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Abstract:

Humanitarian operations research holds a considerable allure for researchers, often promising interesting contexts to develop and extend current theory, large pools of data to validate theory and generate new insights, and, more generally, the opportunity to conduct "research that matters". For many of these reasons, we embarked on several research initiatives over the past several years with mixed results. In this tutorial, we draw on several studies (some abandoned) to explore the use of information and communication technologies for humanitarian purposes, and we synthesize and highlight the distinct features of humanitarian operations research. Specifically, we draw attention to differences between "the process" of conducting these studies relative to traditional research and focus on challenges and opportunities for researchers.

Keywords: Information and Communication Technologies for Development, Research Process, ICT4D, Humanitarian Operations, Tutorial.

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1 Introduction

The potential for improving operations management to enhance the efficacy of humanitarian efforts is profound and has generated a discourse that includes perspectives from the academic, non-profit, and policy communities. Academics in particular are in a unique position to contribute to this discourse by leveraging a variety of theoretical frameworks and rigorous empirical methods to provide evidence supporting (or refuting) often anecdotal claims regarding the role of enhanced operations management in humanitarian contexts. However, as we have discovered, humanitarian operations research does not always lend itself to traditional research approaches and norms. For instance, this research often includes collaborations across cultures and nation states that introduce both philosophical differences around the value and ethics of research and pragmatic differences in norms between research partners (e.g., those related to language, timeliness, willingness to critique management, etc.). These differences can leave scholars who are eager to do research in this extremely important yet underdeveloped research area overwhelmed and, ultimately, discouraged.

We developed our paper with these issues in mind. This tutorial is not so much a "how-to" but rather a "lessons learned" guide for conducting humanitarian operations management (HOM) research. We start from a general research framework (with applicability to traditional research efforts) and identify specific research steps that make up the iterative research process in HOM contexts. In doing this, we highlight 1) the unique challenges researchers face during each step of this process and 2) how researchers can overcome these barriers and, thus, contribute to this nascent research area. To this end, our research team included an expert on "monitoring and evaluation systems" used in developing nations with whom we could validate and extend the proposed guide for conducting humanitarian operations research. We organize the research process and challenges that emerge in this space using theories related to cognitive schemas, processing, and mental models. Generally, our framework suggests that a unique sensemaking process for doing research is being undertaken and that traditional norms for conducting field research are not always effective. Moreover, we suggest the manner in which researchers' cognitive schemas evolve (or do not) throughout this process may predict successful research efforts in this space.

This framework is informed by several HOM research efforts with a large U.S.-based humanitarian aid provider (henceforth "USHAP"). Discussions with the aid provider led to several project proposals all centered on IT-based solutions to issues in the developing world. One project, for example, investigated the impact of a newly developed supply chain management information system (SCMIS) on USHAP's operational effectiveness. The SCMIS was deployed in a phased rollout in several locations—mostly in Africa but also in some locations in Asia and the Middle East. Another project examined the use of an IT-based training tool for farmers to better manage their production inputs and how they sale and transport their crops (henceforth FarmIT). All of the projects (including SCMIS and FarmIT) are considered information and communication technologies for development (ICT4D). ICT4D research is becoming increasingly more popular in a broad range of disciplines ranging from information systems to economics, policy, and health (Toyama & Dias, 2008). At the time of writing this paper, our research efforts spanned over 13 months and included 20 face-to-face, telephone and video (primarily Skype) interviews with key personnel and administrators across several ongoing projects. Our efforts also included an on-site visit, 25 formal presentations, and 34 information exchanges in the form of detailed email correspondence (see Table 1). Participants held titles such as chief executive officer, chief knowledge and information officer, chief of party (similar to a lead project manager), and head of operations. These individuals spanned diverse aid efforts and included people situated in the USHAP's U.S. main office and those in various regional offices, including Jerusalem, Zimbabwe, Kenya, Ethiopia, and Lesotho (see Table 1).

Table 1. Timeline of Data-collection Efforts

Timeline	Data collection[1]	Projects discussed
Month 1	• Presentation: chief knowledge officer/chief information officer • Presentation: supply chain management director • Presentation: director—solution architecture design • Email correspondence: chief knowledge officer/chief information officer • Email correspondence: supply chain management director • Email correspondence: director—solution architecture design	• BarcodeID • GPS/pedometers • iForm/Open Data Kit • mHealth • SCMIS • ProtectionIT • E-vouchers
Month 2	• Interview: chief executive officer • Presentation: chief knowledge officer/chief information officer • Email correspondence: chief knowledge officer/chief information officer • Email correspondence: director—operations standards and systems • Email correspondence: university engagement representative	• SCMIS • mHealth • E-vouchers • Monitoring & Evaluation System • GPS/pedometers • ProtectionIT
Month 3	• On-site visit: USHAP headquarters • Interview: chief knowledge officer/chief information officer • Interview: supply chain management director • Interview: director—operations standards and systems • Interview: procurement IS business owner • Presentation: chief knowledge officer/chief information officer • Presentation: supply chain management director • Presentation: procurement IS business owner • Two Presentations: director—operations standards and systems • Email correspondence: chief knowledge officer/chief information officer • Email correspondence: supply chain management director • Email correspondence: director—operations standards and systems	• SCMIS • GPS/pedometers • Monitoring & Evaluation System • ProtectionIT • Procurement IS • BuilderIT
Month 4	• Two Presentations: chief knowledge officer/chief information officer • Presentation: supply chain management director • Email correspondence: chief knowledge officer/chief information officer • Email correspondence: supply chain management director	• SCMIS • BuilderIT • System integration
Month 5	• Presentation: supply chain management director • Presentation: director—operations standards and systems • Email correspondence: supply chain management director • Email correspondence: chief knowledge officer/chief information officer • Email correspondence: director—operations standards and systems	• SCMIS • Procurement IS • BuilderIT
Month 6	• Two presentations: supply chain management director • Email correspondence: director—operations standards and systems • Email correspondence: supply chain management director	• SCMIS • GPS/pedometers
Month 7	• Presentation: chief knowledge officer/chief information officer • Email correspondence: chief knowledge officer/chief information officer	• SCMIS • BuilderIT

[1] Interviews comprised two-way exchanges with the key informant. Presentations were more structured in nature with the key informant making formal presentations in which we were only allowed to ask follow up questions. During the e-mail correspondence, we asked clarifying and follow-up questions that emerged during the data collection.

