the seven projects on which I focused this study. The projects involved a variety of technologies, from digital video to computer hardware to web-based tools, and operated in a variety of development domains, from agriculture to education. The projects are briefly described below and presented in more detail in the narratives in the next chapter:

1. Project 1: An academic researcher at an Indian university led a project to provide customized advice to farmers using technologies including digital photography and databases.
2. Project 2: An industry researcher at a corporate research lab led a project to connect domestic workers with employment opportunities through a job-matching website.
3. Project 3: An academic researcher at a U.S. university led a project to use mobile technology to support literacy education.

4. Project 4: An academic researcher at an Indian university led a project to develop locally designed and manufactured ICT hardware and software.
5. Project 5: An academic researcher at a U.S. university led a project to support microfinance groups by developing a method to combine paper and electronic recordkeeping.
6. Project 6: An industry researcher at a corporate research lab led a project to use ICTs to supplement and improve existing farmer training programs.
7. Project 7: An academic researcher at an Indian university led a project to answer agriculture questions online.

These projects involved a range of stakeholders: people who were involved with the projects to varying degrees in a variety of roles. The number of stakeholders varied, depending on the scale and status of the project. The projects affected people both directly (for example, by involving them in the design process) and indirectly (for example, by potentially infringing upon their businesses). Because my research question focuses on the transition of ICTD projects from research to implementation, I focused on direct stakeholders: people who were most centrally involved in the transition. The stakeholders I interviewed to inform this research study could be grouped into four categories:

- Project Leaders: These stakeholders envisioned the project from the beginning and spearheaded the early, exploratory research efforts.

- Project Team Members: These stakeholders were involved in the early research, working under the project leader in areas such as technology design, field testing, or partnership development.
- Members of Partner Organizations: These stakeholders belonged to government or nonprofit organizations related to the targeted development domain. Their role involved liaising with intended beneficiaries, providing domain expertise, or funding the project.
- Intended Beneficiaries: These stakeholders represented people who were intended to benefit from the project: for example, local farmers who could learn improved farming techniques or domestic workers who may be seeking employment.

I sought to recruit participants who (1) were most centrally involved in these projects and (2) represented a variety of stakeholder types. When recruiting participants for my study, I was careful to use culturally and contextually appropriate methods that built upon existing relationships and social networks. Project recruitment began with an email from Toyama to each project lead, introducing me and my study. I followed up with project leaders, orally reviewing the information form approved by the University of Washington's Institutional Review Board and answering any questions about the study. I recruited additional participants associated with each project using snowball sampling, a recruitment method in which participants suggest additional people to participate in a study. At the conclusion of every interview, I asked the participant to recommend other

people whom I should contact. I requested that participants refer me to a variety of project stakeholders, such as team members, partner organizations, and intended beneficiaries.

Most of the suggested participants spoke English and had email accounts or phone access. I recruited these participants by contacting them by phone or email (whichever method was recommended by the referent) and referencing the participant who had recommended that I speak with them. A few participants did not speak sufficient English to be contacted directly by me. I recruited these participants through members of their social networks, who also served as interpreters during interviews. Snowball recruiting was very effective, and only one person declined to participate. The snowball recruiting method was also effective in suggesting when to conclude the recruitment for a particular project. When participants repeatedly suggested stakeholders whom I had already contacted and new names became rare, I could feel comfortable in having recruited many of the central project stakeholders.

The number of stakeholders involved in each project varied, depending on factors such as the current state of the project, the geographic scale, and the level of involvement by original project leads. To balance the effect of each project on the overall patterns of outcomes, I sought to interview a comparable number of stakeholders for each project and to speak with stakeholders in a variety of roles. I conducted formal, semi-structured interviews with 5-8 stakeholders for six projects. For the seventh project, I conducted formal semi-structured interviews for the three project stakeholders who were centrally

involved in the early research and transition efforts. I interviewed every project's leader, as well as the stakeholders who were most heavily involved in early research and transition efforts. These stakeholders included (1) project team members involved with technology design and research and (2) members of partner organizations that played a variety of roles, such as liaison with intended beneficiaries, subject matter expert in the development domain, and funding agency. For two projects, I also interviewed intended beneficiaries who were involved in the early pilot research.

Section 3: Data Collection

I collected data onsite in India from October 2009 through January 2010. The primary data informing this study is semi-structured interviews with 48 project stakeholders, including project leads, project team members, partner organizations, and intended beneficiaries. For most interviews, I met with participants at their place of work: often a research lab or nonprofit organization. Being onsite allowed me to observe the environment in which these participants worked on projects and allowed participants to show me, in addition to telling me, about what they do: for example, pulling up a computer program and walking me through a process. In addition to interviews and observations, I took photographs of artifacts created and used by participants but did not photograph any people. I did not record anyone's name, instead identifying participants only by project descriptor and role. I also conducted informal interviews with numerous additional project stakeholders who were onsite during my visits to project locations.

These informal interviews took the form of brief conversations about stakeholders' role in and understanding of the project.

As described above, most semi-structured, formal interviews were conducted in person, though some were conducted by phone, depending on the preference and availability of participants. In addition to conducting interviews in my central location in Bangalore, I flew to project locations in Hyderabad and Mumbai. I sought to make participants comfortable by accommodating their preferences for interview timing and location. Therefore, interviews occurred during the work day or in the evening, on weekdays or weekends. Often, a participant was willing to participate but was busy with travel and other commitments. Therefore, interviews occurred anywhere from hours to months after recruitment—again, depending on the preferences and availability of participants.

Interviews with all but four participants were conducted in English. For interviews with the four non-English speaking participants, a referent (who had a long-standing relationship with the participants) served as the translator. This translation arrangement was appropriate because it built upon existing relationships and seemed to make participants more comfortable and, therefore, more likely to open up with me about their experiences with the project. All interviews were conducted one on one except for a group interview with intended beneficiaries who were attending a meeting with my referent immediately prior to our interview. For that interview, I sought to accommodate

participants by meeting with them as a group and conducting the interview through the referent's translation.

Interviews were semi-structured and focused on the role of the participant, the goal of the project, project scope, and, primarily, on the transition of the project from initial research to implementation on the ground. I began interviews by orally reviewing with participants the information form for this study, which was approved by the University of Washington's Institutional Review Board. In many interviews, participants attempted to skip or hurry me through the informed consent process, interrupting to give their permission for me to record and share the data. But after the interview, participants were often more curious about the study and its purposes. Therefore, for many interviews, we both began and ended the interview by discussing topics described in the information form, including participants' rights, the study's purpose, and its risks and benefits. Interviews ranged from almost ninety minutes to twenty minutes, often depending on how centrally the participant had been involved with the project. In general, the longest interviews were with project leads and shortest with intended beneficiaries.

At most interviews, I recorded data through both audio-recording and typing notes on a small netbook. Two interviews were audio-recorded only: one because of a malfunctioning netbook and one because I believed typing notes to be too distracting and awkward for the setting. (We were sitting cross-legged on the floor, drinking tea in a

room with no electricity.) Two other interviews were recorded through typed notes only, both because of a malfunctioning voice recorder.

Section 4: Data Analysis

Qualitative data analysis often occurs iteratively, particularly in exploratory studies such as this one. Exploratory researchers shape the path of their work by casting their nets broadly to identify promising, interesting areas for deeper focus. The qualitative tradition acknowledges the influence of the researcher, for example, in deciding what questions to ask, topics on which to focus, and the level of structure used to constrain data collection methods such as interviews. I began data analysis early in this research study (1) to identify emerging patterns or themes, (2) to identify information gaps that I could fill while still onsite in India, and (3) to ensure the novelty of my findings. The third reason for early and iterative data analysis was of particular importance for this study. Novelty is a well established and accepted criterion for good research in general and ICTD research in particular (Burrell & Toyama, 2009). The projects I analyzed were themselves research projects that had produced publications regarding their methods, early outcomes, and future plans. Thus, I wanted to ensure that my research did not merely restate information that was previously available but instead identified patterns across projects to contribute novel and transferrable findings to address gaps in ICTD literature. Early data analysis took the form of careful record keeping and repeated review of primary and secondary data.

During data collection from October 2009 to January 2010, I kept detailed records of participants and referrals, including not only name and contact information but also project, role, latest communication, referent, and location. Because I simultaneously requested, scheduled, and interviewed stakeholders from all seven projects, it was imperative that I record this information to ensure that a variety of stakeholders were interviewed for each project and no referrals were overlooked. To maintain the anonymity of participants, I did not correlate this information with the record of conducted interviews. My record of conducted interviews indicated only the type of data gathered (notes, recording or both), brief project descriptor, and number: e.g., JobMatching1, notes, audio-recording.

Record keeping was a useful element of early data analysis because it allowed me to ensure that my data represented multiple perspectives for every project. In addition, it supported me in gathering data from all seven projects simultaneously. Because this study was an exploratory study in which themes and patterns emerged to influence the focus of data gathering, I was careful to balance the influence of individual projects on the broader, emerging patterns. Instead of interviewing all stakeholders for a single project before interviewing another project's stakeholders, I intentionally gathered data about all projects simultaneously and iteratively, beginning with the stakeholders central to the design and transition of research—the project leaders—and then pursing stakeholders in other roles, such as team members and partner organizations.

The second element of early data analysis was reviewing existing data: (1) secondary sources like publications, websites, and presentations produced by and/or about the projects under study and (2) primary sources like my own interview notes and recordings. Reviewing data in the field involved activities such as fleshing out interview notes immediately after interviews, identifying gaps and relevant topics in existing publications to explore in interviews, reading interview notes across a single project and across a single type of stakeholder to identify emerging patterns to explore in future interviews. Reviewing my notes for patterns allowed me to identify gaps in data that I could fill while onsite in India.

The next stage of data analysis involved reviewing notes and transcriptions for emerging themes related to project transition from research to implementation. One of the ways that I analyzed and summarized my data was by writing project narratives to tell the story of each project's journey from initial idea to research to transition efforts. Because this study seeks to identify broad, high level themes across projects, this summary method was quite useful in identifying high-level patterns and preserving the contexts in which these patterns emerged. Iteratively writing the story of each project was a useful way to summarize the data gathered for each project by tracing coherent narratives that not only conveyed themes but contextualized them.

I also conducted an iterative formal coding of interview notes and transcripts to identify patterns of meaning, called themes. As a first step in coding, I repeatedly read

interview notes and transcripts, noting words and ideas that appeared frequently across interviews. In this way, I identified four broad themes on which to focus:

- **Scope creep**: information relating to the expansion of the focus and boundaries of the project. For example, when people explained the desired outcomes, technological approaches, and goals of their project, they were describing what they considered within their scope. When people described challenges or limitations that they chose not to address, for example, they were describing things they considered outside their scope. Expansions to the project scope, or scope creep, was a prominent theme across the projects as they progressed through research and sought to transition into implementation.
- **Scalability**: information relating to applying aspects of the project in other contexts, particularly geographical contexts but also development domains. For example, when people talked about rolling out their project nationwide after a successful pilot project, they were talking about scalability. Across all seven projects, stakeholders discussed scalability as an element of project progression.
- **Project Management and Sustainability**: information relating to managing the project over time. For example, when people talked about planning their project timeline or seeking ways to pay for a project in the long term, they were discussing elements of this theme. Project management and sustainability was another prominent theme across all projects.

- **Perceptions and Behavior**: information relating to how people's perceptions, emotions, mental models, and expectations affected the project. For example, when people talked about motivations of various stakeholders to get or to stay involved in a project, they were discussing an aspect of this theme. Stakeholders in all seven projects discussed the influence of perceptions and behavior on the transition of their projects.

Using these broad themes as a guide, I conducted the first round of formal coding. I imported 231 pages (single spaced, narrow margins, small type) of notes and transcripts into the open source qualitative coding program Weft QDA. I created three broad categories of codes, each with subcategories:

- Projects: projects 1-7
- Stakeholders: project lead, beneficiary, team member, partner
- Themes: scope creep, scalability, sustainability, scalability, perceptions and behavior

I used the program to manually code the data by reading for instances of these themes. For every instance of a theme, I labeled the excerpt with not only the specific theme but also the project and stakeholder type. I then used the program to automatically compile four lists—one for each theme—of all the excerpts and conducted another, more finely grained iteration of analysis. I repeatedly read each compilation, noting more specific subthemes that were prominent across projects and selecting two subthemes per theme to discuss in detail:

- Scope creep: (1) user requests prompted expansions to the project scope, (2) scope expanded from providing information to changing expectations and ways of doing things
- Scalability: (1) project stakeholders expected that people outside of the project would appropriate aspects of the project for use in other contexts, (2) partnerships were vital to scaling projects
- Project Management and Sustainability: (1) it took years for projects to progress to and through a transition from research to implementation, (2) project stakeholders expected to continue changing their solution or offerings over the long term
- Perceptions and Behavior: (1) trust and credibility influenced a variety of project factors, (2) motivations for long-term project involvement were complex and difficult to maintain

I selected these subthemes based on three criteria: (1) they occurred across multiple projects; (2) they were prominent, with a variety of instances and examples; and (3) they filled a gap in the existing literature. The themes and subthemes are described in detail in Chapter 5.

Chapter 4 –Narratives

This chapter presents the research findings in narratives that preserve the individual context of each project before Chapter 5, which presents themes that describe threads of meaning and experience that emerged across projects. Compiled from formal interviews with 48 project stakeholders and informal interviews with numerous others, the narratives below describe the seven ICTD projects that were analyzed in this study. Each narrative tells the story of an ICTD project's journey from initial motivation to exploratory research to pilot study and beyond. These stories focus heavily on the project leaders because the leaders are so central to the journey of each project. It is the project leaders who originally conceived of the exploratory research, who were personally moved to support a particular development domain, and who drove many of the project transitions through decision making. To be clear, the data does not suggest that decision making was unilaterally and solely the responsibility of the founding project leaders. As illustrated in the narratives below, project leaders consistently sought input from stakeholders such as partner organizations, intended beneficiaries, and their own team members. However, it was the project leader who consistently had the final say and the overarching vision, driving much of the transition path: for example, by deciding to implement through a partner organization or a start-up company, by selecting or approving expansions to the project scope, and by forging many of the necessary partnerships to move projects forward. For this reason, the project narratives are at least

as much about the project leader as the project: both descriptively and literally, the projects are difficult to separate from their leaders.

I have chosen to present the research data in narrative form because this form conveys a richer, more nuanced picture of the data than simply listing themes and example interview quotes. Further, presenting data through narrative enables me to introduce themes in the context of each project before analyzing the themes across projects in the next chapter. Themes include (1) scope creep, (2) scalability, (3) project management and sustainability, and (4) perceptions and behavior. As narrative follows narrative, these themes become apparent—without losing the unique framing and circumstances of each project. In this way, the seven narratives establish necessary background and framing for the analysis presented in Chapter 5.

Section 1: Project 1—Customized Advice for Farmers

In the early 2000s, a recent PhD graduate from India was spending two years at the University of Tokyo, applying his background in computer science and electronics by working on projects involving data mining and search engines. One day a friend from home sent him a research report about cotton farmers in Andhra Pradesh committing suicide. These farmers' crops had failed, and the farmers had no hope of repaying their debts without income from a valuable cash crop like cotton. Several of these farmers drank pesticide. The authors of the research report had interviewed fifty families and reported a number of reasons for the crop failure—including a lack of timely information.

Even as he sat in the bustling, crowded urban center of Tokyo, the technology scholar could picture the villages of Andhra Pradesh, and the report deeply affected him. He still owned a home in the Indian rural village where he grew up. Many of his childhood neighbors and relatives were farmers, including his father and brother. He understood that over the generations, Indian farms had been passed down and divided among children several times until each family owned only one or one and a half hectares of land. Such a small amount of land would not support a family with low income crops like rice. Instead, these farmers would have to raise cash crops like cotton or chilies. Unfortunately, these higher income crops were more finicky and difficult to raise, and they often required more expensive equipment and products such as fertilizer and pesticide. Raising cash crops also required specialized knowledge: e.g., usage of the required farming equipment and products, potential hazards and plant diseases, and strategies for increasing yield. Many farmers had learned how to raise traditional crops from their relatives and neighbors, but cash crops were less familiar, so the farmers' need for information was greater.

The technology scholar was familiar with the information resources currently available to Indian farmers, and he didn't believe those resources were sufficient. For example, the government offered free agricultural extension services with call centers, but the number of calls was quite low because farmers did not know what questions to ask. Agriculture extension services also shared information through television and radio broadcasts, but the information was by necessity general, rather than specifically suited to

each farm, crop, and current condition. Partly due to the limitations of agriculture extension services, farmers sought much of their advice regarding the unfamiliar cash crops from shops selling agricultural products such as pesticides. Of course, the more products these shops sold, the better, so much of the advice given by shopkeepers was spurious.

Using the currently available information resources, a farmer could receive timely, relevant information if that farmer (1) contacted a call center with targeted, descriptive, well-timed questions; (2) happened upon a general broadcast addressing a current need and recognized the relevance of the broadcasted information; (3) asked targeted, descriptive, well-timed questions of a shop owner with the expertise, integrity, and in-stock products relevant to the farmer's problem. Thus, farmers lacked information sources. A relevant solution, the technology scholar thought, would be a "push" system in which agriculture experts could regularly survey a farmer's fields and provide targeted, timely advice before major problems developed. However, the scholar knew how remote these subsistence farms were and how much time, effort, and manpower would be required to send agricultural experts on regular visits.

The scholar wondered if he could use digital technologies to bridge the information gap and somehow make it feasible to provide regular, targeted advice to farmers. Could textual and visual information like digital photographs provide data on which agricultural experts could reliably base advice? If so, the technology scholar could use his expertise in computer science to search-ably store the historical conditions of

farms and to track the advice and outcomes. Further, he could compile expert knowledge in a way that those providing advice could reuse previous material. He believed this idea could greatly extend the reach of agricultural experts, and he resolved to test the idea.