Table 1. Timeline of Data-collection Efforts

Month 8	• Interview: senior technical advisor—agriculture • Interview: supply chain management director • Two presentations: senior technical advisor—agriculture • Presentation: supply chain management director • Email correspondence: chief knowledge officer/chief information officer • Email correspondence: supply chain management director • Email correspondence: senior technical advisor—agriculture	• SCMIS • BuilderIT • FarmIT
Month 9	• Presentation: senior technical advisor—agriculture • Email correspondence: chief knowledge officer/chief information officer • Email correspondence: supply chain management director • Email correspondence: senior technical advisor—agriculture	• SCMIS • Monitoring & Evaluation System • FarmIT
Month 10	• Interview: head of operations—Kenya • Interview: head of operations—Jerusalem • Email correspondence: head of operations—Kenya • Email correspondence: head of operations—Jerusalem	• SCMIS
Month 11	• Presentation: supply chain management director • Interview: markets and agriculture program specialist • Interview: head of operations—Ethiopia • Email correspondence: head of operations—Ethiopia • Email correspondence: chief knowledge officer/chief information officer • Email correspondence: supply chain management director • Email correspondence: head of operations—Ethiopia	• SCMIS • BuilderIT • FarmIT
Month 12	• Interview: head of operations—Lesotho • Interview: senior administrative officer— Rwanda • Two interviews: supply chain management director • Two interviews: markets and agriculture program specialist • Presentation: non-government organization liaison • Presentation: chief of party— Zambia • Presentation: markets and agriculture program specialist • Email correspondence: chief of party— Zambia • Email correspondence: head of operations—Lesotho • Email correspondence: senior administrative officer— Rwanda	• iForm/Open Data Kit • SCMIS • Monitoring & Evaluation System • ProtectionIT • FarmIT
Month 13	• Interview: program advisor • Interview: program manager • Interview: regional technical advisor • Email correspondence: agriculture & livelihoods program manager—Malawi • Email correspondence: program advisor	• FarmIT

With this tutorial, we help researchers conduct HOM studies by identifying pitfalls and challenges associated with them. HOM research is gaining interest in multiple research communities (Martens, Scheibe, & Bergey, 2012). Indeed, *Interfaces* devoted its June 2011 issue entirely to humanitarian applications of operations research/management science. More recently, *Production and Operations Management* devoted its June 2014 issue to humanitarian operations and crisis management. As such, we can see that interest in HOM is growing; however, the number of empirical studies in this area remains "pitifully small" (Holguín-Veras, Jaller, Van Wassenhove, Pérez, & Wachtendorf, 2012). While several OM and IT scholars have successfully executed scores of HOM studies over the years, we suspect that many more researchers have attempted but failed to complete important studies due to their falling victim to challenges inherent in the HOM research process. With this tutorial, we provide a lessons learned guide for HOM researchers to help them avoid common pitfalls during their research journey, which can also serve as a catalyst for future research in this extremely important yet underdeveloped research area. We hope our work moves incomplete studies forward and helps in the planning process for new HOM research endeavors. In other words, with this research, we close the gap between what we know and what we need to know about conducting HOM research.

2 HOM and IT's Supporting Role

HOM research has centered on important topics such as supplier selection (e.g., Balcik & Ak, 2014), information diffusion (e.g., Altay & Pal, 2014), decision support systems (e.g., Martens et al., 2012), procurement practices (e.g., Matopoulos, Kovács, & Hayes, 2014), field vehicle fleet management (e.g., Pedraza Martinez, Stapleton, & Van Wassenhove, 2011), and others. Less examined, but equally important, is the role of information technology (IT) (namely, ICT4D) in humanitarian operations management (Sodhi & Tang, 2014). Indeed, while introducing a recent special issue on humanitarian operations and crisis management (HO&CM) in *Production and Operations Management*, Starr and Van Wassenhove (2014, p. 931) note that "an important challenge and opportunity for the field of HO&CM is that of realizing the potential of information technology tools as a catalyst for inter-organizational coordination". Similarly, Ergun, Gui, Stamm, Keskinocak, and Swann (2014, p. vii) highlight that "an important challenge and opportunity for the field of humanitarian operations and crisis management is that of realizing the potential benefits of information technology tools". We can see that scholars recognize that IT can enrich HOM research, yet they often struggle to produce publishable research in this context. We hope that this lessons learned guide will serve as a catalyst for interdisciplinary studies in this emergent research area.

For this tutorial, we use Thomas and Kopczak's (2005, p. 2) definition of humanitarian logistics:

> *Planning, implementing and controlling the efficient, cost-effective flow of and storage of goods and materials as well as related information, from point of origin to point of consumption for the purpose of alleviating the suffering of vulnerable people. The function encompasses a range of activities, including preparedness, planning, procurement, transport, warehousing, tracking and tracing, and customs clearance.*

This definition includes the tools that help one better manage supply chains in aid contexts; such tools include corporate systems such as SCMIS and systems that field agents use such as FarmIT. These tools provide many benefits such as increased data accuracy and operational efficiency and, perhaps more importantly for aid organizations, enhanced transparency of in-kind donations and supplies at various junctions in the supply chain. In fact, using technology is an increasingly pervasive approach to supplement and invigorate aid efforts in developing nations (Ergun et al., 2014). Despite this context's potential to inform the broader debate on technology's role in society at large and to highlight technology's potential to create direct and lasting good, few empirical studies in the operations research and related literatures evaluate the efficacy of relevant technology solutions.

Adding to the intrigue around studying IT in humanitarian contexts is the controversy regarding technology's potential to act as either an economic equalizer or a force for furthering socioeconomic gaps. For instance, the digital divide, a term used to describe connectivity gaps among various regions and/or demographics, persists in both developed and developing nations (Pick & Azari, 2011; Riggins & Dewan, 2005). According to a recent study, however, the digital divide is most apparent in Africa, Latin America, and Southeast Asia because these regions continue to have low connectivity and limited e-commerce development (France-Presse, 2013; Montealegre, 1999). On the other hand, technology has been a force for enhancing productivity (e.g., Dedrick, Kraemer, & Shih, 2013) and bringing about social transformation and economic progress. Some have projected massive online open courses (MOOCs) and other open educational resources, such as Apple's iTunes University, to play a significant role in "revolutionizing" higher education (Woodard, 2012). MOOCs leverage exceptional instruction and cutting-edge technology in an effort to help bring higher education to the masses—especially those in developing countries that have a severe shortage of university and college education (McKenna, 2012). In addition, many have credited information and communication technologies with advancing social change in the developing world. For instance, scholars have documented Twitter's role as enabling popular revolutions in Tunisia and Egypt, which allowed individuals to better disseminate news and organize protests (Howard et al., 2011; Lotan, Graeff, Ananny, Gaffney, & Pearce, 2011).

A similar debate prevails in the specific context of ICT4D because its net effect remains unclear. Some anecdotal evidence suggests that ICT4D can act as a catalyst to support solutions for complex social problems or as a force that worsens existing social problems, creates new problems, or diverts attention and resources from needed social change (Kling, 1996). This debate belies a need for researchers to develop theoretical frameworks and supporting empirical analyses to uncover insights into the conditions under which ICT4D can create value for developing nations while acknowledging both its potential and limitations in generating meaningful and lasting good.

ICT4D research is inherently interdisciplinary because it straddles anthropology, sociology, economics, communications, education, political science, information technology, and humanitarian operations management. Figure 1 overviews various disciplines that touch on ICT4D research and highlights synergies between certain research areas. To help clarify how these diverse disciplines examine various aspects of ICT4D research, we provide examples of possible research questions scholars could explore in each of the areas (see Figure 1). To help direct our efforts in this lessons learned guide, we focus primarily on ICT4D research in two domains: humanitarian operations management and information technology (HOMIT).