The technology scholar returned to India and applied for a government grant to pilot test his idea on a thousand farms. He selected three villages in the Warangal district of Andhra Pradesh with a total of 1051 cotton farms, believing this area to have a great need for information resources. After all, this was the very crop and geographical area that had inspired him to use his technology expertise to benefit farmers. He set up a lab of agricultural experts at a large research university and hired and trained local coordinators in the three villages. These coordinators visited the farms to gather information and photographs that were sent back to the lab for analysis. The scholar used available technologies such as computers, the Internet, digital cameras, and CD-ROMs to link the lab and the coordinators. The agriculture experts at the lab found that not only were the information and photographs sufficient to enable targeted advice, but that in some ways, the technology-mediated observation was preferable to an in-person visit, since the high-resolution digital images provided better detail than was possible with the naked eye. Using the information sent by coordinators, the agricultural experts recorded specific advice for each farmer and sent the advice to coordinators, who then delivered this information to the farmers on their next visit.

Then something curious happened. During the first two months, the project team noticed that farmers were not following the advice, and the technology scholar visited the

farmers to ask why. Farmers did not trust the advice they received from the local coordinators because they feared that if the advice was detrimental rather than beneficial, only the farmer would suffer consequences. The farmers had never met or seen the people who were providing advice, and the farmers believed that blindly following the advice was too great a risk. So the technology scholar hired two busses and went to the villages. He invited the cotton farmers to visit the lab and meet the agriculture experts who were providing the advice. The farmers agreed, and they were given a tour of the lab and shown how the agriculture experts did their job. The experts then challenged the farmers to prove them wrong. The experts told farmers to follow their advice and see if it didn't provide benefit.

The farmers were convinced and began following the advice faithfully. Farmers who participated in this pilot experienced significantly better yield and also spent less money on products like fertilizer and pesticides. The pilot project proved not only the feasibility of using technology to "bring farms to experts" but also the financial benefit of this advice for farmers. The scholar was delighted to have proven the feasibility and value of his idea and to have helped local farmers. But he was not content to stop with local farmers. If the idea worked in the Warangal district of Andhra Pradesh, surely it would work elsewhere.

A not-for-profit organization set up by the Indian government's Department of Communication and Information Technology then approached the scholar and proposed to fund an expansion of his work. The scholar met with a representative of the

organization and jointly determined the scope of the expansion. Although the scholar proposed to continue the focus on cotton, the funding organization encouraged an expansion to include 160 fish ponds, as well as cotton, chili, rice, peanut, castor, and other crops grown on 4894 farms in 35 villages of Andhra Pradesh. During the initial pilot, the scholar had sought to prove the feasibility and financial benefit of using ICTs to provide timely, targeted information to cotton farmers. The funding organization's mission was to promote public-private partnerships that would support technology research. Thus, with the new funding and project expansion, a major focus of the project became proving the financial sustainability of the overall system. Financial sustainability would enable the project to transition from a research pilot project to a long-term implementation through public-private partnerships.

Over time, the project continued to expand in goals and focus. The funding organization hired experts to develop a detailed business model of how the project could become self-funded and sustainable. They found that farmers were unwilling to pay for agricultural advice, since agricultural advice had always been offered for free from government extension services. Thus, a sustainable business model must offer more. Further, the development goal of the project had become financial benefit and increased productivity for farmers—a broader goal than simply providing information. In pursuing this goal, the technology scholar and his team found that optimal financial benefit would require a complex and interrelated support system. For example, some farmers were advised to use a particular fertilizer. But this fertilizer was unavailable at the village

shops, so the project team arranged to sell the product. However, farmers did not have cash to pay for the product; they needed credit. So the project team partnered with a large bank to arrange agricultural loans. When harvest time arrived, the farmers requested market information and intervention to help them to get the best possible price for their yield and enable them to repay the loans and make a profit. Thus, the project expanded in agricultural focus, geographical area, and breadth of services offered.

These expansions suggested possibilities for business ventures that could help the project fully transition over into a self-funding, sustainable venture. In partnership with the funding organization, the technology scholar and his team began seeking a large corporation that would join the venture and enable them to offer integrated services including IT centers, market information, banking credit, and agricultural advice. The search has been difficult, but the team is in discussion with a few possible partner businesses. More than seven years after the technology scholar read the devastating report of farmer suicides, he is leading a large, complex project to prevent those tragedies.

Section 2: Project 2— Job Matching for Domestic Workers

For several years, a researcher at a lab in India had been exploring user interface (UI) design for illiterate or semi-literate users. Her work had identified a number of principles to guide UI design, and she became interested in applying these principles by designing a functioning system to be used by semi-literate users for a specific purpose.

She began thinking about what local needs and applications might warrant such a system, and she began envisioning an application like Monster, the online job search tool, targeted toward finding employment for domestic workers in the large Indian city where she lived.

This researcher was familiar with the domestic labor system in India. She knew that most middle class families hired women for domestic work like cooking, child care, and cleaning. Most of these domestic workers were illiterate or semi-literate women who relied on informal social networks and unregulated, sometimes unscrupulous, placement agencies to find jobs. Using the currently available resources, a middle class family's search for domestic help might begin by, for example, mentioning the desire to hire a cook to the man who guards the gate to their home or apartment. The guard would then spread word of the job opening to his relatives and neighbors.

Given this system, domestic workers lacked a centralized information resource that could enable them to seek the type of employment they desired and compare opportunities in terms of pay, hours, and location. Reflecting on this information gap, the researcher envisioned developing a system in which families seeking domestic help could post their needs to a website, and semi-literate domestic workers could visit a computer kiosk in their neighborhood to seek jobs, using a specialized interface that would incorporate the researcher's design principles.

Though inspired by this vision of a technology-based solution, the researcher had sufficient experience in ICTD to expect complexity, and she suspected that technology

design would be one of the most straightforward aspects of the project. There were surely systemic and contextual issues that would complicate the implementation of such a solution, she thought. Therefore, she arranged to conduct a one-year, paper-based pilot study. This pilot study would test the feasibility of developing and implementing a job-matching service for domestic workers—pursuing the envisioned goal but delaying the addition of technology until the systems and processes were in place.

The design researcher partnered with a small nonprofit organization that worked with people in five slums in the southern area of the city. This nonprofit organization was small enough to respond nimbly to the adjustments required by an exploratory project, and the organization's director and her staff already had a foundation of trust with the women who lived in the city's southern slums—women who were likely to be semi-literate domestic workers. The director of this nonprofit organization was interested in partnering on the project because she believed that a job-matching service could be a potentially valuable benefit to offer women who joined the union she was organizing.

As the design researcher had suspected, the required human and physical infrastructure was far greater than the required technology (which was no small matter itself). Establishing a job-matching service was incredibly complex. One of the first challenges was finding interested employers. Many families that needed domestic help already had people in their social networks who could refer them to employees. They had no perceived information gap. Thus, the team had to recruit potential employers who were new to the city.

Once requests for employees came in, there were new challenges. For example, the pilot study was originally focused on the southern area of the city—neighborhoods that were convenient for women in the southern slums to access quickly and cheaply. However, as employers spread word of the service through their own social networks, the team began receiving calls from all over the city and beyond—including at least one request from abroad. Domestic workers had no desire to travel so far for work. The team then had to decide whether to turn away potential employers or to find additional partner organizations that had relationships with domestic workers in other areas of the city.

In addition, the employment requests were quite specific and often beyond the current skill sets of the women in the pool of potential employees. For example, a frequent request was for skilled cooks who could make certain dishes or cook in a particular regional style, but the potential employees had experience cooking only the types of foods their own families ate. Thus, the team decided that the project should address not only the problem of an information gap but also the problem of a skills gap.

Further, the design researcher found that what initially seemed like straightforward tasks—such as cook dinner—could mean different things to different people. For example, does cooking dinner including purchasing the food? chopping the vegetables and creating the spice mix? cleaning the cookware afterwards? Or does it include solely cooking pre-prepared foodstuffs? There would be problems if employers and domestic workers did not share the same definition of a task. In the absence of an

established relationship and foundation of trust between the employers and employees, both sides feared being taken advantage of.

In addition, there were culturally based restrictions and norms, often based on caste, that affected whether a woman would perform certain tasks, such as cleaning toilets, for example. Other complexities derived from the unregulated nature of the domestic industry. For example, the hours for domestic work were unregulated, as was the pay, training, recompense for disputes, and other conditions. Further, as the team was seeking to establish its processes and the scope of service, there was a spate of thefts (which were unrelated to the project) reported in the local news. This increased awareness of in-home theft amplified potential employers' concerns regarding the trustworthiness of domestic hires.

The design researcher hired a full-time coordinator and worked with contacts at the nonprofit organization, potential employers, and potential employees to establish the scope of the project and determine its specific services. Over the course of the one-year pilot, the team developed two contract options to regulate the relationship between employers and employees, organized and funded a training workshop for cooking, established a pay rate based on highly detailed task descriptions, conducted UI research in which potential employees interacted with computers, and placed seventeen women in jobs.

At the end of the pilot, the team decided not to transition the project into long-term implementation. The requirements for such a venture far exceeded the available

human, physical, and technical capacity. In addition, establishing a job-matching service was not the primary focus of anyone on the team. The design researcher's primary goal was testing an implementation of her UI design principles. The nonprofit organization's goal was testing the feasibility of supplementing its main service: unionizing workers in the five southern slums. Even the potential employees who participated in the pilot did not expect to get matched with a job but instead participated in the project for the small compensation they received and the opportunity to touch a computer for the first time.

Stakeholder goals varied significantly. Trust was a major area of concern among not only project team members but system users outside the team. While domestic workers had a perceived lack of information, many potential employers did not. Geography was a complicating factor due to limited transportation options for domestic workers. Even what seemed like specific tasks could mean different things to different people. Employers desired highly specific skill sets, only some of which women in the southern slums of the city possessed. Reflecting on the pilot project, the design researcher believes that year to be a beneficial learning experience—even if she didn't learn exactly what she expected.

Section 3: Project 3— Mobile-Based Learning

A PhD student at a large U.S. university had been struggling for about a year and a half to find a thesis topic related to ICTD. He had worked on three projects and garnered interesting field experience, but so far a thesis topic had not materialized.

Interested in technology interventions in education, the student began working with a visiting professor, exploring technology and education in India. He engaged in field work and spent more than a year experimenting with a variety of technologies, trying to get a sense of what interventions would be suitable for the local environment.

With a background in computer science and economics, the student had studied human computer interaction (HCI) in graduate school. Early in his graduate career, the student's goal was to bring human-centered design approaches to technology for the developing world. As his experience in the education domain of ICTD grew, he began to realize that prototype development was not the major challenge of ICTD work; the challenge was more complex and at a much deeper level. In the education domain, problems could not be addressed by iterative prototypes, he came to believe. The work must start much further back—at curriculum development. Early on, he had considered himself a technologist who would design the perfect application, a silver bullet technology for education intervention, but later in his graduate career, he shifted to believing that interventions should target a different problem: limitations of the curriculum development process.

After he graduated and became a professor at a U.S. research university, his thinking shifted again. As a new faculty member, the professor viewed himself not just as a researcher or expert in a particular domain of ICTD but as a strategic leader whose focus should be paving the way for graduate students in ICTD to conduct research, build reputations, and seek jobs in this emerging field. This new role affected his research

focus by expanding it beyond curriculum development to the ecosystem surrounding education in developing countries. Thus, the project that began with technology-focused explorations evolved over time to embrace the goal of building a resource ecosystem around mobile learning in developing countries. This shift in his view of the problem broadened his project scope in terms of geography, stakeholders, timeline, research focus, and goal.

In observing early education in India for several years, the professor noted that one of the major impediments to learning was infrequent or inconsistent school attendance. Many children were periodically prevented from attending school by their parents, who needed the children to work at home or in the fields. After conducting years of field work in technology and education, the professor came to believe that mobile phones offered a suitable hardware for educational games that could address the information gap: helping children learn outside the classroom. He wanted to see mobile-based learning become a widely used and accepted educational approach, but generating broad support for mobile-based learning required not only pilot studies proving the effectiveness of this approach (which he and his graduate students conducted) but also buy-in from stakeholders such as educational service providers, mobile phone manufacturers, wireless service providers, government organizations, and others.

Calling his work a partnership-based approach, the professor spent significant time collaborating with nonprofit organizations, government contacts, and industry supporters. He sought partners who shared his vision and would not require persuasion

and significant attention, which he felt would drain resources away from the focus of the project. But even among strategic partners, there were differences that affected the collaboration. Industry supporters in particular had shorter timelines and goals related to immediate, concrete results that incrementally improved existing education approaches, while the professor had a longer term goal of fundamentally changing education through mobile-based learning.

With visions of developing multi-faceted support for mobile-based learning, the professor further broadened his approach. He and his team studied curriculum development as well as game development. He conducted studies on culturally appropriate games, as well as mobile-based gaming. The team designed a number of games and ran pilot studies with local students, in partnership with an existing after-school program. The professor offered game development workshops at Indian universities and hired interns to join his team. He pursued funding from a number of sources, including grants from mobile phone manufacturers. In addition, he hired a full-time employee in India and began planning to found an organization to provide the stability and long-term sustainability that he believed would be required to generate a resource ecosystem for mobile-based learning. The professor's approach to ICTD has undergone some significant shifts since his early days as a graduate student, and his project continues to expand to accommodate these shifts.

Section 4: Project 4— Locally Designed Technology

In the late 1990s, a computer science professor at a major Indian university attended a conference that explored how technology could address the digital divide. A major theme of the conference was that local needs should be addressed locally. The theme prompted several conference attendees to discuss the tiny percentage of the Indian public that used information technologies at that time and the fact that none of this technology was designed in India. The professor thought about what would be necessary for ICTs to become more widely used in India, identifying three major needs: content in local languages; devices to create, store, and share that content; and network access to link the devices. Content creation and network access were beyond his purview, the professor thought, but he was intrigued by the challenge of developing hardware and software specifically suited to Indian users.

Conversations continued long after the conference, particularly among three IT industry professionals and four computer science professors, including our main character. The next year, the men decided to register as a formal group to create a technology device that was locally designed for local needs. They spent the next three years in exploratory research on their own time with no external funding while working their full-time jobs. Their goal was to design and develop a handheld computer for use by a typical person in India, what they called "the common man."

During the late 1990s and early 2000s, only very wealthy people in India owned or used computers and mobile phones. Much of the rural population had never seen a PC,

much less had a desire or the skills to use one. With this in mind, the team members brainstormed potential applications of handheld computers, based on needs they observed. They decided that a computer for the common man need not offer flashy, entertainment-focused applications but instead should provide simple information. One of the professors' first ideas of an application for their device was providing the price of produce at local markets. Each year farmers would harvest their tomatoes and take them to local markets. Farmers had perhaps five local markets to choose from but no pricing information to help them decide which market to select. The unlucky farmers selected markets that were already flooded with tomatoes. Tomato prices at these markets were too low to make a profit, but once a farmer had arrived at a market, there was not enough time to leave and reach a different market. Thus, many of these farmers dumped their tomatoes on the road and returned home with nothing to show for their harvest. Familiar with this annual tragedy, the professors envisioned their handheld computer providing these farmers with five numbers on the morning of their tomato harvest: the prices of tomatoes at their local markets. Armed with this information, farmers could make the best selection and profit from the harvest.

The example above was only one of many possible uses of the computer. The team sought to develop a flexible technology platform that people could use to do whatever they wanted—whether that was seeking market information, supplementing educational resources in schools, making personal notes and messages, or improving the security of group banking. The driving vision was that the team would develop an

incredibly flexible and usable device and that users could develop and share open-source applications. The team conducted extensive research with local populations to understand both specific needs and more general guidelines for design. Because the envisioned device was so flexible and the envisioned user base so broad, the team sought to incorporate as many design features as possible.

After the three years of research, the team had produced a prototype with original hardware, software, and applications. They offered to license their intellectual property (IP) to interested parties with the condition that all hardware design be in the public domain after 18 months. Believing that competition would spur better design, the team licensed the IP to two competing start-up companies, one founded by the professor and one by another member of the team.

The professor's start-up company encountered a variety of challenges to product launch. For example, they struggled to keep down the cost of the device because of the variety of features they had included. To reduce costs and put the device within purchasing range of a large portion of the population, the company needed to reduce features, but they did not know which features were least important to their target users and therefore most strategic to eliminate. In addition, the company experienced significant delays in manufacturing. At that time, very few manufacturers capable of producing electronic devices existed in India, and the government-owned manufacturer with which they contracted delayed several times. Over the next several years, the company produced three versions of the device, but sales were not as high as they had

anticipated. The professor who founded the company believed that potential customers, both individuals and organizations, were waiting for others to buy the device first.

Eventually, the product was taken over by a much larger company, which hired many of the employees from the professor's start-up business. The handheld device itself evolved from the computer for the common man of India to a specifically targeted device, customized for large enterprise customers such as financial institutions and government organizations. More than a decade has passed since the technology conference that inspired seven men to locally design technology to meet local needs, and the challenges proved as significant as they were unanticipated. Looking back, the professor and start-up company founder is glad that they were unaware of the challenges they would face; otherwise, he believes, they would never have tried at all.

Section 5: Project 5— Integrated Electronic and Paper Records

A computer science scholar was working in Gujarat, India, on a project with a nonprofit organization whose partners promoted microfinance self-help groups. The scholar saw firsthand the way that self-help groups could empower people and help them secure capital, and he decided to see if he could use his expertise in software engineering to support this work. Building on his contacts in Gujarat, he found a partner organization and began exploratory research, seeking to better understand the goals of microfinance organizations and self-help groups, as well as the challenges to meeting those goals. Through field work, he began to understand which aspects of self-help groups were

common across agencies, groups, and geographic regions and which aspects tended to vary.

He began working on a technology solution that he suspected could be useful beyond microfinance, so he intentionally designed this technology with a specifically focused application for self-help groups and a more generalized platform, on which applications for other usage scenarios could be built. As he designed the technology solution, he mentally switched back and forth between thinking about the specific design problem and users and context for the self-help groups and thinking about ways to generalize the technology and scale it for other contexts. As the technology design become more concrete, the scholar and his partners applied for grant funding, which not only provided the financial means for implementation but also drove the schedule for finalizing and implementing the solution.

Soon the scholar had developed the technology solution for self-help groups and realized that the research was complete. This research had enabled the development of a product which now required a long-term implementation to test its feasibility. The technology scholar knew that implementing a technology product over the long term would require a support structure, including an organization to provide IT management and support. At about the same time that he first began the project, the technology scholar and a friend of his had started a company to provide business technology and management services to nonprofit organizations. Thus, when his research produced a

product suitable for long-term implementation, it seemed natural to the technology scholar to bring in his own company to provide the training and technical support.