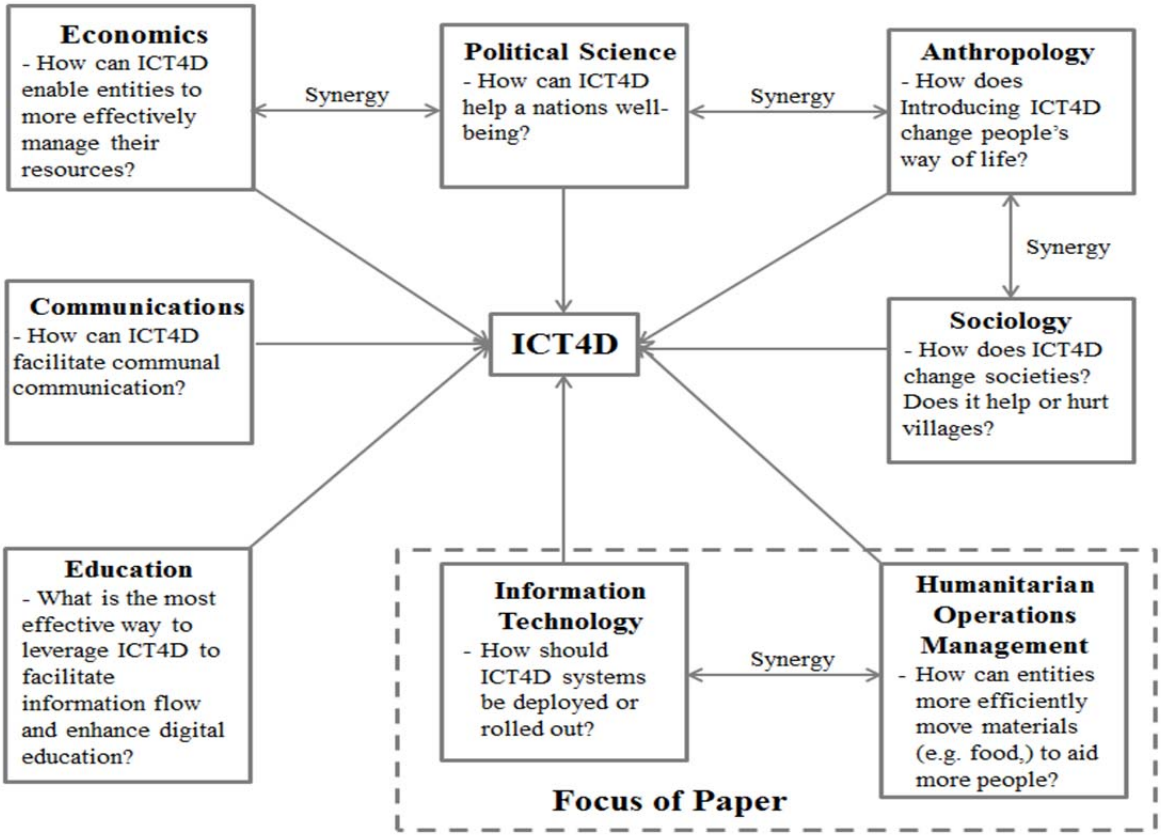

Figure 1. ICT4D Research's Interdisciplinary Nature

3 Conceptual Framework

As we note in Section 2, when we began these studies, we simply wanted to conduct research in an interesting context and, hopefully, extend theory in operations and/or IS research. We discovered along the way that we were not so much modifying our conceptualization of the study but instead actually attempting to make sense of the process scholars go through when conducting research in this area. We also realized that documenting our process and providing prescriptive guidance about how to overcome barriers we encountered might offer valuable insights to others who hope to start or are currently initiating this type of research. To accomplish the goal of making sense of the process, we sought a lens through which to guide our work. In what follows, we define the term cognitive schemas, discuss how our schemas evolved during our research journey, and highlight how cognitive schema evolution impacts the extent to which HOM research is successful. Using these schemas as a basis, we created a framework that highlights this cognitive schema transformation during the research process. We close with a discussion that ties our framework back to HOM research.

Our framework builds on other research processes that the extant literature discusses (e.g., DeTombe, 2002; Van Wassenhove & Pedraza Martinez, 2012) yet departs in several important ways. First, although the research processes put forth thus far are generalizable because one can apply them any research context, they fail to holistically explain the pitfalls and challenges unique to HOM research. Thus, they fall

short in providing prescriptive guidance to HOM researchers. Second, we focus less on the underlying problem or research topic at hand but more on how a scholar's cognitive schema evolves during the research process. We argue that scholars can successfully conduct ICT4D research projects more often by simply being conscious of their original cognitive schema and how it transforms during the process.

Research investigating cognitive schemas has a long tradition that extends back into the middle of the 20th century (Tolman, 1948); however, practical applications of theories of cognition and their impacts remain limited with some researchers calling for measuring schemas as a way of venturing outside of the "speculative stage" (Gould & White, 1974). Social schema research draws extensively on Hayes-Roth's (1977) theory of knowledge assembly, which suggests that schemas comprise components (cogits), which interact with other components through links (associations). Schemas begin as a collection of separate components but, over time, evolve into a tightly woven unit of strongly tied cognitions. Other scholars in psychology and organizational behavior research (e.g., Fiske & Dyer, 1985; Fiske & Taylor, 1991; Gioia & Chittipeddi, 1991) have described cognitive schema in significant detail, but, in short, cognitive scientists assert that schemas are cognitive representations of reality that have evolved from prior knowledge, memory, and interpretations of social information (Fiske & Dyer, 1985). In other words, cognitive schemas represent organized knowledge about a concept that shapes or influences what individuals perceive and remember (Fiske & Taylor, 1991). A schema acts as a mechanism to simplify and comprehend environmental signals and evolve through noticing cues, processing information, and subsequent sensemaking (Tallon & Kraemer, 2007; Weick, 1995). In Section 3.1, we discuss how our schemas intertwined with research.

3.1 ICT4D Research Process

Not surprisingly, our prior knowledge and things we found familiar (e.g., our reference disciplines and methodological expertise) guided our initial approach to ICT4D research (Fiske & Taylor, 1991). Our team itself came from diverse academic backgrounds: one had training in OM and supply chains, two were IS researchers, and one was an economist. In this section, we describe 10 steps that we undertook in the research process and how our schema evolved during this process.

We began our work much in the same way we would begin any research study. We started by talking with a humanitarian organization about their research interests and considered whether or not their interests overlapped with our research team's interests. Interestingly, the projects that we discussed all seemed to center on the technology tool rather than the contexts under which individuals use the tools. The IT tools we discussed were:

1. SCMIS: supply chain information systems used to enhance transparency of donations and supplies
2. FarmIT: IT-based training tool for farmers
3. BuilderIT: IT-based tool used to efficiently collect data to enhance decision making
4. ProtectionIT: IT-based tool used to send alerts to isolated villages to help mitigate the impact of violence, such as attacks for supplies and abduction of children or women
5. E-vouchers: IT-based tool used to securely transfer money and food vouchers to program participants
6. BarcodeID: IT-based tool used to register and track beneficiaries
7. Monitoring and Evaluation (M&E) system: IT tool used to monitor personnel, resources, and outcomes for beneficiaries
8. mHealth: mobile technology used to enhance access to health services for various target populations
9. iForm and Open Data Kit: mobile applications that facilitate data collection for evaluation and assessment of studies, and
10. GPS and pedometers: IT-based tools used to measure the distance individuals travel to collect water for household use.

Although we could not pursue all of these projects, our interaction with stakeholders from these various projects exposed us to a wide range of contexts, organization levels, and target beneficiaries, which allowed us to better understand unique characteristics inherent in research in developing nations. Even with a small subset of these projects, our research captured perspectives of local personnel, government

employees, and expatriates working in developing nations. Through our interviews, presentations, detailed email exchanges, and on-site visits (see Table 1), we also determined that many of these IT tools have been used in multiple applications that span water and sanitation projects, health, economics and entrepreneurship, child nutrition and maternal health, education, climate change, and others.