With the project handed over to the company, the technology scholar retained a relationship with the company but pursued a full-time career in academia. His interaction on the project diminished as he pursued other cutting-edge research in ICTD. The types of work that remained—finding clients with needs relevant to the technology, customizing applications for clients, optimizing the technology design, providing customer support—was not his area of focus.

After he transitioned out of the project, the company he co-founded used the technology solution as the first iteration of a business software product that it could market to nonprofit organizations. In response to input from potential clients, the company developed another iteration of the product that could meet wider needs. The company continues to modify the underlying technology platform and to develop customized applications for nonprofit organizations in its clientele. Though the company's focus remains primarily on India, it is seeking to expand throughout South Asia and eventually into Africa.

Even as the company iterates and scales up the technology solution, other researchers have also taken up the technology that the scholar developed, iterating the underlying platform and creating new applications for a number of development uses. These researchers include students who are studying with the technology scholar (who has since become a professor). The technology scholar himself is involved in a few of the

new efforts descending from his original solution, but his main focus is on other ICTD research and projects. Reflecting on the project's multiple versions, iterations, uses, and players, the technology scholar sees this project as a complex evolution, in which it is difficult to identify where the research ends and product implementation begins.

Section 6: Project 6— Human-Mediated Agricultural Videos

A researcher at a technology lab in India became interested in leading a project to improve farmer livelihoods. He sought to use technology as an aspect of an intervention that would produce real, measurable impacts in farmers' lives. Such a broad goal provided little constraints on the early project design, and he was unsure of the best approach to meeting that goal: e.g., the type of technology, the role of technology, the definition of impact (whether financial, environmental, etc.), the specific need that would be met. He spent between three and four months investigating the domain of agricultural development, identifying organizations operating in the domain and becoming familiar with their objectives and approaches to achieving them.

The researcher then sought to develop a better understanding of farmers and their needs by partnering with a nonprofit organization that worked with local farmers near his research lab. Funded by the lab where he worked, the researcher conducted exploratory research for several months: shadowing nonprofit employees who trained farmers in sustainable farming practices, interviewing farmers and extension workers, observing outcomes of the current intervention programs, and experimenting with a variety of

technologies. After that first phase of research, he felt confident that he'd developed an intervention approach that addressed the more specific goal that had since developed: using technology to supplement the current agriculture training practices. It was important to the researcher to build on the expertise of his partner organization by using technology to extend their reach and impact. When the project appeared capable of achieving that goal, he conducted a long-term controlled experiment for 18 months to prove the effectiveness of the approach.

The experiment did show the value of the researcher's approach to encouraging farmers to adopt sustainable practices, and the researcher sought to scale up the project to cover a much broader geographical area. At this point, the original partner organization amicably ended the relationship. The partner organization had hoped that the inclusion of technology in the agricultural intervention would significantly reduce the required manpower, whether by eliminating the need for human trainers or by enabling farmers to produce their own training materials. This did not prove to be the case. Technology-based training without human trainers proved ineffective, and the development of technology-based training materials proved beyond the capacities and interests of local farmers. Scaling up the approach developed by the researcher would require significant funding for technologies, which were not central to the interests of the partner organization. Thus, the researcher and the organization ended the partnership.

Inspired by the success of his intervention approach, the researcher successfully sought grant funding to start his own nonprofit organization. He left the research lab to

transition his research into a long-term implementation. The researcher viewed his project as more centrally a development project than a technology project. Thus, the goal of the nonprofit organization he founded was to help its partner organizations to better serve farmers with training that could improve their livelihoods.

Scaling up has proven to be a complex undertaking. The researcher's organization cannot take a cookie cutter approach to scaling because so many factors vary across regions and partner organizations. Before expanding into a new region, the researcher seeks partners with an existing relationship with farmers in the area, enabling his employees to build on this existing level of trust. In addition, he considers the agro-ecological conditions of the regions, since the training material is specific to types of crops, weather and soil conditions, and other regional factors. The technologies that the organization uses to amplify its partners' efforts also vary according to the conditions of the region, the costs, and the stakeholders. When the organization does expand into a new region, its employees commit to living in the region for at least a year, working closely with the partner organization in that area and learning to best way to customize their work to amplify their partner's efforts.

What began as an effort to use technology to improve farmers' livelihoods has remained just that: an effort to use technology to improve farmers' livelihoods. The broad development goal has remained consistent, while the approach, the researcher's career, the project, the technology, the partners, and the geographic scope have all changed to accommodate that goal.

Section 7: Project 7— Online Forum for Indian Agriculture

In the early 2000s, a professor at an Indian research university reflected that although the Internet had the potential to provide any type of information to any type of person, only certain information was available—much of it irrelevant or unsuitable for Indian users. He thought of the Internet like a system of pipes through which information could flow, but many pipes were remaining empty. Therefore, as a summer project, he began working on an online system that would answer people's questions, particularly targeted to Indian users. The project had not long been underway when he decided that this scope was far too broad—trying to be anything to any user. Thus, he decided to narrow the system's focus and test his idea, selecting the domain of agriculture and a specific geographic region on which to focus as a year-long pilot. He partnered with a government organization that provided region-specific agricultural expertise, and he worked with his students to design a technology solution to connect farmers with the agricultural experts.

Even with this narrowed focus, the professor discovered that it was incredibly complex to use technology to answer people's questions. For example, he had to consider how quickly answers should be posted to satisfy the farmers, how many questions the experts could be expected to answer in this time, and the way that these answers might affect the lives of the farmers. In addition, there were issues of specificity. The agriculture experts sometimes found the questions to be vague or confusing, but the

farmers expected to receive specific, relevant, and actionable answers. Language added another layer of complexity, with questions posted in Hindi, for example, and answers posted in English. In addition, agricultural expertise is geographically specific, so if a farmer from outside the pilot region posted a question, the experts may not be able to answer. Building trust was another challenge; farmers needed to feel confident in the responses they received. So the professor arranged to bring the agricultural experts to the villages in the pilot areas so that farmers could see the people who answered their questions. The professor decided that, in comparison with these factors, the technology part was easy.

The professor established a lab at his university to support the project and continued the relationship with the government organization providing agricultural expertise. His team continued to conduct field research, interacting with farmers and agricultural experts to better understand what changes and additions they should make to the system. After a few years, the professor saw that the Internet was not becoming widely available in India through shared kiosks, as he had initially expected. Many of the kiosks that had originally made his solution available to farmers had closed, so he and his team began experimenting with additional ways to make the information available, including mobile phone-based and offline versions. He also added services and information beyond Q&A, including options to ask for prices and transportation from farm to market. In addition to expanding the technology approaches, the professor and his team scaled the geographical reach of the project. He expanded the project's regional

agricultural expertise by partnering with additional regional offices of the government agricultural organization and also with research universities in other areas of the country.

To make the project self-sustaining, the professor sought commercial customers and tried to sell the idea of his project—but without success. He thought that businesses and investors would not take the project seriously because it was run by a university lab. Even a start-up company would seem more viable, he thought. The professor believed that transitioning the project from the lab to a business would enable a greater geographical scale, the necessary staff to commit to the project, and long-term sustainability. Therefore, he helped to transition the project from the university lab to a business incubation program offered at his university. One of the team members who had been involved since the beginning became the CEO of this new business. During the incubation period, the fledgling company focused on hiring the right team and establishing responsibilities, while working closely with the lab. The company began seeking investment funding, particularly with social entrepreneurs who focus on social impact in addition to return on investment. The professor and company CEO want to be prudent in securing early funding to ensure that the company can deliver on its promises. Securing the next round of long-term funding will be highly influenced by the outcomes of initial funding.

From its humble beginnings as an exploratory summer research project, this project has evolved through many stages: pilot study, university lab, business incubation, to fledgling business. Throughout these stages, the professor believes that resources of

the university, in terms of funding, networking, and personnel, have been instrumental in moving the project forward. Even as the project transitions out of the university lab, its ties to the university remains strong.

Chapter 5 – Themes

This chapter discusses patterns of meaning that emerged from interviews with stakeholders of all seven projects. While the previous chapter foregrounded individual projects, this chapter foregrounds the themes that emerged *across* projects. As mentioned in Chapters 2 and 3, ICTD literature is heavy on case studies, and this research study seeks to fill a gap by presenting findings that transfer across case studies. Therefore, the themes analyzed in this chapter are those that surfaced across multiple projects. The data informing this study was extensive, and the four broad themes of scope creep, scalability, project management and sustainability, and perceptions and behavior each contained numerous subthemes. I selected eight subthemes, two for each of the four themes, to discuss in detail (see Table 1).

Table 5.1: **Findings overview: Themes, subthemes, examples, and projects**

Themes	Subthemes	Example	Projects
Scope creep	User requests prompted scope expansions.	Potential employers requested domestic workers with cooking skills, but few domestic workers involved with the project possessed these skills. So the scope expanded to include a cooking workshop. (See p. 116)	1, 2, 4, 5, 6, 7
	Scope expansion from providing information to changing established perceptions and ways of doing things.	A mobile-learning project began with the goal to develop a "killer app" for mobile phones to support education but is now aiming to legitimize mobile education as a key component of the broader education "ecosystem." (See pp. 119-120)	1, 2, 3, 4, 6

Themes	Subthemes	Example	Projects
Scalability	Project stakeholders expected that people outside of the project would appropriate aspects of the project for use in other contexts.	A technology design project licensed its intellectual property (IP) to interested parties with the condition that all hardware design be in the public domain after 18 months so that others could appropriate the technology for their own use. (See p. 124)	1, 2, 3, 4, 5, 6
	Partnerships were vital to scaling projects.	An agriculture project sought to develop a web of partnerships with universities and government organizations across India to access the range of expertise necessary to answer farmer questions at a national level. (See pp. 132-133)	1, 2, 3, 5, 6, 7
Project management and sustainability	It took years for projects to progress to and through a transition from research to implementation.	The project with the shortest timeline ended after a year. At the end of one year, many human and systemic barriers had been identified and addressed, but many others remained, and technology development had not begun. (See pp. 117-118)	1, 2*, 3, 4, 5, 6, 7 *This project ended after one year, but it had not yet achieved a working pilot; see example column
	Project stakeholders expected to continue changing their solution or offerings over the long term.	A project that provided agricultural information continually developed additional methods by which to share that information: e.g., Internet kiosks, offline hardware device, SMS messages. Project leaders plan to continue developing new information paths and resources in response to technology trends. (See pp. 141-142)	1, 3, 4, 5, 6, 7
Perception and behavior	Trust and credibility influenced a variety of project factors.	A software development project had difficulty developing a scalable design because user groups with different trust levels wanted different levels of security procedures. (See pp. 189-190)	1, 2, 3, 4, 5, 6, 7
	Motivations for long-	Farmers who had saved a few thousand	1, 2, 3, 4, 5,

Themes	Subthemes	Example	Projects
	term project involvement were complex and difficult to maintain.	rupees because of the advice they received from an agriculture pilot project were unwilling to pay a few hundred rupees to continue project involvement past the pilot phase because they believed that agricultural advice should be free. (See pp. 201-202)	6, 7

As shown in Table 1, each major theme contains two subthemes that are presented in detail in this chapter. Within the broader theme of scope creep, the first subtheme is that user requests prompted scope expansions, and the second is that the scope expanded from providing information to changing expectations and well-established ways of doing things. Under the second theme, scalability, the first subtheme is that project stakeholders expected that people outside of the project would appropriate aspects of the project for use in other contexts. The second subtheme under scalability is that partnerships were vital to scaling projects. Within the theme of project management and sustainability, the first subtheme is that it took years for projects to progress to and through a transition from research to implementation; second, project stakeholders expected to continue changing their solution or offerings over the long term. Finally, under the theme of perceptions and behavior, the data showed that (1) trust and credibility influenced a variety of project factors and that (2) motivations for long-term project involvement were complex and difficult to maintain.

Each broad theme contained numerous subthemes beyond the eight subthemes discussed here. Some of these subthemes occurred rarely or in connection with only one project, and some are already well established in the literature. For example, in the theme of sustainability, many participants mentioned difficulty in securing adequate funding:

> "I think probably the problem was to have financial support for taking up large scale testing and implementation, so think we were lacking in that area."
>
> "Funding is becoming a significant constraint because we need funds."
>
> "Funding is a huge, huge barrier."

Difficulty in securing funding or in making ICTD projects financially sustainable is already well established in ICTD literature, and the data from this study confirm that finding but add novelty to that previously established finding in its relation to other factors. Therefore, this subtheme was not itself selected as a focus for analysis but is discussed as it relates to subthemes that meet the selection criteria of being (1) shared across multiple projects, (2) prominent, and (3) novel.

The sections below describe the eight subthemes, using quotes and examples from the interviews to illustrate how they affected the projects. Commonality across projects is highlighted, as are interrelations among subthemes. Table 1 overviews each theme and subtheme, providing an example of each subtheme and identifying which of the seven projects referenced each subtheme.

Section 1: Scope Creep

The scope establishes the boundaries of a project. The project scope includes, for example, the technologies employed, the goal of the project, the problems addressed, and the services offered. Because the projects in this study began as exploratory research, it is not surprising that every project experienced changes in project scope over time. What is interesting is the prevalence not only of scope creep but of common causes of scope creep across projects. This section discusses two subthemes of scope creep—scope expansions due to user input and scope expansions to address long-established beliefs and systems of behavior—focusing on common reasons and experiences across projects. While expansions to project scope were quite prominent, two projects experienced significant contractions of scope. Because only two projects narrowed their scope and because the reasons were unique to each project, this major theme is restricted to "scope creep," not the broader "scope changes." Two common reasons to expand the project scope were requests from users and the inadequacy of information alone to achieve project goals.

5.1.a Scope Creep Due to User Requests

All seven projects included user-centered design in the form of interactions with and observations of intended users. These users often prompted expansions to the project scope by requesting additional services beyond those initially within scope. For example, farmers suggested new topics on which they desired training and additional information:

> "Changes come based on feedback from farmers. Farmers gave us feedback on how they want information in workshops and other places and then we decide whether to make changes."

Several projects invited feedback from specific groups (e.g., by surveying local farmers) and from interested people more broadly (e.g., by posting an email address online for general feedback). This request for feedback often resulted in requests for scope expansions:

> "We do a lot of infield surveys, and the group spends several months with clientele, and we do run workshops. A whole host of things. We get flame mail; we get fan mail. We take every one of them directly. People post on [project name], or they call us. A lot of smart people do. They feel that something should be done, and they say, 'Why don't you just do that?'"

We see in these examples that user feedback was invited at various points in the project, but these points occurred after some of the major decisions had been made. For example, by the time user input was sought, the project goal, geographical location, development domain, and often the technology approach was already defined for most of the projects in this study. Thus, users were brought in to shape existing projects, not to define future projects. This approach to scoping projects contributed to a problem underlying the first subtheme of scope creep due to user requests, the problem of inappropriately defining the problem space. Because much of the problem space was defined by project leads, their partners, and their funders before user input was sought, many projects were founded with inadequately defined or incorrectly defined problem

spaces. These inappropriately defined problem spaces then led to user requests for an expanded scope.

Early on, many projects sought to provide information or advice, with the expectation that users would apply that information and subsequently experience benefits to their welfare. But information alone often proved inadequate to achieve the goal of improved welfare, and user input suggested how the scope could be expanded in an effort to meet the goal.

For example, one of the agricultural projects sought to achieve financial sustainability by charging farmers for customized agricultural advice. However, merely generating this customized advice (i.e., information) was inadequate to satisfy the small percentage of farmers who had begun to pay continue participating in the project. Information need not only be generated but promptly conveyed. The project had to construct a complex infrastructure of humans and technology not only to generate the advice but to convey it to the farmers. Early in the project, human coordinators would physically travel between a regional hub and each farm not only to collect information by taking photos and interviewing farmers but also to convey the advice that had been generated based on the information collected during the previous visit. When coordinators were unable to travel, for example because of holidays, illness, or turnover, farmers who had begun paying for information became dissatisfied with the promptness of feedback:

> "The farmer is asking, 'I already paid you your contribution fees and uploaded the photograph. Why am I not getting the advice?' The dependence on coordinator is increasing. Then what happened, we got the idea, what we will do is we will store voice advice into the system, then send the farmer one SMS, 'Please call this number and listen your advice.' In this way, the delay can be reduced. If the farmer wants, he can call and listen. It is a service level guarantee we can provide is what we are thinking."

The project's early approach of depending on human coordinators to convey advice was too slow and unreliable for farmers who had begun paying. Thus, the project expanded its technology scope to include audio-recording advice and creating an automated SMS feature that would notify farmers when their customized advice was available. To make this advice available regardless of call time, the project scope expanded to include developing a system to allow agricultural experts to audio-record their advice and play the right advice for each farmer who calls in. In response to farmer feedback, the project expanded its scope to include digital recording and SMS notification.

This example is interesting because it illustrates that even providing information can require a scope expansion. While several projects expanded beyond information provision (as discussed in examples below), providing information alone often required scope expansions in terms of developing multiple paths to share information. The requirement for multiple information paths is related to factors such as trends in technology usage, insufficient infrastructure, and motivation for project involvement. Specifically, farmers who had begun paying for information in the form of agricultural

advice required additional incentives, what the interviewee called a "service level guarantee," to be motivated to continue project involvement. In addition, when the existing infrastructure of the human and technology network proved insufficient to provide this service level guarantee (due to coordinators being occasionally unavailable), the scope was expanded to develop additional information paths to offer farmers. Technology trends also played a role in developing additional information paths. Since the beginning of the project, mobile phones had become common enough in the villages served by the project that many paying farmers had access to a mobile phone indirectly (through a relative or neighbor) if not directly (owning one themselves). Thus, when farmers requested prompt, reliable access to information, the project identified SMS notification and recorded messages as a suitable information path.