Using a variety of methods including personal journals, email threads, calendar entries, and notes, we retrospectively made sense of the process we undertook during the research inquiry phase, which spanned a 13-month period—we call this process the "ICT4D research process". In Figure 2, we overview the ICT4D research process, which is multidimensional in nature and spans four distinct levels: individual, research team, partner organization, and country. As we discuss the ICT4D research process, which comprises 10 steps, note that certain steps are level specific (e.g., step 5) while others span two (e.g., step 2) or three (e.g., step 8) different levels. Our experience suggests that the research process in developing nations is non-sequential and is more of an iterative process with multiple feedback loops, which creates complex interplay among different steps.

As we note above, we put forth a lessons learned guide for conducting humanitarian operations research. Therefore, as we present the ICT4D research process, we also discuss: 1) the unique challenges researchers face during each of the steps, 2) how researchers can overcome these barriers and, thus, contribute to this nascent research area, and 3) how our cognitive schemas evolved during our research journey, which may impact the probability of success.

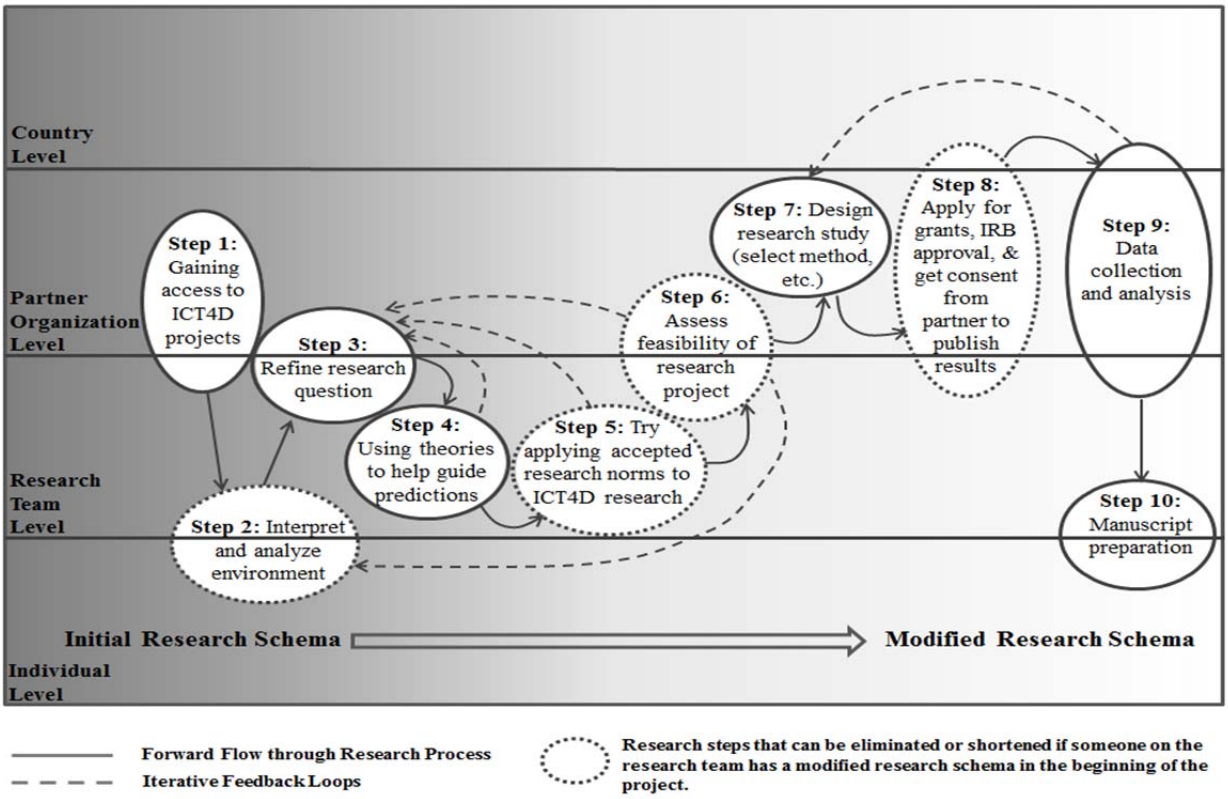

Figure 2. ICT4D Research Process

All scholars have an initial research schema that naturally influences their research process. In other words, scholars often have a particular way of conducting research that they have refined over time based on prior research experience conducted primarily in the Western world. Through the course of research, however, we discovered that this initial research schema, while beneficial when conducting research in traditional operations contexts, is too myopic and structured for humanitarian operations research. Specifically, traditional research efforts are more systematic and linear (e.g., describe problem/phenomena, apply theories, and develop hypotheses and model) (DeTombe, 2002) in contrast to ICT4D research. Consequently, to successfully navigate the iterative ICT4D research process, scholars slowly transform their cognitive schemas until they eventually reach a "new" or modified research schema that better suits research in the developing world (see right-hand side of Figure 2). As we note above, this

cognitive schema transformation plays a large role in the extent to which ICT4D research endeavors are successful. Therefore, when elaborating on each step in the ICT4D research process, we intermittently discuss how this cognitive schema transformation occurs.

3.1.1 Step 1: Gain Access to ICT4D Projects

ICT4D lies at the intersection of various sectors (e.g., government, academia, large corporations, non-profit organizations, and non-government organizations (NGOs)) (see Figure 1). To gain access to ICT4D projects, researchers typically need to partner with one of these entities. Scholars can partner with a variety of organizations such as United States Agency for International Development, Millennium Challenge Corporation, and Social Impact to gain access to ICT4D projects. Certain institutions are migrating faster toward more rigorous research studies than others, and, thus, scholars need to select their partner organization carefully. Other institutions, such as The Abdul Latif Jameel Poverty Action Lab (J-Pal) and Innovations for Poverty Action (IPA), are well known for conducting rigorous research in developing countries using primarily randomized controlled trials (RCTs) and, thus, may be an ideal partner organization if scholars wish to take that approach. Another alternative is to engage a funding agency, such as International Initiative for Impact Evaluation (3ie). These organizations are not necessary "partners" with the research team, but provide much needed financial support for research in developing countries (more on this later) and guidance on other aspects of the project (e.g., communicating findings to policy makers).

However, a NGO's (or other similar organization's) and scholars' objectives can differ, which can surface during various stages of the partnership because of the latter's initial cognitive schema. For instance, in one example we encountered, a regional director did not want to undertake a study that was designed to assess a technology's value. We intended to conduct a RCT in which we provided some regions with access to the technology solution but not others. While we found this design ideal, the regional director felt uneasy about offering a technology solution to certain regions and withholding it from others. In this case, because the partner organization's mission was to enhance the lives of as many people as possible, they resisted a research design that put beneficiaries in some regions at a short-term disadvantage. Similarly, if the partner organization agrees to an RCT, the research team has to ensure that the groups are selected randomly. During another study, the partner organization agreed to an RCT but selected the treatment and control group based on what they thought was best. It is easy to fall victim to situations such as this if the partner firm does not see value in rigorously designed research studies.

Other times, the partner organization agrees to a particular research design, but the participants "contaminate" the study. For example, during one RCT, some participants in a treatment group gave their supplies to participants (without the research team's knowledge) in the control group and invited participants from the control group to attend training sessions. Both the partner organization and research team were unaware of this contamination until a few months into the project. Scholars also have to be aware of studies that other agencies are conducting in the region. During another RCT, for instance, we discovered after the fact that another organization was conducting a similar study and that some of the participants in our control group were in their treatment group, which rendered the entire project useless.

Consequently, scholars have to not only partner with entities that see value in rigorous research methodologies and are willing to invest in long-term research efforts but also be aware of studies that other organizations are conducting in the area. If scholars partner with organizations that lack the same focus and/or are unware of studies in the surrounding regions, the partnership will likely result in wasted effort for both parties. Regardless of the organization that scholars partner with for their research, both parties need to clearly and promptly communicate their goals. In our experience, NGOs (or similar organizations) have a much different timeline than researchers and face different pressures (e.g., donors), which often cause them to deviate from agreed-on protocols. Expectations related to how and what will be published in the event that the results do not align with the perceptions of donors, sponsors, or other agents should be explicit. With that said, however, when partner organizations and scholars' objectives are properly aligned, their efforts can result in rigorous and highly impactful research. For example, rigorous studies that include experimental and quasi-experimental designs have been used in measuring the impact of many different projects, such as: 1) water quality in Burkina Faso, Kenya, and Ghana; 2) conditional cash transfers in Mexico; 3) teacher training in Uganda and Haiti; 4) microfinance in Thailand; 5) agriculture markets in Burkina Faso; and 5) text messages used to encourage healthy behavior in Uganda (Guzman, 2014b).

3.1.2 Step 2: Interpret and Analyze Environment

The numerous idiosyncrasies and nuances inherent in ICT4D research across regions and contexts requires researchers to engage in sensemaking early in the research process. As the name suggests, sensemaking means "the making of sense" (Weick, 1995, p. 4) and involves the "structuring of the unknown" (Waterman, 1990, p. 40). As Figure 2 shows, this step is multidimensional because it straddles the individual and research-team levels. When researchers engage in sensemaking at the individual level, they begin to realize that their initial cognitive schema may be ill-suited for research in this context but still believe they can modify their conceptualization of the study to align with their initial schema. When sensemaking occurs at the research team level, it is known as collective sensemaking (Weick, Sutcliffe, & Obstfeld, 2005); when this occurs, there may be underlying traces of sensegiving, which is when individual sensemaking processes are linked or interconnected across researchers (Whiteman & Cooper, 2011). Specifically, sensegiving refers to when actors attempt "to influence the sensemaking and meaning construction of others towards a preferred redefinition of…reality" (Gioia & Chittipeddi, 1991, p. 442). Several factors, such as complexity, can trigger sensegiving (Whiteman & Cooper, 2011). Because ICT4D research occurs in particularly ambiguous and complex environments, researchers need to be cognizant of sensegiving to ensure they do not adopt a preferred redefinition of reality in lieu of interrupting environmental cues.

While research in any context requires some degree of sensemaking, this process in the context of ICT4D research is particularly nuanced and challenging. Indeed, scholars have commented that research on HOMIT "differ[s] markedly from those of conventional supply chains associated with profitable enterprises" (Starr & Van Wassenhove, 2014, p. 925). Similarly, Bhattacharya, Hasija, and Van Wassenhove (2014, p. 1511) note there are numerous "differences between the design requirements of humanitarian logistics systems and those of corporate supply chains". Sensemaking in developing nations, for example, usually entails learning about socioeconomic conditions and cultural traditions and understanding societal norms. In particular, the need to understand varying dynamics between regions (e.g., the hierarchy of people living in villages in developing countries) can be particularly foreign to researchers and, thus, overwhelm their information-processing capabilities. As such, this step often requires an iterative approach in which researchers repeatedly interpret and analyze the environment of study to unpack the specific idiosyncrasies and nuances relevant to their research context (Ancona, 2012). Starbuck and Milliken (1988) use "perceptual filter" as a metaphor and argue that this filter helps individuals sift through all the information that they are receiving by amplifying some stimuli and dismissing others. Consequently, in ICT4D contexts, researchers often need to use a mixed-methods approach (i.e., use both quantitative and qualitative tools) to help themselves understand the environment.