Another example of scope expansion due to user requests is illustrated in the job-matching project. Originally the scope centered on matching potential employers with domestic workers seeking better opportunities. However, potential employers did not want merely a referral; they wanted formal assurance of the applicant's integrity and some method of recourse if the employee proved untrustworthy:

> "It was not as easy as we had imagined it to be because some people said, 'Okay, how, okay, if there is a theft in my house, then who is responsible? Who is the responsible person?' So now the next big problem is we needed to address accountability. … after visiting multiple employers, they felt like they wanted the NGO to sign a document saying that yes, they promise that if something goes wrong, we will reconvene and then sort it out. So that's when we thought, 'Okay, contracts! Let's have a contract.'"

Therefore, the project scope expanded beyond information provision (e.g., employee referrals and a job database) in response to user requests. The project lead and the partner organization worked with both major user groups—potential employers and domestic workers—to develop a contract, which they finalized four months into the project.

This example is significant not only for illustrating scope creep due to user requests but also for illustrating how scope creep interrelates with other themes. For instance, the first subtheme under sustainability and project management is that it took years for projects to begin transitioning from research to implementation. Here we see one example of why project transitions are so long in coming: merely creating a contract to structure the relationship among project stakeholders took several months. The contract was a necessary precursor to stakeholder involvement, which was a necessary precursor to designing, building, and testing a job-matching website. In other words, establishing a working prototype of the project required significant scope expansions, which took time to discover and address.

Another interaction among themes is seen between scope creep and perception and behavior. The second subtheme under perception and behavior is that motivations for project involvement are complex and varied. The above example shows that a stakeholder group vital to the existence of the project, potential employers, was unmotivated to become involved without the incentive of formal recourse if employees proved untrustworthy. Therefore, to motivate stakeholder involvement, the project scope

expanded beyond information provision to include developing a contract to formalize accountability.

One of the most extreme scope expansions due to user requests occurred in one of the agricultural projects. This project began by providing information to farmers and expanded to provide a variety of services. One major scope expansion was acting as liaison between farmers and a large Indian bank that agreed to offer loans to allow farmers to purchase materials like fertilizers:

> "Farmers said, 'it's fine, but we don't have money to buy because we have been using this credit from the local vendors, so we need money.' So then we tied up with [a specific Indian bank] and started providing finances also to the farmers, financial services. So we acted as agents for [the bank]. We identified the right farmers and did the processing and documentation of the loan, submit to [the bank], and then get the money and give it back to the farmer, and get the money back and give it to [the bank]. In the process, [the bank] was paying us some service charges, too, for the services, paying charges to us for services. Then the farmers said, 'Everything is fine, but then we produce and the market goes down, so we are not getting the right prices kind of thing. So why don't you do market also?' ...So we provide all these services to the farmers: [project name] for advice, finance, input, and marketing."

Liaising between the bank and famers was not the only new service that the project adopted beyond information provision. Requests from the local farmers prompted the project to expand its services to include selling agricultural products and providing market prices as well. Another participant with the same project described why these scope expansions occurred:

> "The farmers were not willing to pay. After a few years, the farmers were willing to pay because it is useful, but they want additional services. For example, the

> data alone is not always credible, so there is a direct need for this application also. So if [project name] is to be successful, you will follow a commercial model. You must provide extra services; the farmers do not find it otherwise useful."

As the participant described in the quote above, the project scope expanded far beyond information provision alone because farmers were unmotivated to continue project involvement if they were charged for services and if the services were restricted to agricultural information. Again, we see the interrelation between the subthemes (1) scope creep due to user requests and (2) the complexity of stakeholder motivation for project involvement. This interrelation is an important finding because scope creep (or the more development-focused "mission creep") are often considered problematic, for good reason: too broad a scope is impossible to achieve. However, this finding shows that too narrow a scope can de-motivate stakeholders from participating, thus suggesting that scope expansions be considered in conjunction with other important factors such as motivation for stakeholder involvement. The finding also raises questions related to scope shifting or narrowing. This data suggests that working closely with stakeholders can lead to scope expansions, but it would be interesting to discover whether these expansions could be mitigated by narrowing the scope in other ways, for example geographically.

Other user requests for scope expansions were prompted by a need for human capacity building. For example, the job-matching project identified an important gap in the domestic workers' skill set: cooking. To meet the needs of potential employers for

domestic workers who could cook, the project scope expanded to include training domestic workers in this skill:

> "Regarding human capacity, I think, just to go back, one thing that we saw with this cook thing, right. People cannot cook. A lot of the request was for cooks, so we realized that we would actually have to make people cook. So we should have a cooking workshop, and, of course, it's not possible to train people cooking for like within a day.... So now we are going to have a cooking workshop, and, you know what, I am negotiating and what issues come up like the supplies, food, yeah, just the entire set up—vegetables, spices. I mean, like if you want to cook people nice things, you have to have a lot of supplies. And we thought, okay, now we actually need a van to transport the vessels and carry the employees to the location where the workshop is taking place, to the cooking workshop."

This example shows that gaps in human capacity prompted the expansion of project scope from creating a computer-based job-matching system for potential employers and low-literacy domestic workers to also include identifying commonly requested domestic skills and training domestic workers to develop those skills. This finding is congruent with the messages of ICTD scholars like Kentaro Toyama, who describes technology as an amplifier of existing human capacity but insufficient to create or substitute for that capacity where it is lacking (2011). The capacity of domestic workers with the requisite skill set to find jobs would be amplified by an online job website, but the capacity of unskilled domestic workers to find jobs using a technological tool would still be nil. The technology would amplify, not create capacity, so to meet a goal of helping domestic workers find good jobs, the project scope was expanded to create some missing capacities which could then be amplified by technology.

The experiences of other projects support this finding (i.e., that technology amplifies but does not replace or create new capacity). For example, an interviewee from one of the agricultural projects described the limited number of region-specific agricultural experts as the major problem that the project faces. To address that problem, the project has created university-based training programs in agriculture and in the intersection of agriculture and ICTs:

> "So main problem here is to have an expert who can deliver advice in different agriculture situations, different climate situations. That is the main problem we are facing. As a result, we have started an education program also: field agriculture. And we have started ICT for agriculture education also."

Again we see human capacity as a potential barrier to the project. Much like the example above in which employers and employees must have congruent needs and skills for the project to begin matching them, this example shows that for farmers to receive relevant agricultural information, experts must be available to provide that information. Technology could amplify existing capabilities, for example, by making more efficient use of agricultural experts' time and therefore enabling them to help more farmers. But technology alone could not create more experts or even develop appropriate agricultural information without human experts. Thus, we see that these scope expansions were not foolish or naïve efforts to address problems tangential to the project mission. These scope expansions sought to create human capacity that, if lacking, would likely cripple or end the project altogether because without this human capacity, the project goal would not be addressed. Technology may work, but the development mission would not be supported:

e.g., a job website may exist, but domestic workers would not be qualified for the jobs being posted.

The example below illustrates a slightly different approach to the same problem of a lack in human capacity. This example comes from the project that sought to integrate digital and paper-based forms used by microfinance organizations and other nonprofit groups. While some aspects of the software design were transferable across organizations, other aspects needed to be customized for each organization. But the NGOs lacked the in-house capacity to provide their own customization and technical support:

> "So all of it, almost all of it, requires some element of customization, training, technical support, especially for these NGOs that don't have in-house capacity. See, the problem is that if we were talking about business software, this kind of software, in a developed-world context, that service market already exists. There are companies that are already set up to essentially provide software support and customization and all of the services surrounded with software.... That same kind of service infrastructure doesn't exist for the kinds of organizations we're targeting."

As the interviewee describes, not only did the NGOs who used the technology lack the capacity to customize it and provide their own training and technical support, but there was a lack of service companies that could provide this technical support for NGOs in India. The earlier project examples illustrated the most common response to capacity gaps like this one: the project scope expanded to develop the missing capacity. The approach taken by this project was slightly different in that the project lead handed off the technology and potential client organizations (i.e., the NGOs) to a start-up company

that he had co-founded. The project lead reduced his involvement at that point, and the company took over the project, expanding the company focus to include technical service, support, and customization. What is different about this approach to capacity gaps is that the project lead phased out his own involvement in the project because the type of work that was required to meet the needs of multiple organizations was not the type of work he sought to do. What is the same about this example is that, yet again, we see project scope expanding to address capacity gaps that would otherwise stop the project. If NGOs had no source of technical support and software customization, they could not use the technology developed by the project or could not use it for long. If these capacity gaps were not addressed, the project goal of enabling microfinance organizations and other NGOs to collect and store information using the benefits of paper- and digital-based systems would go unmet.

We have seen in this first subtheme that working closely with stakeholders often leads to scope creep—either due to requests for services beyond information provision or due to requests for scope expansions to address human capacity gaps. In response to requests from stakeholders, six of the seven projects expanded their scope. The examples provided in this section illustrate that, for many projects, this phenomenon is not the case of rampant and unfocused mission creep but that these scope expansions are often necessary for the survival of the project.

5.1.b Scope Creep to Change Established Perceptions and Behaviors

The second subtheme within the broader scope creep theme is that scope expansions were prompted by a desire to change deeply held perceptions or long-established systems of behavior. The first subtheme could be addressed by relatively straightforward scope expansions like offering training or software support. However, the second subtheme is more complex, as it represents scope expansions that were more strategic than tactical: i.e., focused on changing mindsets or ways of doing things on a grander scale. Prompting changes at the society or institutional level was not an early goal of any of the seven projects. For example, initially, two projects sought to provide agricultural advice, and the third agricultural project in this study sought to support agricultural extension training. The goals of these projects initially focused on making agricultural information available through technology, with the expectation that farmers' livelihoods would be improved by the availability of information. However, all seven projects in this study discovered that achieving livelihood benefits would require more than technology and information. In fact, although technology was no small matter, some interviewees said that it was the easy part:

> "After talking to the NGO people and visiting the slums and actually talking to potential employers, there were so many other issues that we needed to address that we just decided technology is the least of our problems."

> "The technology is easy; collecting the right information is the hard part. So if you're growing wheat in an area which is otherwise growing rice, you want to be careful about those combinations. You can't generalize."

After working on the ICTD projects for some time, these interviewees came to believe that technology development, while itself challenging, is one of the most straightforward challenges. This perspective is significant, as these interviewees are technology developers and designers. Their expertise and training centers on technology; yet, their experience with ICTD projects tempered that technology focus, causing them to view human and contextual factors as more significant and challenging. For example, working out human relationships, as eluded to in the first quote, and customizing interactions and information for individual users, as mentioned in the second quote, are significantly more complex than technology design itself.

The insufficiency of information alone was illustrated by the first subtheme under scope creep, when user requests prompted relatively straightforward scope expansions like selling fertilizers or running cooking workshops. The second subtheme under scope creep has the same foundational cause—the insufficiency of information and technology alone to improve well-being—but the type of scope expansion in subtheme two is different: it involves scope expansions that address long-standing beliefs or ways of doing things.

One example of subtheme two occurred in the mobile learning project. This project began with the goal of creating a mobile phone application that would support English literacy education—a straightforward and narrow scope. However, more than five years later, the project scope has broadened beyond application development to address fundamental beliefs about where and how education should take place:

> "The real struggle is that how do we create an ecosystem around mobile learning. ...So what I'm really trying to say is that in India, you have interesting content developers who are already targeting these market segments. And they're doing it with their own revenue stream, not expecting to make profit. I think the challenge is that a lot of these guys are targeting the desktop computer and not mobile phone because they have some reservations about trying to move to the mobile platform. That represents a major shift for them in terms of the expertise they need to develop for learning, and they are not even sure that mobile learning will work. For us the challenge is about trying to grow that whole ecosystem such that people actually see mobile learning as a viable space to be working in."

This interviewee is describing an expansion not just of the project services or stakeholders or geography but of the *level of the goal*. In other words, the project goal is not just improving people's level of education or language skills or future income but also changing people's perceptions of which tools are appropriate for use in learning. The project continues to develop and test mobile phone applications to help elementary school children learn English. But it also explores mobile phone technology trends, game design (both digital and traditional Indian games), curriculum development, and language acquisition. Beyond that, the project involves intentionally, strategically networking with educational resource providers, funders, and government education officials to promote the use of mobile phones as learning tools. The project involves producing and distributing research results that show the viability and appropriateness of mobile technology for both education and for developing regions. The project has hired a full-time employee in India to facilitate networking and begin laying the foundation for starting either a nonprofit organization or start-up company to promote mobile-based

learning. To summarize, the project scope has expanded not just in tactic but in strategy. It is seeking to change long-held beliefs about what tools are appropriate for use in education.

There seem to be two major causes of this scope expansion. The first cause is the need for a broad support base among stakeholders. For the project to retain the narrow scope of developing mobile-based games to support English language literacy (and for this narrow scope to result in actual educational benefits for students), there would have to be a broad base of support for mobile-based education already in place. For example, there would have to be suitable existing curriculum in schools that the project could use as a basis for game development. Parents and teachers would have to allow children to use mobile phones for educational purposes, which implies that they would view mobile phones as a learning tool and allow children time with these devices. Educational funding sources (governmental and private) would, at best, fund mobile-based education or at least give nominal support to the approach. Educational content providers (curriculum developers, game developers, etc.) would need to support mobile-based learning with the development of additional mobile-based content. However, this broad base of support for mobile-based education does not currently exist. Digital games, much less mobile phone games, are not widely understood and supported as educational tools in developing-world contexts. Therefore, the project scope has broadened to include not just game development but the development of a new perspective on educational tools among these stakeholders.

A second major cause of this scope expansion is the maturing career of the project lead. Before the project officially began, he was a graduate student seeking a research focus. Now the project lead has become a professor at a major research university. Developing mobile phone applications, even beneficial educational games, would be too narrow a research goal for a professor leading a team of graduate and undergraduate students at a major university. The project lead is pursuing this project not only to benefit Indian students learning English and not only to develop his own research, but also to support current and future ICTD students:

> "At this stage as a faculty member, I realized that a bigger challenge is to develop a resource ecosystem around mobile learning and, more probably, to help create that ecosystem for ICTD so that current and future generations of graduate students can actually be doing projects on this."

The mobile-learning project provides an example of both internal factors (e.g., project lead's career) and external factors (e.g., need for broad support) leading to this type of scope expansion (e.g., from providing a tool or service to changing long-held perspectives). This finding is important because, thus far, the motives for scope expansions have originated outside the project development team, for example, with intended beneficiaries or in the surrounding context. Here we see the subtheme of complex motivations (subtheme two under perception and behavior) interacting with scope creep in a new way. The project lead's motivation to continue project involvement over the long term was influenced not only by his desire to support literacy education in

the developing world but also to pursue a research agenda that was appropriate for a faculty member at a major research university.

This finding is particularly interesting considered alongside one of the examples of scope creep from subtheme one. In the project to develop integrated digital and paper-based forms, NGO clients required technical support and customization to actually use the tool developed by the project. However, that scope expansion was incongruent with the project lead's career goals, so he phased out his involvement and handed off to a start-up company. Though he co-founded the company, his interaction with the project has become minimal while he pursues an academic career. Viewed in conjunction with the example of scope expansion from the mobile-based learning project, we see two examples of how a project lead's career can affect ICTD projects.

Another example of a scope expansion from providing information to changing long-held opinions comes from one of the agriculture projects. This project began by seeking to use technology to improve upon existing agricultural extension programs. However, as the project continued, the partner organization providing domain expertise ceased its involvement, and the project lead founded a nonprofit organization to continue the project with new partners across a broader geographical area. In his new role as the founder of a nonprofit organization, the project lead expanded the scope of the project to include both short-term goals (e.g., improving agriculture extension) and long-term goals (e.g., changing perspectives of villagers on the viability of agriculture as a career):

> "Many are migrating away from agriculture due to perceptions about the viability of it as a sustainable livelihood. And now what I think we want to try to do is see how we can try to better address that. So we can, you know, take together both these types of models: on the one hand, this high intensity type of intervention where you get high levels of impact, and at the same time, be able to affect perception of a more kind of large perspective."

Here we see again a project that began with a narrow, straightforward scope expanding to address development not just through the provision of information or technology but also through the changing of people's perceptions and opinions. This example also shows how a particular sustainability strategy—starting a nonprofit organization—affected the project scope. Transitioning this project from research into implementation by founding a nonprofit organization created the need for not only short-term but long-term goals. The approach to long- and short-term planning that this project adopted is continue providing agricultural information through whatever technological and human-mediated means were appropriate for the communities served while adding a long-term goal of affecting these communities' perception of agriculture as a sustainable livelihood.

The next two quotes provide further examples of scope expansions that address long-held beliefs and modes of behavior. First, the job-matching project sought to provide not just an *alternative* way but a *better* way for domestic workers to find jobs and for potential employers to find domestic help. Second, one of the agricultural projects sought to provide information that was valuable enough to farmers that they would pay for it. These examples speak to scope expansions stemming from the value proposition of

the projects for intended beneficiaries—i.e., the challenge in proving value great enough to motivate stakeholder participation when that participation requires changing stakeholder behavior or perspective:

> "Currently, this takes place through small, informal social networks. So like if I want a helper, I would tell my security guard, who knows a friend who lives in a slum. …The system had to have a value proposition over the word of mouth system. …Otherwise, why would these people come to us? Why would they not ask their security guards or their families?"

> "People may not pay so much for only advisory because especially in India for farmers any advice is free. Our history, you know, this government of India program how to improve the crops and everything. People can go to an extension officer who can advise on all those things, and this advice is supposed to be free. So here otherwise people think any advice is usually free."

These quotes show that for the projects to transition from research into a long-term implementation, the project need not only "work" (i.e., provide job listings or agricultural advisory, respectively) but also be perceived as valuable enough for stakeholders to participate, which often requires not *creating* but *changing* perceptions. And changing people's existing perception of what is valuable is no small matter. The first quote from the job-matching project acknowledges that the existing word-of-mouth system seems to work fine for potential employers. For these employers to instead use an online referral (which was the eventual goal, even if it was never developed) would require that the online approach be worth changing their typical way of doing things, which makes use of long-standing socio-cultural networks of relatives, friends, and employees. Thus, the project scope must include not just information provision but value

proposition. The scope was expanded to encourage people to change their established ways of seeking job information. Domestic workers needed little encouragement to explore a new method of job seeking; they already desired more complete information about available jobs that would allow them to select work based on factors such as pay and location. But potential employers seemed content with the word-of-mouth system. To change the way employers sought domestic help (i.e., to participate in the project), potential employers required more incentive: they requested a method of recourse for problematic referrals, a request that was met through contracts. Thus, the scope expansion to include contract development is an example not just of scope subtheme one (scope expansion due to user requests) but also of scope subtheme two (scope expansion to change well-established perceptions and behaviors). It also has obvious connections to the motivation subtheme, as previously discussed.

Similarly, the second quote shows that a significant challenge to one of the agricultural projects is changing people's expectations of who should pay for information—the government or an individual. As the interviewee describes, many farmers expected agricultural information to be available for free because of the long-established, government-run agricultural extension program. The agricultural ICTD project proved through extensive pilot testing that project participation saved farmers an average of a few thousand rupees, but most of the same farmers who experienced that savings through pilot participation were unwilling to pay a fee equal to less than 10 percent of that savings to continue their participation. The project hired an outside source

to research why, and this research found that while people did believe they would save money through participation, they were still unwilling to pay on principle: agricultural information should be free because it has always been free through agricultural extension. The project tried to prove the value of paying for information to little avail. In this example, attempts to change long-held beliefs (by proving financial benefit of paying for information) were unsuccessful. To preserve the project, scope expansion eventually took a different tack and began offering (i.e., trying to sell) farmers additional services beyond information provision, while exploring the possibility of selling information about the farmers to marketers and companies selling agricultural products. (These scope expansions were new and in the "idea stage" at the time of data collection for this study.)

These examples have shown that several projects which began with a scope centered on providing information expanded to encompass a much broader scope of changing commonly accepted perceptions and ways of doing things. This significant scope expansion affected the project timelines, slowing the projects' progression from exploratory research to implementation. As will be discussed in the sustainability section, all seven projects would require years to progress through the exploratory stage and even then, many projects entered long-term implementations with the expectation of continued change. For example, projects transitioned into startup businesses and continued to expand and change their solutions and services. Thus, scope creep and sustainability were closely linked.

In summary, most projects experienced significant expansions in scope, driven largely by user input and the inadequacy of information provision to achieve project goals. Because so many projects were seeking not just to make information available but to improve people's welfare, these projects responded to requests and gaps in capacity by expanding project scope in order to meet the overall project goal. Whereas similar projects outside ICTD might respond to user requests by adding additional services for additional fees or by intentionally retaining a narrow focus, these ICTD projects were largely mission driven and used user centered design approaches to establish the scope. Because these projects sought to improve people's welfare, the scope expanded to accommodate requests from those whose welfare was the project focus.

The findings have shown that these scope expansions were not unfocused efforts tangential to the project but most appeared necessary for project survival. Without these scope expansions, key stakeholders would not have participated, technology would have been useless, or intended users would not have access. That said, these scope expansions did have challenging effects, such as significantly slowing the timeline of a project (as will be discussed in more detail in the sustainability and project management theme). While most of the motivations for scope expansion were external, an interesting internal motivation emerged as well: career goals of the project leaders. Several of the project leaders experienced changes or maturation in their careers over the life of the project, and these changes affected the transition of projects from research to implementation.

Section 2: Scalability

Scalability refers to applying aspects of a project in other contexts. Most references to scalability focused on geographical scaling, though some referred to scaling across development domains. Since scalability is one of two common criteria for success in ICTD projects (i.e., scalability and sustainability), it is not surprising that scalability was a prominent theme across all seven projects. Two interesting subthemes emerged regarding project scalability: (1) the importance of partnerships to scaling and (2) the expectation that people outside the project would take up aspects of the project for their own purposes.

5.2.a Importance of Partnerships to Scaling

The first subtheme is the importance of partnerships to scaling. When participants spoke about efforts to scale up projects, particularly geographically, they repeatedly mentioned the role of partners, advisers, and champions. For example, in discussing plans to roll out or implement a technology-supplemented agricultural extension program, one interviewee described efforts to find partner organizations that were already working in the geographic areas and the particular agricultural sub-domain in which the project wanted to implement:

> "In this deployment phase of the project, it was again about identifying partners who had kind of the scale of operations and scope in terms of, more in terms of domain expertise, in terms of agricultural types of practices and technologies that are going to yield better to the farmer livelihoods."

The quote above is an example from a project seeking particular types of partners to support implementations in preselected geographic and sub-domain areas. While some project operated in this way (i.e., first setting geographic criteria, then seeking partner organizations meeting that criteria), other projects worked in the opposite order: "I didn't really have any specific constraints on which country I would work in other than the fact that there must be a partner on the ground who can help with that sort of thing."

The importance of partnerships was ubiquitous. Whether the ICTD project selected geographic areas in which to seek partners or allowed the geographic region to be driven by partners, interviewees from all seven projects discussed the importance of partnerships to scaling their implementation. The role of these partners varied somewhat, but, as evidenced in the quotes above, projects consistently sought partner organizations that were experts in the development domain: e.g., agriculture, education, microfinance. The project leader and ICTD project team members typically retained a focus on technology, while relying on partnerships to contribute domain expertise.

One of the reasons that partnership building is vital to project scaling is that all seven ICTD projects were led by technologists who partnered with experts in the development domain: "As a set of engineers, we didn't have any development goals of our own. The development was driven by our partners, mainly NGOs, that are working on the ground." Thus, to expand their project into a new region or a new development domain, the technologists-led ICTD projects needed partners not only for networking with government officials and potential beneficiaries, but also to provide or mediate the

information content delivered by the technology: "[Organization name] was our first partner; they were answering questions. New partners are quite recent. Why get new partners? We cannot [otherwise] scale the project." Only the mobile-learning project sought to develop internal expertise in the development domain, and one other project brought some domain experts into the project team, while continuing to partner with outside domain experts to support scaling.

During the progression of the projects from exploratory research into a more long-term implementation, most projects preserved a division of expertise, looking outside the ICTD team for domain experts. This division of labor seemed to work well across the projects, with project leads, team members, and partner organizations reporting beneficial interactions. For example, in two of the three agricultural projects, the partner organizations had pre-existing and ongoing interactions with local farmers, which provided beneficial knowledge not just of local agriculture but of users and their needs. The partners communicated frequently with ICTD project leads and team members, suggesting additional services or information paths, like SMS messages.

In addition to supplying domain knowledge and preexisting relationships with users, some partners served another useful role: advocate. For example, one of the partners for the mobile-learning project served as liaison between the ICTD project and government officials, as well as with local parents and school officials:

> "They [the partner NGOs] go to the government people and ask for approval, and I don't do that. They speak to the parents and the headmaster that I can't do because of their standing in society and in these villages. He's a professor, and

> he's got this respect going on. I have not even spoken to a government official. The government officials know him, and he can get approved in a snap of the fingers."

This advocate role was particularly important for projects led by researchers living outside of India because seeking approval from stakeholder groups is largely a face-to-face endeavor. As implied in the above quote by a project's sole full-time, in-country representative (a young female), she does not command the same respect from government officials and community members that the partner does. The partner organization is led by a physics professor who is well-known and highly respected for his work with an educational NGO. Thus, the relationship with this partner organization, and specifically its leader, is useful not only for extending the project knowledge in the development domain (English literacy education) and not just in gaining a better understanding of users (elementary school children and the adults supervising their education) but also in securing the necessary approval and support to move the project forward.

Particularly for projects that have expanded their scope beyond information provision and into changing long-established beliefs and behaviors, having partners who play an advocate role is vital to scaling. Advocates who can build upon existing ties within a community can secure the necessary approvals for a project about which stakeholders may initially feel skeptical. In other words, partners can be useful to scaling efforts because they lend their own credibility to the project, increasing the trust of local

community members in the project and therefore increasing their likelihood of participation. Thus, this subtheme (importance of partnerships to scaling) has important links to the first subtheme within perceptions and behavior (importance of trust and credibility building), which is discussed in more detail in the perceptions and behavior section.

Projects sought multiple partnerships as they shifted focus from limited pilot testing to a broader implementation. To provide a range of benefits, projects often sought new partner organizations that varied in size and type (e.g., NGOs, government organizations):

> "We essentially started up many additional pilot sites across various parts of the country so that we could work with different types of partners, some who might be more similar to a public type of institution—relatively large, relatively bureaucratic—some that were small—more like community-based organizations—and some that were kind of like in between."

> "One aspect may be about trying to involve a greater set of types of people into the system. So at the current moment we're mostly focused on NGO organizations of different types of scale of integration and integrating with them. But eventually we'll start trying to work with government institutions and legislative institutions."

Seeking a range of partnerships, as mentioned above, was an important strategy for projects seeking to scale up. Several projects discovered that they would need different partners or additional partners to scale the projects. In other words, the ideal partner for exploratory work was not necessarily the ideal partner for long-term implementation—not if that implementation plan included scaling over a large

geographical area. The early exploratory work required partners that were small enough to collaborate closely and to respond agilely to feedback in modifying early approaches. But long-term implementations required much larger partners to support project expansion over a broad geographical area. In some cases, the push to scale prompted project members to recruit additional partners, while maintaining a close relationship with the early partner:

> "We have already pulled in two of the universities in the country: one university in the south, and there is one university in the north, and one international institute involved with the panel of experts with [project name]. So as of today, given more number of questions coming in, we should be able to manage."

In some cases, the push to scale led to a cessation of the early partnership:

> "The expectation from [project name] was that we [the NGO partner] should scale up, for which our organization was not big enough. We have a very small organization; we did not have the kind of resources that they expected that we would match… So we had to tell them, 'No, our projects are very small. We don't have resources to match those things.' So right now we have put it on hold."

And in some cases, the inability to scale using the original partner or to make adequate additional partnerships contributed to the end of the project altogether:

> "The reason that the project, well, I wouldn't say died, but well. With one NGO, I think that we cannot work with the whole of Bangalore. It is not possible for us to sort of establish connections with NGOs all over the city."

This first scalability subtheme (the importance of partnerships to scalability) has some interesting implications. It identifies quite a strong trend across ICTD projects: relying on partner organizations to provide domain expertise. On the one hand, this

approach helps to limit one possible avenue of scope creep; if partner organizations provide domain expertise, that is one less demand on the ICTD project. As discussed in the scope creep section, demands to expand scope are not only high but largely valid and necessary, so "outsourcing" some of the necessary expertise for a project is a useful strategy. On the other hand, it makes the project more vulnerable, since one of the two major thrusts of the project (the "development" part of information and communication technology *for development*) lies outside the project team. While projects need not retain the original partner, they must have *some* partner within the development domain. And developing and maintaining these partnerships can be difficult and time consuming: "ICTD projects are more challenging to do because one of those important aspects is partnership development. You spend a lot of time building relationships with prospective partners." However, as the examples of partner advocates have shown, having partner organizations with a strong sense of buy-in and support for an ICTD project is extremely beneficial.

5.2.b Indirect Approaches to Project Scaling

The second subtheme under scalability is the expectation that, at least to some extent, project scaling would occur outside the original project. In other words, in addition to scaling up the original project, another scalability strategy included sharing much of the knowledge generated in the ICTD project with others who may apply the knowledge in new ways, building upon and extending aspects of the original ICTD project. This subtheme emerged in six of the seven projects. Whereas the first subtheme

relates to efforts to scale the original project, the second subtheme relates to influencing other projects. In other words, the second subtheme involves a different type of scaling in which people unassociated with the original project adopt aspects of the original project for their own purposes, in this way scaling up approaches, technologies, or programs from the original project.

Several projects sought this indirect scaling strategy from the beginning of the projects:

> "What we wanted to do was that, even in the beginning, was that if [project name] is successful, that organizations, whether they are NGOs or government institutions or private players, that they'll be able to take aspects of this system and be able to run it for themselves."

> "Others must build their own solutions based on our general device. It was never our goal to attack these problems ourselves."

The quotes above indicate not only that projects intended to share their knowledge with others who would build upon it for their own purposes, but also that this indirect approach to scaling can serve as another way to reduce demands on the original ICTD project. In the first quote, the project lead of one of the agricultural projects implies this benefit by saying that organizations taking up aspects of his original project will "be able to run it for themselves." In other words, not only will these other organizations and the farmers they serve benefit from adopting and adapting aspects of the original ICTD project, but because they will run the efforts themselves, the original ICTD project will not bear the burden of managing these efforts. The second quote is even more direct. An

interviewee from the project to develop locally designed information technology explains that the project scope never included developing all the necessary applications and customizations for users. The project sought instead to do the initial work, developing hardware and software that would be released into the public domain 18 months after launch. The project sought to scale its locally designed technology across domains and users through an indirect scaling strategy: making the IP publically available for others to adopt and adapt it to their own needs.

The project that developed integrated digital and paper-based forms similarly sought to scale indirectly (i.e., through influencing other projects):

> "Various people were getting [project name] in different ways..., and there were a number of follow-on open source efforts that built their own systems that are arguably more complete and richer than [project name]."

The locally designed technology project (Project 4) and the project to integrate digital and paper-based forms (Project 5) were similar in that they were led by academic researchers who developed a general technology that could be customized for a variety of applications in different domains. However, the projects experienced very different levels of success in their indirect scaling efforts. While Project 5 seems to have scaled both its technology design and overall concept through several additional projects, Project 4 did not experience the widespread adoption and adaptation it sought. The data suggests that the difference in the success of the indirect scaling relate to three key differences: (1) the

people expected to modify the original technology, (2) the project timing, and (3) the project leads' careers.

First, Project 5 (the integrated digital and paper-based forms project) sought to proliferate the knowledge generated by the project primarily within academia, sharing designs and results through publications, conference presentations, and conversations with ICTD researchers and activists who had technological expertise. These efforts to scale indirectly by influencing others' work (i.e., research impact) was an important criterion of project success in the eyes of the project lead:

> "Those ideas have also proliferated really well: the replications of that pattern or that model in lots of different applications, in lots of different technologies. From a research perspective, I think that's good impact, so I think that has worked fairly well, too. I would consider it a success both in terms of [development] impact and in terms of research impact."

In contrast, a major knowledge-sharing strategy of Project 4 (the locally designed technology project) involved putting the project's intellectual property into the public domain 18 months after product launch. This strategy was arguably more passive and unfocused than actively sharing the project knowledge in venues already attracting people in the ICTD field (such as conferences, blogs, and journals). The ICTD community is, by definition, seeking ways to use technology to solve development problems. Thus, this community was already seeking relevant work to inform their own efforts. But rather than pushing its information to a specific community, Project 4 used

more of a "pull" strategy: it passively made the information available to anyone who sought it.

However, ending the comparison between these projects with the first key difference would be misleading. The ICTD community targeted by Project 5 and the venues used to target this community were largely unavailable to Project 4 because of the second key difference: timing. Project 4 began in the late 1990's, when the ICTD field was new and knowledge-sharing venues were extremely limited. For example, in 1999 only two ICTD-specific journals existed, publishing a total of 33 articles that year (Heeks, 2010). Targeting ICTD researchers to build upon Project 4's work would have been difficult due to both the limited venues and the small number of people in the budding field at that time. In contrast, Project 5 began approximately five years later, and those were key years for the growth of the ICTD field. For example, leading ICTD scholar Richard Heeks estimates an annual growth rate of 39 percent for ICTD publications from 1999 to 2008 (2010), a statistic that is useful for estimating the growth and maturity of the field more broadly. Thus, a mere five years' difference between the starting dates of Project 4 and Project 5 translate to quite a large difference in the maturity of the field and therefore the possible venues for indirect scaling efforts.

The third major difference affecting the indirect scaling efforts of these projects is the careers of the respective project leads. Project 5 was led by a graduate student at a U.S. research university. Over the course of the project, this student co-founded a company and began an academic career as a professor at another major U.S. research

university. He primarily focused on his academic career, which requires a high number of research publications, and he handed off the ICTD project to his start-up company. Thus, he remained free to pursue indirect scaling efforts in a targeted way by sharing knowledge and generating research impact within the ICTD academic community. In contrast, the project lead of the locally designed technology project was one of the first professors at an Indian university seeking to retain his academic position while also pursuing a start-up business:

> "The thing that did not exist is for a faculty to take, to start a company where faculty can own equity in the company.... So we created that linkage. So prior to that, faculty, if you want to start a company, then you leave faculty and start the company or stop thinking about the company. Those are your two choices. That was in 2000."

He was successful in persuading his university employer to develop new policies that would allow him to retain his academic career while commercializing technologies through his own start-up business. However, pioneering this new career path (simultaneously being a professor and company owner) required time, effort, and energy that was not required of the other project lead. Further, he discovered a tradeoff in his attempts to engage with local industry and retain his high publication record:

> "For the transfer of technology to industry to happen, it has to be of interest to industry, but unfortunately, what is of interest to local industry is not of interest to international journals. So you cannot publish your work and also transfer technology. So you choose."

The leader of Project 4 eventually chose to leave academia altogether, seeking to scale his project indirectly (i.e., through others' customizations) by putting his company's designs into the public domain. As this discussion shows, this less-focused strategy (compared to pursuing indirect scaling through the ICTD academic community) stemmed in part from timing (i.e., the ICTD field was too new to have much of a community) and in part from his career path (i.e., pioneering a joint industry-academic role that was difficult to sustain). The project lead still believes that it is not feasible for a professor at an Indian institution to pursue ICTD efforts without having a strong commercialization focus, a belief that would be interesting to explore in future research.

In the extended example above, we have seen two strategies for indirectly scaling ICTD projects: academic publications in the ICTD field and making IP publically available. Many of the projects in this study used some combination of these strategies to indirectly scale their projects through others' efforts. One common approach to encouraging others to scale aspects of the project for their own uses was to design open-source technologies that could be easily modified by others:

> "[Project name] was from day one designed to be an open-source solution... Anybody can use it."

> "With [project name], for instance, that's part of why we make this sort of open source goal explicit from the start. We're working to make service learning experiences something that can contribute to an open source code base that could continue on a variety of different platforms."

The open-source approach has offered mixed success, since many of the envisioned users (such as those from Project 4) were not tech savvy enough to repurpose the technology or customize their own solutions. This challenge became a sustainability opportunity for some projects, which worked with users who requested customized solutions. Many of these users represented organizations such as NGOs or government agencies that could pay for solutions, which had implications for the next theme to be discussed below: project management and sustainability.