Understanding the environment is critical to a project's success. Many cultural aspects, such as language and the concept of time, influence how research is conducted in developing countries. In many cases, the local language is different from the country's official language, and, thus, many concepts cannot be translated seamlessly. For example, in one study, we wanted to understand the perceptions of men and women about their ideal family size, so we asked "what is the ideal number of children a family should have?". The word "ideal" did not exist in certain local villages, so the interview data we captured did not make sense. Similarly, in Indonesia (Eder & Khatiwada, 2016), to assess infant development, we adapted preexisting tests from the Western world that contained the word "peekaboo". We discovered, however, that an equivalent to the word "peekaboo" did not exist in Indonesia, nor could we effectively explain what "peekaboo" meant to our enumerators (locals involved in the data-collection efforts). As such, we had to eliminate that part of the test from the study. Also, when translating questions into local languages, scholars have to be particularly careful that they do not alter a question's meaning or intention in the process.

Time is another concept that varies according to the culture and the context, and it affects even the most simple questions such as "how old are you?". In many rural areas in Africa, one cannot trust the answer to this question because, in some cases, no formal records exist and, in other cases, individuals purposefully report fraudulently for a variety of reasons. Another example of how time affects research in developing nations is in appointments and schedules: "I will pick you up at 9am" does not mean the same thing in different parts of the world. Sometimes, it means 30 minutes later, and, in some countries, it broadly means sometime in the morning. Obviously, it is important to understand these contextual issues very early in the project as time delays can dramatically impact deliverables.

3.1.3 Step 3: Refine the Research Question

After interpreting and analyzing the environment, researchers have a more holistic understanding of the context and can begin to refine research questions. Scholars often start with a portfolio of research questions that emerge naturally as a result of their reference discipline or research expertise and focus. These questions then evolve depending on the NGO's (or other partner organization's) needs and pragmatic considerations regarding their feasibility given the research team's interpretation and analysis of the environment (see step 2 in Figure 2). In particular, identifying a subset of research questions of mutual interest to both the partner organization and the researchers is critical in ICT4D research. Conducing ICT4D research requires a considerable investment of time and resources on behalf of the partner organization and the researchers, and, thus, to increase the likelihood of a project's success, both parties need to have a strong interest in the selected research question. As such, this step straddles two dimensions: partner organization level and research-team level (see Figure 2). Once both parties select a research question (or set of research questions), the researchers can continue with the research process. Note, however, that the research team may revisit the original research question and, thus, revert back to this step during the iterative research process.

Iterating on and refining the research question is a common practice when conducting research in developing countries. When we conducted a research project with a hospital in Zambia, our initial research question was "how does employee satisfaction affect the quality of patient care?". As the project evolved, so too did the research question, and we eventually conducted a market study about how people decide to go to the hospital or the local health facility. In this situation, the question changed due to our poorly understanding the context, the partner organization's lack of interest, and the research methods' impracticability.

3.1.4 Step 4: Use Theory to Help Guide Predictions

After identifying a research question, the team turns to the extant literature to find theories that would help guide their research efforts. Note, however, that, in some cases, research questions originate or evolve because extant theory does not exist. In our case, we encountered a significant obstacle in that existing theoretical frameworks were not available, so we reverted back to the previous step (the dashed line in Figure 2 denotes this feedback loop). We specifically sought theories that applied directly to ICT4D research but discovered limited information. The University of Manchester's Development Informatics Group has a project underway to develop a series of publications that draw on a wide range of theoretical ideas to support ICT4D researchers, but this project is still in the early stages. Although most researchers may view the lack of theory as an obstacle, we viewed it as an opportunity to develop more elaborate theories of ICT4D.

Applying/using existing theory is a good starting point, but, as step 3 describes, researchers need to be agile and willing to iterate. In particular, they need to find a balance between existing theory, their data, and practical limitations. One avenue available to developing-world researchers is to see how well existing theories (most of which originated in developed contexts) translate to developing or undeveloped contexts. Indeed, Zhu, Kraemer, and Dedrick (2004, p. 39) note that "most theories were developed in the context of industrialized countries and…these theories need to be reexamined in the context of developing and newly industrialized countries". In an early study, we used behavioral economic principles for guidance when we realized it was not feasible to carry out a natural experiment. Similarly, in Mali (Bleck, 2013), we examined how membership in local discussion groups affected trust, tolerance, and the sharing of public goods. Using game theory, we looked at the community members' capacity to provide shared goods and how ethnicity, gender, and community membership impacted decisions. Game theoretic predictions suggested how subjects should respond, but we discovered that certain characteristics, such as contrasting ethnicities in pairings, drastically altered results. Because the context was simulated and experimental rather than real life, we could manipulate treatments more easily than studies in natural settings.

Scholars also need to scrutinize the underlying assumptions on which most studies in developing countries rely. For instance, the majority of studies that examine the impact of water wells and pumps in developing countries assume that they improve the health of locals, increase economic opportunity for the community, and allow women (who are usually responsible for carrying water to villages) time to undertake other ventures. While these benefits are intuitive, scholars have found it extremely difficult to prove these outcomes. Research confirming (or refuting) the underlying assumptions that most ICT4D studies rely on could offer particularly enrich insights and guidance for future research in this area.