In summary, the scalability theme highlights the importance of involvement from stakeholders outside the ICTD project itself. The first subtheme (the importance of partnerships) shows the valuable contributions made to ICTD project scaling efforts by partner organizations. These organizations contribute locally specific domain knowledge that allows projects to be scaled up into those localities, and partner organizations often lend their own credibility to ICTD project efforts, easing entry of the project into new communities. In addition, we see that relationships with partners often change over time, as projects transition from exploratory research into implementations that are being scaled up into larger geographic areas. Some of the qualities that make a partner ideal for exploratory research (e.g., agility and flexibility) are not the same qualities that make a partner ideal for scaling efforts (e.g., an extended geographic reach). That said, three qualities of beneficial partners that appeared to be important regardless of project status were (1) domain expertise, (2) existing ties with intended beneficiaries and/or authorities, and (3) a strong sense of buy-in to the ICTD project and its goal.

We have also seen that many projects sought to scale their projects indirectly, i.e., by sharing knowledge with others who would adapt aspects of the project for other uses. This is an important finding because it represents the concept of scalability in a unique way that, thus far, has been missing from ICTD literature. Two main strategies for this indirect scaling were (1) targeting the ICTD community by sharing knowledge through publications, conferences, blogs, and professional networking and (2) making IP available, largely through open-source technologies. Both scalability subthemes interrelate with the concept of scoping, as they represent ways to curb an aspect of scope creep. Subtheme one illustrates not just the value of partnerships but also aspects of the project scope that can be addressed by sources outside of the ICTD team. Similarly, subtheme two shows that one way for an ICTD project to scale is through influence and knowledge sharing. Allowing others to take up aspects of the project and apply them not only increases scaling but reduces demands on the original ICTD project.

Section 3: Project Management and Sustainability

Sustainability involves a project continuing to exist over time. Participants from all seven projects mentioned sustainability in reflecting upon the project progression from exploratory research to long-term implementation. In fact, sustainability as defined here is centrally relevant to project progression, since progression occurs over time. The project management and sustainability theme comprised a number of interesting subthemes, two of which are explored in detail below: (1) the length of time required for

a project to progress to and through exploratory research and approach implementation and (2) the expectation that changes would continue to occur to the project over the long term.

5.3.a Lengthy Transition Timelines

The first subtheme is that the timeline for projects to progress through exploratory research took several years. I would claim that all seven projects support this subtheme because although one project existed for only one year, that year was insufficient to fully develop a process or approach that could be implement over the long term—let alone to develop the technology to support that process. The technology was not even attempted during that first year. Although a lengthy timeline was ubiquitous, it was not an intentional aspect of the projects:

> "You know, I don't think that we ever did any really good chronic management or any good timeline until we got more towards the end of the project."
>
> "Still I believe the vision of [project name] is very, very good. But we didn't have a focused road map."
>
> "A lot of this is organic. A lot of things that happen in [project name] really just happen through fate or by chance. Well, you can call it destiny if you want, but it wasn't due to me specifically thinking that we need to do this."

There were several common reasons for the lengthy project timelines. First, agricultural projects required that pilot studies follow the crop cycle at least once if not more to test a single idea:

> "So especially in agriculture you know, it's important that for an evaluation of any agricultural type of intervention that you give enough time because there are so many variables external or internal to agriculture, things that are beyond your control like weather patterns or like pasture disease crisis that might occur. So in general, agriculture interventions are typically measured in terms of doing like research study over a period of 4 to 5 years or longer."

Three of the seven projects in this study were agricultural ICTD projects. All three of them underwent lengthy pilot phases, to test not the technology but the use of technology as a component of an agriculturally focused development project. In other words, testing the technical feasibility of an online forum for asking and answering agricultural questions did not require a long time, but building relationships with farmers and gathering information about the effects of the forum on farmers' crops and livelihoods did. Because so many factors, such as weather, seed quality, and soil condition, can affect crop yield, it is difficult to test the influence of agricultural ICTD projects with much certainty. Thus, ideally, agricultural ICTD projects will have multi-year pilot periods to better evaluate the impact of the project. It is not the "ICT" part but the "D" that requires a lengthy test period.

Another reason for lengthy project timelines was slow or undependable funding. For example, one of the sustainability strategies of the locally designed technology project was to sell its device to government organizations. This approach seemed ideal because government organizations would generally pay a higher price than industry and private customers and because government organizations would purchase in large quantities. However, project members learned through experience that securing a

government contract, while lucrative, would take so long that many small start-up companies would go out of business before the contact finalized and payment arrived:

> "We underestimated the time for the Indian government to work. Suppose we had a proposal from Tamil Nadu [an Indian state] electricity devices. From the RFP [request for proposal] to the time they would sign the contract is 3-5 years. For a start up, it just won't work. Unfortunately, that's not uncommon with other bodies of the government. We didn't realize it would take so long, so we'd develop prototypes and software to meet these needs."

This delayed funding extended the project timeline because the project team kept modifying the technology design to meet the needs of potential government clients. One of the agricultural projects had a similar experience, unnecessarily extending its timeline due to efforts to meet changing requests and requirements from funding sources:

> "See, generally this whole area of ICT for development has interesting characteristic to it where if you go and ask an end user, 'Will you use this technology when it becomes available?' They, he or she, will nod their head, saying 'sure.' Similarly, when a large corporation which has, or which wants to work in the area and you want to partner with them, they will say, 'Sure, we want to partner with you if you do X, Y, and Z.' If you do X, Y, and Z, either they have moved on to doing something else, or who knows what happens in between."

As described in the quote above, when the ICTD project sought to partner with a for-profit company seeking to move into the agricultural arena, the company initially expressed interest in partnering but only if the ICTD project would do certain things, make certain changes. However, after the project met these requirements, the company had moved on to other opportunities, taking its funding and influence with it. Not only did the ICTD project lose time in pursing the relationship but also in making the

requested changes without achieving a partnership that would offer important funding to sustain the project.

The quote below illustrates the effects of limited pilot funding on another project's timeline. An interviewee from the project to integrate digital and paper-based forms felt that the time spent on initial technology design was unnecessarily long and could have been shortened if there were funding to support large scale testing:

> "Well, I think the process, what we call the technology incubation process and the design process and research process, was a very, very long drawn process. It took a lot of time. And I think probably the problem was to have financial support for taking up large scale testing and implementation, so think we were lacking in that area, and had we been able to do that, we would have been able to do 3 or 4 demonstration pilots and, hence, would have a better solution at a faster timeline to be able to offer it commercially."

These examples have shown that difficulty in securing funding was a common barrier to quick project transitions. One project repeatedly modified its technology solution for clients that took years to finalize an order. Another project pursued corporate partners that lost interest in the project, and a third example project spent years on early design and testing because the pilot budget was so limited. This lengthy research and design slowed the overall project effort, delaying the ability to charge NGOs for a final solution. Lack of funding in general and lack of reliable, long-term funding in particular are common woes in ICTD. However, the finding reported here is important because it illustrates a specific effect of this unavailable, unreliable funding: lengthy project timelines. Due to limited or unreliable funding, projects that may have otherwise

transitioned more quickly from research into implementation were instead repeatedly cycling through design modifications, making unnecessary and unfruitful project changes, and slowly exploring research and design in limited pilot efforts.

Another common contributor to the lengthy timeline was resource gaps, either in terms of infrastructure like a high-quality local manufacturing industry, or in terms of human capacity, like technology skills. For example, one of the projects required hardware to be manufactured, but electronics manufacturers in India were almost nonexistent at the time. The project partnered with a public sector manufacturer that had a monopoly on defense manufacturing. This manufacturer lacked both the expertise and the urgency to meet the project expectations:

> "The thing is [manufacturer name] is a public sector company, okay? And their people don't have that much of enthusiasm to get things done in time, but whereas [project name] was a private company and time pressures here and time pressures there are totally different."

Another example comes from the job-matching project, which was impeded by a lack of technology support—a human capacity gap. Even if the technology for this project had been developed and developed successfully and implemented successfully, it would still require humans with sufficient technology skills to update the database of available jobs and domestic worker profiles and to troubleshoot any problems. Thus transitioning this project into a long-term implementation would require technical support, and that support was not readily available:

> "Who is going to handle the database? And the NGO itself does not do much technology. They do not have the technology expertise to handle a computer-based system, so you will have to bring another stakeholder: a bigger NGO for better things, a technology company or organization."

Human capacity gaps also slowed the long-term implementation of the agricultural projects, particularly when these projects sought to geographically scale up. For example, an interviewee with an agricultural extension project said that even once the technology solution was fully developed and had proved useful, numerous additional resources were required to sustain the implementation, many of these resources human centered and not easily mobile across rural communities:

> "In spite of the fact that there was this equipment, ICT, lot of human inputs were also needed. Human resources. People who understand it, to take it forward. See, and given the fact that the villages have very poor infrastructure, and people commuting from one place to another, all this is very difficult."

One example of human resources required for transition into long-term implementation is region-specific domain knowledge and language skills. An interviewee from another of the agricultural projects said the project was slow to offer information in additional languages not because of technical barriers but because of human barriers. Without agricultural experts who had both local language skills and local agricultural knowledge, the project could not progress into the national-level implementation that was the goal:

> "We have only a few experts; two are from Maharashtra [an Indian state]. We don't have a lot of experts from other places. If we employ experts from all over India, we can expand languages."

In summary, all seven projects took several years to even approach a long-term implementation. The sustainability of projects was slowed by several common factors: agricultural cycles, slow or undependable funding, and resource gaps. This third factor overlaps with the scope creep subtheme: the scope of many projects expanded to fill the infrastructure and human capacity gaps that were slowing their progress toward a long-term implementation. For example, as described in the scope creep section, when one university-hosted agricultural ICTD project was impeded by a lack of trained agricultural experts, it founded a new agricultural program at the university. Expanding the project scope in this way does address the gaps that could otherwise end the project, but it also slows the project timeline significantly. Testing the impact of agricultural interventions, pursuing funding, and filling resource gaps were all necessary efforts for ICTD projects. However, these necessary efforts greatly slowed the project timelines, resulting in all seven project requiring years of work before approaching a final implementation.

5.3.b Expectations of Change

The second subtheme in sustainability may be counterintuitive at first glance: project members expected the project to continually change, even after it transitioned into long-term implementation. While exploratory research by definition implies continual change over the course of the exploration, a long-term implementation may seem to imply a cessation of that change: i.e., the exploratory research has led to a discovery of the best way to achieve the project goal, so the long-term implementation now sustains that way of achieving the goal. However, interviewees from six of the seven projects

expressed expectations of continual change, often in the form of customizing aspects of the project for certain users. For many project members, this expectation of continual change was not initially present. Initially, the early research efforts of several projects focused on developing one solution that would be the final solution for any user:

> "When we came up with this product, we wanted it originally to be one for all. So we wanted to have all features with which we could address all requirements. That was the idea."

> "It [progressing through an ICTD project] really means that you change the way you think from becoming an HCI guy or computer science guy who will come up with a perfect, killer application—and a lot of computer scientists think like that."

The above quotes by technologists involved with two different projects show their early expectations of a project end point. They initially expected to develop a technology-based solution (e.g., a "one for all" product or "perfect, killer application") that would meet the project goal. Once the project developed that technology-based solution, they thought, the technology could be implemented across contexts, users, and organizations. However, these technologists discovered that to meet project goals of improving people's welfare, the project would continue to change over time because different users and contexts had different requirements.

Over time, project members discovered that, instead of trying to design a one-for-all technology, a more effective strategy for sustaining the project was to design easily customized technologies and approaches, with the expectation of working with each client or group of users to finalize the design: "We talk to them, see the requirements, and

build what they want." A consistent theme was that instead of designing a single, complete technology, the project would develop modular technologies that could be customized or modified:

> "Different organizations have very different ways of doing things. The technology needs to be designed such that it is actually tailored for those kinds of practices."

> "I was working with [project lead] on technical aspects and also on implementation part. So on technical aspects, it's like customizing, maybe for a particular client to their needs....I used to do small changes or regular changes according to the contract and then implement with the augmentations."

> "It's again the same kind of process where you start with a specific user population and specific operating context. But in the back of your mind, from your own experiences and things you've read, you're thinking about how that experience would apply in other places...As you start coming up with different things, more and more requirements, some things carry over, and some things don't... You just want to have good modularity."

We see a different type of mindset reflected in the above quotes. Rather than seeking a final, one-for-all technology, we see projects shifting their sustainability strategy to develop easily customizable technologies. This new sustainability strategy implies working with each user group to customize the technology and, thus, to continually change the project, as driven by each customer or user group.

As a variation on this theme, one project developed different versions of a single solution as part of a strategy for securing government customers and taking advantage of the government's slow funding timelines:

> "Because of government change, politics, there are delays. So we can buy at least three, four months time now. So though there is opportunity, we have all sort of signed on a contract. …So we have two designs in place. This is the basic; we've got the zero model. We have our model which is ready but is not our targeted profit period. …The idea is to make profit; there is no question about that."

Unlike the previous examples in which projects planned to modify their technology designs to suit each user group, this example shows a project that planned to modify its technology designs for a single paying customer. The rationale is explained below. This project team, now employees of a for-profit business, expected to continually modify its solution—even after securing a signed contract from the government agencies which comprised the customer base. The project team created a design that met customer requirements but cost more to make than the agreed-upon price. Then after contracts were signed, the project team continued iterative design and development, taking advantage of the expected delay between order and payment, to focus on developing versions with similar capabilities at lower cost. This reason for developing several versions of a solution was unique; only one project purposely secured orders for a device they intended to modify during what had become an expected funding delay. But it provides an interesting example of overlap among subthemes. All projects, including this one, experienced funding delays that stretched their project timelines far beyond what was initially expected. However, over time, this project built into its sustainability strategy an important use of that time: continued design of the solution.

While some projects adopted a sustainability strategy of developing modular or customizable technologies, other projects adopted a sustainability strategy of continually seeking new project offerings. This exploratory approach continued even after a startup business or nonprofit organization had been created to sustain the long-term implementation. For example, the quote below is from the president of a start-up company founded by one of the agricultural projects. This company president is describing his sustainability strategy, which involves continually seeking new products and services that the project can offer farmers:

> "[To find new ideas, we look at products] which are already selling in some parts of India and then we need to retarget. For example, products which are made for rich farmers would not work at a BOP [bottom of the pyramid], which is where most of the farmers get products. So it's an evolutionary process for them, and we are also evolving and redesigning their products."

Similarly, the quote below is from the head of a nonprofit organization founded to carry forward another of the agricultural projects. Here he describes the project intention to fix the development goal while remaining fluid in the project approach to achieving it:

> "First, you know, there's a very clear development objective where we're really open-minded about, you know, what the technology or approach that is taken is, as long as we're seeing the developmental impact at the end."

The above examples are interesting because they convey an exploratory mindset that has continued to drive these projects, even after permanent organizations have been founded to sustain the projects. These organizations (e.g., the startup business and the nonprofit organization) exist not to repeatedly implement the same approach with every

user group but instead to support the continued exploration of how to serve user groups. In other words, project leaders released expectations of a "final" project approach and instead embraced a sustainability strategy that requires flexibility and customization. Projects continued to change in response to a range of stimuli: e.g., shifting technology trends and advances, funding opportunities, and requests from partner organizations or intended beneficiaries. This sustainability strategy implies intentional, continual change—an exploratory mindset.

Another sustainability strategy was to continually develop additional means of conveying the same information: for example, using websites, kiosks, SMS messages, interactive posters, voice calling, human mediation, and several versions of a single hardware design. Continuing to develop a range of options or paths to the information was an intentional strategy for five projects that had founded organizations (four businesses and one nonprofit organization) to carry forward the project over the long term. Some projects that transitioned into a for-profit startup business used this range of information paths to guarantee information access to paying customers. These customers may access information or services through different means because, for example, their Internet connection is unstable or unavailable in their village, the human mediator is delayed because of a holiday, or they have inconsistent access to a mobile phone that is borrowed or shared.

In summary, six of the seven projects adopted sustainability strategies that involved the project continuing to change over time—even after the project had founded

a nonprofit organization or started a business to carry the project forward. These sustainability strategies included developing customizable or modular technologies that would be adapted for particular user groups (including paying customers like government organizations and local beneficiaries like the farmers of a particular rural community). Another common approach was continually seeking new offerings to add to the project. This strategy was the least focused of the three strategies, since it did not necessarily build upon core efforts (like modifying a previously developed technology) but instead cast about within the development domain for new services, products, or offerings that could support the development goal. A final sustainability strategy that involved continual change was developing new paths to access information and services, paths that would accommodate the fluctuating resources available to users/customers. Identifying these common sustainability strategies is a useful contribution to ICTD literature because discussion of sustainability strategies is often limited to a post-mortem analysis of the failure of a single case study (for example, see Brand & Schwittay, 2006). In contrast, this study identifies some common strategies across disparate ICTD projects. By explicitly describing these strategies, this study presents the strategies for consideration by future ICTD project leaders who desire to transition research findings into a sustainable implementation.

Further, this contribution is useful because it identifies some of the benefits of these sustainability strategies, such as meeting the specific needs of individual user groups while building upon the project's work thus far (strategy 1: modular technology)

and enabling users to access important information in an environment with not only limited but fluctuating resources (strategy 3: multiple information paths). Considered alongside the scope creep theme, the findings from the sustainability theme also convey some of the drawbacks of these sustainability strategies: e.g., working with user groups to identify their needs and modify technologies to be appropriate for each group increases the project scope and extends the project timeline. Future work could build upon these findings by analyzing the outcomes of each strategy to convey a more specific and prescriptive recommendation for future ICTD projects.

Section 4: Perceptions and Behavior

The perceptions and behavior theme focuses on how people's perceptions, emotions, mental models, and expectations affected the project, influencing their own behavior and/or that of others. This theme contained more unique examples and instances ("one offs") than the other themes, but it contained two very prevalent subthemes that are discussed in this section: (1) the importance of trust and credibility, and (2) motivation to get or stay involved with the project.

5.4.a Influence of Trust and Credibility

The first subtheme within perceptions and behavior is the influence of trust and credibility on the project. All seven projects referenced this subtheme, illustrating how trust and credibility influence a variety of project factors such as technology design, sustainability strategy, and ability to scale. For example, one project struggled with how

to design a scalable ICT because the existing level of trust among users affected what they wanted in an interface:

> "The field agent which comes to the groups has a lot of trust and confidence in the group workers and likewise. So what happens is that they would like to skip some steps which are part of security…So that kind of thing when we tried to implement in a commercial scenario, there the trust may not be there, essentially. So you have to have an authentication system which cannot be circumvented by the field agent."

In other words, the project's exploratory research discovered that user groups with high levels of trust did not want to be slowed by security procedures, whereas contexts of use in which users did not have such high levels of trust would require the security procedures. Thus, trust affected both the technology design and scalability.

Participants discussed trust and credibility in a range of ways: for example, describing the effects of a lack of trust, the value of having a deep rapport between project members and partner organizations, and the strategies for achieving credibility. Several participants mentioned the importance of domain experts appearing credible to intended beneficiaries:

> "So when we started delivering the advice, the first two months we delivered the expert advice, farmers were not following any advice… Farmers are fearing this is kind of children delivering advices. These are experienced agriculture experts, actually. I employ people at the university, but farmers think that unless he is senior, he can't deliver expert advice."

To build credibility with these farmers, the project lead hired two buses to bring the farmers from their village to the project lab. The farmers met the agricultural

scientists who were the domain experts and saw the ICT equipment being used. Their fears that college kids were providing non-credible advice were allayed, and the farmers began following the advice.

Another project employed an almost identical credibility-building strategy:

> "...credibility is important. So if I know that an expert is answering the question I have, then I believe in the answers. We used to run workshops where we would take experts to the areas where are most prominent in the questioning, the people who asked us."

Thus, instead of taking farmers to the domain experts, this project built credibility by taking the domain experts to the farmers. In both projects, meeting domain experts face to face allayed the concerns of farmers and built the trust required for them to apply the experts' advice.

After that initial trust was built, further trust-building efforts were less strenuous and better suited to scaling. Specifically, these later trust-building strategies did not require face-to-face meetings but could use technology-based strategies like posting online photos of agricultural experts and making use of strong socio-cultural networks that serve as traditional information sources. In other words, the project could build upon a good reputation because farmers who trusted the project would tell their friends, neighbors, and relatives.

> "This [bringing domain experts to villages to meet farmers] doesn't scale very easily. So we put up photographs, pictures of experts on the web. ...An example is the Voice [project name]. We were thinking we would have the experts recorded in their own voice, with a mail attached to it, to help farmers see it as more credible."

> "After proving by first year, then we don't bring all the farmers. Now we don't need, actually… now what will happen, a few top farmers will we bring to [project name] lab and show them."

Participants from five projects mentioned the importance of building credibility not only through the direct experience of stakeholders but also indirectly, for example by reputation or through advocates. For example, one project used local farmers to demonstrate farming techniques to their peers because the adoption rates for those techniques would increase greatly when farmers saw someone they knew advocating for the new approaches. Similarly, a participant involved with a different project described an effort to warn farmers of imminent rain that could damage their wheat crop. This participant said that those farmers who trusted the message and threshed their wheat immediately were the best proponents of the project in their communities: "These are the people who acted upon it. These are the people who are going to spread the word faster." But the project credibility was also enhanced among farmers who ignored the message because the warning proved true:

> "Those who did not believe in it—that is the other side of the coin—who did not believe on it and did not act upon it, they had their wheat in the field, which got wet and which got hampered. The next time they get such message, I am sure they are going to act upon it. In the previous experience, they learned that I should have done what the people sending the message want me to do. It's not just useful for those who acted upon it but it was also useful for those who did not act upon it."

A similar example of credibility building through advocates came from a participant who described the benefits of partners advocating for a project:

> "It helps a lot if you have some credible NGO people also who can actually help to advocate for our mission in the NGO world and who have a huge connection, a huge group of contacts among other NGOs because that helps us a lot when we want to think about expending the projects to work with more NGOs."

This example highlights connections between credibility and scalability, specifically the value of building credibility through partners who advocate for the project among other organizations that may support scaling efforts. A participant from a different project gave an interesting example of how enthusiastic partners can help build the reputation of a project:

> "Almost any time they [the partner organization] talk about themselves, one component they talk about is [project name]. In fact, the chairman of the planning commission—the planning commission is involved in creating a 5-year plan for India, a very important Indian organization—so he came to [the Indian university employing the project lead], and the director asked me to bring him here to the lab, and I said, 'I'll show you one of our systems,' and he said, 'Oh, I've already seen it.'"

This government official had recently visited one of the project's partner organizations, members of which enthusiastically described the project. Thus, the credibility of the project was enhanced by not only project team members but by partner organizations which advocated for the project.

Several participants also linked credibility to scope. For example, in both of the two projects that experienced a significant narrowing of scope, credibility concerns played a major role in scoping decisions, the role of motivating a narrower project scope.

This finding is particularly interesting because it involves some of the only examples of scope *narrowing* seen across the data from all seven projects:

> "We wanted to be all things to anybody. So we built a very simple system: anybody can ask any question; anybody can answer…Then we realized that authenticity is important, authentication is important, and to do that, you have to focus…One lesson we learned was that we have to be modest...[in] the number of questions we can expect to be answered in a way that people will believe the answers."

> "We can do something because we are computer scientists; we are technologists….We should be able to build a universal access device and show that we can do something and once we have something, that will actually fill one part of the need. So we were looking at the access device as one part we can tackle credibly."

In addition to scalability and scoping, credibility also affected sustainability strategies. Project sustainability requires financial stability, which the leaders of one of the agricultural projects believed could be achieved through ICT hubs offering a comprehensive range of government and private services for a fee. To manage the complex array of partnerships and meet the needs of local users, an aggregator—a charismatic individual or an influential organization—would be required. As a central component of the project sustainability strategy, project leaders were seeking "…an aggregator who has the credibility" to fill such a role. One participant said that finding an individual or organization with the right credibility was challenging because the aggregator must be business savvy enough to coordinate public-private partnerships yet

ethical enough to act as a "conscience keeper" who would ensure that the services needed by rural people are the services being provided.

Another example of credibility affecting sustainability strategies is when a different project transitioned into a startup business to increase its credibility in the eyes of potential customers and investors:

> "When we tried to get commercial customers like [organization name] and people like that, they wouldn't take us seriously because we were a research project in a lab…That was one of the primary movers, triggers. It took us a while to start [startup business name], but we realized that until we do that, people don't take us seriously."

In summary, trust and credibility proved vital to the existence of all seven projects; without concerted efforts to build trust, project could not survive because local beneficiaries would not participate, funders would not contribute, and paying customers would not purchase. This subtheme related to others in all three of the remaining themes by affecting scope creep, scalability, and project management and sustainability. Projects discovered the importance of building trust with local beneficiaries and of building upon their partners' credibility to create new relationships to enable scaling. As projects sought to establish the long-term implementation of the project, they encountered challenges with building credibility with investors, customers, and partners.

5.4.b Complex Motivations for Project Involvement

The second subtheme in perceptions and behavior is the motivation for getting and staying involved with a project. All seven projects included the motivation subtheme.

Whereas participants discussed the motivations for several types of stakeholders to be involved with a project, these motivations varied among stakeholder types.

Among project leaders and project team members, major motivations for project involvement were a mixture of conducting interesting research and doing work that they believed in. For example, one of the project leads explained that his motivation was a desire to balance pioneering research with on-the-ground development impact:

> "Some people are really motivated by intellectual curiosity: they want to come up with new things; they want to come up with interesting things; they want to be the first to do something. Other people are very much driven by real impact and pragmatic goals. And a lot of people fit very easily into one or the other category, but a lot of people don't. I think I'm one of those people that don't. I kind of go back and forth."

The project lead is pursuing a career in academia, a career for which he must show research contributions to the academic community. Thus, he is motivated by both his own curiosity and the requirements of his work to conducting pioneering research. But this individual also has a drive to produce not just intellectual findings but also to apply research in ways that achieve pragmatic goals. One of the ways that he seeks to balance these interests is to pursue novel research with the expectation of handing off his findings to organizations that he believes can apply those findings. These organizations are not NGOs but technology organizations that serve NGOs. Because there was a dearth of such organizations providing technical support to NGOs in developing nations, this interviewee co-founded a start-up company to fill the market gap. In this way, he set up a partner to which he could hand off projects that passed the phase of being cutting-edge

research. This approach has not proven to be financially successful, but profit is not the project lead's motivation: balancing research with impact is. Thus, he is satisfied with this sustainability strategy of handing off research to his own start-up company not because the company earns high returns (it doesn't) but because it allows him to balance research with results.

A team member for the mobile-learning project sees similar motivations in the many university students who contribute to that project. These motivations include conducting publishable research, doing work they believe is important and valuable (i.e., development work), and gaining hands-on experience:

> "Where students feel that work they're doing is making an impact, that can really increase motivation …So right now, pretty much all the students are doing it for a combination of service learning and academic development. I mean, they either want to publish a paper, they find it important, or it's good experience."

While this dual motive of ICTD technologists (i.e., doing interesting work while also doing something meaningful) was common, some ICTD project members said that they were motivated almost exclusively by the noble aim of ICTD:

> "One thing I like is the purpose. I don't see many people who go about helping people to improve their own lives. It is a selfless aim and is what is attracting me."

The motives of ICTD project leads and team members shaped the scope of the projects by focusing technologists, and therefore the ICTD projects, upon problems that technologists felt moved to try to solve. In other words, technologists became aware of a development problem and believed that their own skills may be relevant to a solution. For

example, one of the agricultural projects began when the project lead heard of farmer suicides due to crop failures:

> "So it happened that in 1999 and 2000 lot of farmers have committed suicide in Andhra Pradesh. Hundreds of farmers have committed suicide in one hundred districts of Andhra Pradesh, especially cotton farmers... There were several reasons for suicides, and one of the reasons is that they are not getting timely information, agricultural information...So I thought that if a farmer needs this, this kind of information, then we may help the farmer. The question was how to build such system."

This project lead had an agricultural history (his father and brother were farmers), and the news of the suicides touched him deeply. He was thus personally motivated to see if his technology expertise could be used help subsistence farmers and prevent tragedies like the suicides. The technology skills this project lead possessed could have been applied in a variety of ways to meet a variety of goals. The ICTD project took the form it did because of the project lead's personal motivation. And other projects offered similar examples:

> "We believed in the SHG [self help group] model. We had firsthand experience of how it led to empowerment and access to capital in specific circumstances. ...Our job was really to build tools to support those organizations' development goals or missions and the community organizations themselves in terms of the SHG groups and federations, what were their goals and bottlenecks in achieving those goals."

> "We just looked for opportunities of where can you apply this. I was in charge of software as chief technologist. It struck me as true that this is transforming. And over time these insights took several years to come. We observed and took [project name] to a class and let the children interact with them. Several of these

> things happened.... My job was to be open to information coming in, and if it touched me deeply, I would say let's build this."

In the first quote above, a project leader described having seen firsthand the benefits that microfinance organizations can bring to people's lives. Inspired by the experience of seeing microfinance organizations help people, the project lead sought to use his own expertise to help these organizations do what they do better. The second quote offers a similar example. A founding member of another ICTD project served not only as chief technologist but also as a person who sought ways to apply that technology, ways that "touched [him] deeply." These potential applications not only provided motivation for the team member's involvement, but they also shaped the project itself by providing specific goals and users, whose requests shaped the technology design (for example by requesting specific features or services).

These examples have shown that a moving personal experience led to the birth of several ICTD projects and continued to not only provide motivation for continued involvement but shape the course of the projects' development, particularly driving scope decisions. We have seen in the scope creep subtheme that many expansions to the project scope were necessary for the survival of the project and the achievement of development goals. Seeing here the personal motivations of some ICTD project leads and members to support these development goals suggests that this personal motivation may increase the likelihood of scope creep. In other words, project stakeholders who are motivated by improving people's livelihoods are unlikely to be satisfied by merely creating

technologies that supply information when so much more than information is required to bring about livelihood improvements.

Another stakeholder group that featured prominently in the motivation subtheme was local beneficiaries. Five projects found that one motivation for local beneficiaries to get involved with an ICTD project was a desire to use technology. Local beneficiaries claimed this motivation, and other types of stakeholders observed this motivation:

> "People feel happy that they are entering into some kind of technology rather than just using notebooks and pens. They are just feeling that themselves boosted up, using a mobile device for their own recordkeeping."

> "This will make students give 100 percent attendance because they are happy to use a cell [phone]."

> "Nobody will allow us to touch a computer because it costs so much: 30,000 rupees. But here there was an opportunity to touch them."

While some local beneficiaries were drawn to project participation by the opportunity to use ICTs, this motivation was exclusively mentioned in reference to early participation—that is, during exploratory research or pilot phases. This does not necessarily mean that the glamour of using ICTs is an irrelevant motivation to long-term project involvement, but it suggests that this motivation may more likely to *get* some local beneficiaries involved, rather than *keep* them involved. This longer term motivation is discussed at more length below. (It should also be mentioned that some local beneficiaries for one project experienced the opposite: i.e., finding ICTs to be intimidating and therefore more of an inhibitor than a motivator to project involvement.)

Partners from two projects expressed concern about the motivations of local beneficiaries to participate, believing that long-term involvement would require beneficiaries to believe in the central goal of the project rather than being motivated by other factors:

> "We wanted a group effort where women decide who will go for which [jobs]. There was no impetus for women to do that. It was not like all the women had no jobs. Their role became less and less."

> "The representatives that were involved from the community looked at it more as, 'Okay, I get a job'...So, you know, somewhere I felt that the whole meaning of this was lost. People started looking at it as a source of income for them and not as a deliverable which people would benefit from...So, you see, the community also starts looking at the person who is showing it, even though the person is from their own community, this person is a paid person. So he is doing it because he is getting a salary. So I don't know, it's a little bit tricky how to get people to [show up and feel committed]."

Thus, some stakeholders believed that long-term participation from local beneficiaries would require the beneficiaries to desire the service or solution being offered. However, one agricultural project found that offering a desired service—targeted advice resulting in proven financial benefit—was not sufficient motivation for famers to pay for it. Farmers were either unwilling to pay at all or unwilling to pay enough for the project to financially break even. Even farmers who had experienced a financial benefit that exceeded the proposed fee were unwilling to continue participation in the project because agricultural advice has always been free through the Indian government's agricultural extension service:

> "Funders have been asking for it [the project] to be self-sustainable. That is a major suggestion. Since independence of India, agriculture extension is a free service provided by the agriculture department. Now we want to introduce this paid service, but they [the farmers] are not psychologically ready to pay.... From Delhi a team came and went to the village center and asked farmers who were getting 20000 profit per hectare. They were asked, 'Are you convinced that [project name] is a benefit? Why not pay 300 per acre?' And they say, 'No, we will not pay because the government would provide this to us.' [It's] more about psychology than economics."

Thus, motivation to participate in ICTD projects is complex. Many project leaders and team members are seeking interesting research opportunities that enable them to perform work they feel is important or meaningful. Local beneficiaries may be initially drawn to participate in ICTD projects for the opportunity to use ICTs, but their motivation to participate over the long term is much more complex. As suggested by the first perceptions and behavior subtheme, trust and credibility, local beneficiaries must feel confident that any information they receive is credible. They must also desire the service or information being offered, but even valuing the service or information is not necessarily sufficient to secure participation once a project transitions into long-term implementation—particularly if the sustainability strategy involves charging local beneficiaries fees for services.

This chapter has presented several patterns across the seven ICTD projects analyzed in this study. Four broad themes emerged: scope creep, scalability, project management and sustainability, and perceptions and behaviors. Each theme contained numerous more specific subthemes, two of which were selected for each theme, using the

criteria (1) the subtheme occurs in at least five of the seven projects, (2) the subtheme is prominent, and (3) the subtheme makes a novel contribution to ICTD literature. The value of the subthemes is not only that they occur across disparate ICTD projects but also the implications of their interrelations for future ICTD project stakeholders (particularly project leaders).

For example, motivating key project stakeholders to participate in ICTD projects (subtheme 8) often required expanding the project scope to meet their requests (subtheme 1). Thus, leaders of future ICTD projects should work closely enough with key stakeholders early enough in the project to set initial scoping boundaries together. Further, project stakeholders should not expect the scope to gel entirely but should expect fluidity due to the dynamic nature of ICTD contexts and the impossibility of foreseeing factors that may affect the scope. This flexible mindset can be a great benefit in the ICTD field, where the impossibility of anticipating possibilities can be daunting. In fact, one project leader reflected back upon what went right with the project from its early days, concluding that ignorance of challenges and motivated project leaders and team members were useful:

> "Then I didn't know how hard it would be to build, and if I had, I never would have. We didn't do anything right except to have the intuition that what we are doing is the right thing."

Drawing from the work of scholars like Lucy Suchman (2007), I would counter that a flexible mindset or expectation of a fluid scope would be more useful than

ignorance of challenges to ICTD projects, and I suspect that the project leader would agree, as he is now working on his third start-up business, building off the early research. Suchman claimed that all purposeful actions are situated (*i.e.*, they take place in a specific context that affects the details of actions) (2007). Thus, plans cannot predict the course of an ICTD project in detail nor reconstruct the course of one ICTD project in a future project because of how unknown details of future situations affect a course of action. Instead of a call for more rigidly detailed plans, Suchman called for more open-ended design and, I would add, a more flexible mindset. Project leaders can never anticipate every specific challenge the project may encounter, but being aware of patterns such as the frequently causal relationship between motivation and scope creep can establish reasonable and useful expectations. These expectations can then be the impetus for specific strategies like early involvement of project stakeholders and jointly negotiated scoping boundaries. (See the second takeaway in Chapter 6, Section 2 for more information about this point.)

Another example of interrelations of subthemes with useful implications for future ICTD projects occurs at the intersection of perceptions and scalability. For stakeholders such as local beneficiaries to participate in the project (subtheme 8), they had to trust the source of information and services (subtheme 7). But the trust-building strategies that proved effective in small-scale pilot studies did not scale to national-level implementations, thus, requiring projects to modify their trust-building strategies as projects transitioned from research to implementation. These interrelations of common

themes across ICTD projects are important information for ICTD project leaders. When planning future projects or transitioning current projects into long-term implementations, these leaders can build into their plans trust-building strategies like those employed by the projects under study, while building into the transition plans different trust-building strategies that make use of, for example, partnerships and reputation developed early in the project. Takeaways from this study are further explored in Chapter 6. The conclusions in Chapter 6 below interpret the findings presented in this chapter and suggest areas of future work building upon this study.

Chapter 6 – Conclusions & Moving Forward

ICTD is a complex field, involving (1) stakeholders who often vary in education, nationality, area of expertise, and other factors; (2) developing world contexts impeded by infrastructure limitations; and (3) ICT components that are highly dependent upon those stakeholders and contexts. While existing ICTD literature convincingly establishes this complexity and provides a number of case study level analyses, this study takes a different tack by seeking patterns *across* case studies. In asking which elements are important when transitioning ICTD projects from research to implementation, this study explores broadly to identify patterns (identified here as subthemes) emerging from a variety of factors. In this way, this study bridges some of the major tenets of modernism and critical perspectives on development. Modernism's contribution is the expectation no ICTD project would be entirely unique. Classic modernism posits that all nations are progressing down the same path from traditional to modern. Thus, in its extreme form, modernism implies that a well-designed development project would scale across contexts because all contexts are progressing in the same direction toward the same goal. This study modifies that expectation and marries it with critical perspectives' emphasis on situatedness, dialogue, and local perspectives. The modified concept from modernism is the expectation that ICTD projects would overlap in *some ways* with other ICTD projects, whether that be in the goals of certain stakeholder groups, the type of technology that may be appropriate, or contextual factors like weather patterns and transportation challenges affecting a project. After all, this study is seeking patterns across disparate

case studies. However, this study does not support the modernist perspective, which under-emphasizes context, respect for local perspectives, and dialectic exchanges. This study brings the expectation of shared patterns across projects to the critical perspectives tradition, acknowledging situatedness and local perspectives but seeking to share knowledge across projects to amplify the value and contribution of each development project.

As the findings in Chapters 4 and 5 illustrate, the elements important in transitioning projects are themselves complex and interrelated. A major contribution of this study is identifying elements or subthemes that are *shared* across ICTD projects that differed in areas such as technology type and development domain. These shared subthemes suggest areas of focus for future ICTD researchers seeking to transition their own projects. Because the subthemes identified by this study were shared across disparate ICTD research projects in a variety of development domains, they can be expected to surface in many future ICTD projects. ICTD project leaders who expect to encounter these subthemes will be more prepared for meeting the myriad of challenges inherent in ICTD work. To further support these ICTD scholars and project stakeholders, Section 1 below identifies three major takeaways from this research.

Section 1: Conclusions

The findings presented in Chapters 4 and 5 suggest at least three conclusions with important implications for ICTD as a field and ICTD stakeholders such as project leaders and funding organizations. The first conclusion is that ICTD project stakeholders should

conceive of sustainability more broadly than a binary question of whether a project continues to exist or not. Rather, in evaluating ICTD project sustainability, a broader definition should be used to identify aspects of the project that sustain over time or influences on other projects that live on. The second conclusion is that, even for experienced ICTD stakeholders, expected challenges manifest in unexpected ways. This conclusion implies that being aware of important principles is insufficient to prevent unwelcome surprises as those principles play out in a particular project. The third conclusion is that interpreting ICTD best practices through a complex systems lens can result in more reasonable expectations of ICTD projects. For example, project stakeholders will expect to encounter not just benefits but challenges that directly result from employing best practices, becoming more prepared to meet challenges and to weigh the benefits of following best practices. These conclusions are important not only for informing how project leads conceive of and manage ICTD project but also for educating donors. Funding organizations have much power over the form and progress of ICTD projects. Funders who share a broad definition of sustainability or who expect mixed results from following best practices may be less likely to harmfully constrain ICTD projects by, for example, making funding dependent upon success as defined by a narrow concept of sustainability—i.e., continuing to exist in its originally planned state.

6.1.a Broader View of Sustainability

This study has some important implications for sustainability, which is a major theme in ICTD literature and one of two criteria commonly used to judge ICTD success.

In much of the ICTD literature, sustainability is conceived of as fairly straightforward: either a project continues to exist or it doesn't. But this study suggests that the sustainability of ICTD projects can take many forms. Common strategies to sustain a project include creating a startup business or founding a nonprofit organization. But in exploring interrelations between scalability and sustainability, this study identified some other interesting strategies, such as sustaining *aspects* of a project by influencing other projects, technologies, and organizations. By publishing the technologies, processes, and outcomes of early research work, the projects involved in this study sought to share their findings with others who may appropriate certain parts of the original project for their own uses. Similarly, when participants discussed what they felt was done well or was successful about their project, participants often identified project influences beyond the bounds of the original project. For example, one of the local beneficiaries of a project said that she gained courage and confidence, which is continuing long after the ICTD project has ceased to exist. Several of the project leaders, all of whom were professional researchers, cited contributions that their projects made to the ICTD field more broadly, especially through pioneering aspects of technology design that were later taken up by others.

Further, the finding that project stakeholders continued to modify project solutions and services well into long-term implementation has implications for conceptions of sustainability. Specifically, this finding suggests that exploration may never end and therefore that sustainability does not imply the cessation of exploration.

Explorations may continue for several reasons, for example, in connection with motivation. Motivations for continued involvement during and after the project transition were more complex than motivations to briefly participate in early research. So to keep student team members engaged, for example, the project may continue exploring new (publishable) approaches to providing development services and information. Or, for example, a project may continue exploring new services desired by local beneficiaries who may otherwise withdraw from project participation.

Therefore, a major implication of this study is that sustainability is not a single-faceted concept. The sustainability of ICTD projects is not limited to whether and how long a project lives on in its current format. Instead, sustainability can take a number of forms including continued existence through continued iteration and influence on other projects and people.

6.1.b Expected Challenges, Unexpected Manifestations

The second conclusion is that expected challenges manifest in unexpected ways, indicating that familiarity with common challenges or important principles is insufficient to identify the myriad of ways that those principles may play out. The ICTD projects analyzed in this study were led by professional researchers, all of whom were either familiar with ICTD, familiar with the context of use, or both. Similarly, the other types of stakeholders had varying levels of experience in ICTD, the development domain, the context of use, or a combination thereof. Therefore, the fact that this study uncovered several surprises to project stakeholders may be itself surprising. But what suggests an

even greater value of this contribution is not just identifying discoveries or surprises across projects but finding common discoveries across disparate projects led by experienced ICTD researchers. Thus, this conclusion could be expected to have a high degree of transferability to future ICTD projects.

One specific example involves trust and credibility. Many stakeholders expected credibility to be important and therefore incorporated credibility-building strategies into their project plans. However, many of these same stakeholders experienced challenges when trust and credibility affected project factors in unexpected ways. To be clear, the surprise to many participants was not that trust and credibility had a role in ICTD projects, it was the variety of ways that role manifested itself and the degree of impact it had:

- Surprise: Farmers did not automatically trust the advice they received from agricultural scientists. Trust affected pilot testing.
- Surprise: User groups with a high degree of internal trust had different data-entry preferences than groups that lacked that trust. Trust affected the scalability of interface design.
- Surprise: Corporate customers and investors did not find a research project in a university lab credible. Trust affected the sustainability strategy.

Of the eight subthemes discussed in Chapter 5, trust and credibility were the most highly interrelated with the other subthemes, affecting all four major themes: scope creep, scalability, project management and sustainability, and perceptions and behavior. While

many stakeholders expected trust and credibility to be relevant to their project, they did not expect it to have so many significant interrelations and effects.

Another common surprise was the extent of what would be needed, beyond "the right technology," to meet project goals. The fact that this was surprising to many project stakeholders suggests the relevance of complex systems literature to ICTD. For example, Davenport (1997) identified this characteristic of complex systems years before the oldest of the projects in this study began. To some degree, all seven projects initially shared what turned out to be the misconception that the right technology would achieve the project goal, which could be generalized as improving people's livelihoods in various ways to various degrees. One participant described early project conceptions as "naïve," chuckling embarrassedly at the fact that she and the other early stakeholders had thought they could develop an ICT solution that would provide sufficient information in an accessible way that could be maintained by existing human resources over the long term. This surprise—the range and extent of what would be required to meet development goals—is a major cause of three subthemes discussed at length in Chapter 5: scope creep due to the insufficiency of information alone, scope creep due to user requests, and the years-long progression to long-term implementation. Like the discovery above (influence of trust and credibility), this discovery is one of degree: i.e., stakeholders were not surprised that something was necessary beyond technology but that so much was necessary and would continue to be necessary.

The value of this contribution—identifying surprises across projects—is partly its implication that even things that stakeholders may think they already know can surprise them in the course of project transition. It is a specific finding: credibility and trust influence many aspects of ICTD projects, and technology is not only difficult to get right but woefully insufficient alone. And it is a broader conclusion: expected challenges often manifest in unexpected ways or degrees.

6.1.c Complex Systems View of ICTD Best Practices

A third major contribution of this study is to present a more realistic and balanced picture of ICTD best practices as seen through a complex systems lens. As described in Section 3 of the literature review, a complex systems perspective emphasizes a long-term, holistic view of a dynamic system in which system components overlap, interrelate, and compete. Using this lens to interpret the study findings provides a more complex, nuanced perspective on ICTD best practices. Section 2 of the literature review presents three best practices proposed in much of the ICTD literature: partner deeply with stakeholders, design appropriate technology, and consider the environment or context. Typically, these best practices are presented relatively simply: they are presented individually and are framed as if solely beneficial. Although the difficulties in implementing these best practices may be acknowledged, difficulties or challenges that directly stem from following these best practices are not presented.

However, the findings from this study make clear that following ICTD best practices is not a silver bullet. These practices can, in fact, directly lead to challenges or

difficulties that may not have otherwise occurred. As the complex systems perspective suggests, these best practices affect a number of ICTD project factors, and outcomes are not straightforward or solely positive. However, taking a holistic view suggests that following these best practices is better than the alternative (i.e., not following them). Thus, the major contribution here is not to *refute* the best practices but to more fully convey their effects—both positive and negative, intentional and unintentional.

The first best practice is partnering deeply with stakeholders, particularly intended beneficiaries. This deep partnership can have a number of positive effects, such as motivating stakeholders to become and remain involved the project and developing a clearer, more accurate understanding of what these stakeholders want or need, relative to the project goal. This better understanding of stakeholder needs and desires can inform a solution design that is better suited to supporting decision making (a goal broadly advocated by the complex systems perspective). These potential outcomes are, indeed, positive and important. But they often lead to scope creep. When intended beneficiaries are deeply involved in project design, their input into the project often includes requesting additional services, information, or support. The first subtheme under scope shows that a common effect of stakeholder involvement is scope creep. But years of ICTD failures have shown the folly of neglecting to partner with local stakeholders. The conclusion is therefore not that ICTD projects should not involve partnering with stakeholders such as intended beneficiaries but is that project leaders should be aware that a common effect of these partnerships is scope creep. This awareness can lead

project leaders to develop strategies for addressing scope creep, such as developing partnerships with organizations with similar missions or intentionally limiting scaling efforts.

The second of the best practices advocated in ICTD literature is to consider the context or environment. Many of the projects analyzed in this study operated from a deep understanding of context. Unlike many ICTD projects, which are led by researchers who are in many respects unfamiliar with the country and culture in which the solution will be used, six of the seven projects analyzed in this study were led by people with a deep understanding of Indian culture, five of whom were Indians living and working in India. Thus, the project leaders informing this study can be assumed to have a deeper understanding of the national context of use than project leaders from outside the country. But culture and context are not only national phenomena but regional, organizational, and familial; that is, context differs not just nation to nation but village to village and school to school, for example. As one participant said, "You might think India is one country, but it's not. It's like 100 different countries." And if India is like 100 different countries, then scaling from a pilot solution that is appropriate to the context of a few villages to a solution that is appropriate for the context of all of India is, to say the least, challenging. To use complex systems language, these two important factors, context specificity and scaling, are in direct competition and should be balanced as projects move forward. The competitive nature of these two important factors is one cause of the second sustainability subtheme: ICTD projects continue iterating their solutions well into long-term

implementation. As with the first best practice, the findings from this study do not negate or contradict the best practice, they just provide a more complex picture of how following the best practice affects other factors in the system.

Finally, ICTD literature advocates for designing appropriate technology. Carefully, intentionally designing technologies that are appropriate for the people, purpose, and context of use results in an ICT solution that is more likely to contribute to the project goal. But much like the previous best practice, this best practice is a moving target: what is appropriate in one place at one time for one group of stakeholders is not necessarily appropriate if the place, time, or people change. For example, the sweeping popularity of mobile phones affected the ICT approach of several projects:

> "When we launched in 2003, the Internet, we thought, was going to boom through kiosks. It happened in the beginning, but then after that, the movement was replaced by mobile phones. And so it was a question of waiting for the Internet kiosks to catch up or capitalizing on the mobile, cell phone momentum."

To offer a technology-based solution that was appropriate for the users and their context, the project switched its focus from kiosks alone to both Internet-based and mobile-based technologies. Like the previous two practices, following this best practice has both positive and negative consequences: designing a useful ICT and complicating both sustainability and scalability.

Section 2: Moving Forward

This study could inform future research in a number of ways. Because it is an exploratory study, its focus was intentionally broad to allow themes to emerge from the data. This data has suggested four overall themes and eight specific subthemes that should be explored further in future studies.

One of the most obvious ways to extend this research would be to conduct a similar study with other ICTD projects that meet the same inclusion criteria. Such a study would provide a useful indication of the transferability of these findings, addressing a number of interesting questions: would similar themes emerge? would the examples of these themes support the conclusions proposed here? would the emergent themes suggest a different interpretation of the findings from this study? A similar extension of this work would be to conduct this study with ICTD projects meeting slightly different inclusion criteria: for example, exploratory ICTD research projects led by professional researchers in Africa. Another variation would be to conduct a wide-ranging survey with hundreds of ICTD project stakeholders to gauge the prevalence of these themes. Using a combination of open- and closed-ended questions would be a useful way of retaining at least some of the richness of qualitative data while enabling far more projects to contribute.

Another interesting path for future research would be to select a subset of the eight subthemes to study in greater detail, exhaustively tracing and mapping its relations and overlaps with other project factors. Exploring how to visually convey this type of data may be another interesting extension of this work: for example, using knowledge

maps or information visualization techniques to convey these complex relationships in a single graphic. Such work would complement the current study, which uses quotes and narratives to convey relationships through individual examples, by using images to convey all relationships at once at a lower level of detail. This type of approach would be particularly interesting for a subtheme such as trust and credibility. Trust and credibility were the most highly interrelated of all the subthemes, affecting aspects of all four major themes. Tracing these relations and influences could suggest further avenues for future research.

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Appendix A: Information Form

University of Washington Information Form

Researchers: Rebecca Walton, PhD Candidate, Mark Haselkorn, Advisor
Department of Human Centered Design & Engineering, University of Washington, 206 543 2567
Microsoft Research India, Bangalore, India

Researchers' statement: We are asking you to be in a research study The purpose of this document is to give you the information you will need to help you decide whether to be in the study or not Please read it carefully You may ask questions about the purpose of the research, what we would ask you to do, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear When we have answered all your questions, you can decide if you want to be in the study or not This process is called "informed consent " We will give you a copy of this form for your records

PURPOSE OF THE STUDY

We are exploring the relationship between people's perceptions of the goals and scope of information and communication technology for development (ICTD) projects There is much information about ICTD case studies and outcomes, but not as much information available about processes and perceptions and the way those perceptions affect project design and outcomes So that is what this study focuses on We are investigating the complex goals and views of project designers and stakeholders These views often depend on what people have implicitly decided as their scope, which is another focus of the research The long-term purpose of this research is to help people plan and carry out more successful ICTD projects

STUDY PROCEDURES

If you decide to participate in this study, you will participate in an interview that should last from 30 minutes to an hour The interview will focus on the goal and scope of the project, relevant technologies, transition from research to implementation, and influences on the project design A few interview questions are given below as examples
□ When the project was being planned, how did the team determine what was and was not within the scope?
□ If you had it to do over, knowing what you know now, what changes would you make to the planning process?

You may refuse to answer any question During the interview, I will audio record our conversation and will type notes I will not record your name

RISKS, STRESS, OR DISCOMFORT

Some people feel embarrassed or uncomfortable discussing negative topics, such as the aspects of a project that did not go well Some of the interview questions ask you to discuss negative topics, such as what you wish had been done differently or what did not go well A risk of participating in this study is that you may feel uncomfortable describing negative aspects or opinions of the project Please remember that you can always refuse to answer if you prefer With your permission, I will audio record our interview You are welcome to ask to review the recording and ask me to delete portions of it

BENEFITS OF THE STUDY

The long-term purpose of this research is to help people plan and carry out more successful ICTD projects We hope that the patterns of information we learn from people like you will help to create better understandings of how to plan and implement more successful ICTD projects in the future You may not directly benefit from participating in the study, but you will contribute to the purpose of improving future projects

OTHER INFORMATION

You may refuse to participate and you are free to withdraw from this study at any time without penalty or loss of benefits to which you are otherwise entitled The data collected for this study is confidential, we are not recording your name If you have questions later about the research, you can ask Rebecca Walton, whose contact information is listed above If you have questions about your rights as a research subject, you can call the Human Subjects Division at (206) 543-0098 You will receive a copy of this information form

Vita

Rebecca Walton grew up in Clyde, Texas, a very small town on the plains of West Texas. She earned a Bachelor's degree in English with minors in Journalism and Digital Media from Abilene Christian University in 1999. In 2006, she earned a Master's degree in Technical Writing with a cognate area in Public Administration from the University of North Texas. Before beginning her doctoral studies, her work experience included writing, editing, and design in a variety of fields, including technical communication, multimedia development, and nonprofit fund raising. She earned a Master's degree (2010) and a PhD (2011) in Human Centered Design & Engineering from the University of Washington. Her research explores how human and contextual factors affect the design and use of information and communication technologies (ICTs) in resource-constrained environments. Her research contributions include modifying the value-sensitive design methodology to increase transferability of findings and contributing nuanced, rich pictures of Internet and mobile technology use in often-overlooked regions such as Central Asia.