3.1.5 Step 5: Trying to Apply Accepted Research Norms to ICT4D Research

ICT4D research is particularly interdisciplinary (see Figure 1) and, thus, unlike research in other domains, may not lend itself to the "traditional" research norms most scholars adhere to. Consequently, our pragmatic initial approach was to adhere to the research norms in research team members' reference disciplines. Given the varied and unique nature of research in humanitarian contexts, this approach may not always be feasible because it requires scholars to modify their cognitive research schemas and adopt new research customs. At this point in the research process, scholars often realize that they may not be able to modify their conceptualization of the study to align with their initial schema, and, thus, their research schema begins to transform. If the IT community views ICT4D research to be of considerable interest, they should be prepared to engage in a cognitive schema-transformation process during this step to more successfully navigate the nuances of this study context. If researchers, however, are unable or unwilling to adopt a modified research schema, we recommend that they end the research partnership as the probability of success is minimal.

Researchers' being unable or unwilling to adopt a modified research schema tends to be one of the most salient issues for new researchers in the developing-world context. Each new project provides new opportunities for learning, and no two projects—even those in the same country or village—are the same. A specific example in which the research team, which included an author of this manuscript, faces difficulty in modifying their individual schemas was during a project in Mozambique (Guzman, 2014a). The team wanted to analyze the effectiveness of local disaster committees (related to climate change and other natural disasters) in communicating risks to constituents. The research team came from diverse disciplines including economics, political science, and climate change. Bringing together researchers from various backgrounds can be a double edged sword: it can help ensure the research is rigorous and generalizable, but it can also produce myopic, discipline-specific philosophies that conflict with each other. Specifically, the scholar from economics wanted to approach the project from one perspective, yet the scholar from political science wanted to approach the project from a different perspective; their approaches conflicted with each other, which created a troubling situation. In our case, these philosophical differences resulted in the team's not being able to agree on a particular research design prior to kicking off the project. Once the team arrived in Mozambique, however, they were able to gather additional information about the context, which helped them modify their individual schemas and allowed the group to agree on a research design.

3.1.6 Step 6: Assess Feasibility of Research Project

After gaining access to a research project and selecting intriguing research questions, scholars in developed and developing countries have to assess the project's feasibility. However, researchers should consider several specific challenges when assessing the feasibility of an ICT4D research project, which are unique to this context. The first challenge centers on the availability of high-quality data for research. Our experience suggests that ICT4D research is particularly susceptible to a dissonance between staff perceptions of the availability of high-quality data for research and the reality on the ground. Another challenge inherent in ICT4D research is the travel requirements associated with particular research projects. Depending on the research team's methodological expertise, collecting data in developed countries often requires little (or no) travel but collecting data in developing countries often requires a significant amount of time and travel; this discrepancy fuels a researchers' cognitive schema evolution. Specifically, if researchers wish to limit their travel requirements, they can hire third parties to collect data for them. Data collection by third parties, however, can be unreliable, expensive, or both (more on this below). Consequently, the research team needs to be open to traveling (at a minimum for short intermittent periods) to the data-collection sites to ensure the validity and quality of the data being collected. Assessing the feasibility of various research projects is one point in this process where the iterative nature of ICT4D research is particularly salient: it often requires researchers to re-evaluate the environment (step 2 in Figure 2) and/or available research questions (step 3 in Figure 2) to identify questions of interest that are doable in the constraints of the context and researchers' resources. Once the research team and the partner organization deems the chosen research question(s) to be feasible, the research team can continue to the next stage of the research process.

Field site visits are typically mandatory when conducting developing-world research. Not every member of the research team needs to visit the site, but at least one or two members should be on-site to ensure the project is feasible and properly designed. Specifically, gathering information about where, how, and when a project will begin is critical to maximizing the product's probability of success. Due to language barriers

and cultural differences, pivotal information can get "lost in translation", and, thus, this information can only be accurately obtained when a member from the research team is on-site. Similarly, researchers may foresee potential issues and, thus, may be able to influence the project's design before it is implemented to maximize the probability of success considering the limitations specific to each context.

Accounting for all of the cultural and logistical challenges associated with conducting research in remote locations is simply not possible without spending time on-site. In Burkina Faso (Guzman, 2013), we designed an RCT to measure the impact water wells had on the health and economy of the people they served. Only after being on-site did we realize that several factors, including cultural issues, divergences in the concept of time, and the distance between villages, would have made it extremely difficult (if not impossible) to successfully execute an RCT in this context. Consequently, we realized we would not have the proper controls in place to do random assignments; thus, we ended up changing the study's design and objective from examining the impact of the water wells to examining the process by which the water wells were built (which reinforces the insights from steps 3 and 4 in Figure 2).

One way for scholars to streamline this step is to collaborate with local experts (e.g., professors from a local university), which offers several benefits. First, local experts often have an idea of what projects are feasible in the surrounding region and, thus, can reduce the probability that a team will have to revert back to a previous step. Second, it lessens the travel requirements for a particular research project because local experts are often in (relatively) close geographic proximity to where the project will be conducted. Third, it can help bridge the divide between language and cultural differences among the research team, enumerators, and other locals. Lastly, it can eliminate the need to hire third parties to collect data because the local expert is on-site to help oversee and train enumerators.

3.1.7 Step 7: Design Research Study

Because researchers' cognitive schemas will have progressively transformed during the research process, they will discover that designing research projects in developing countries differs significantly from designing projects in developed countries. Consequently, they will realize that certain methodologies may not be amenable in developing counties. Some authors note, for example, that participatory action research (Cassell & Johnson, 2006) may not be appropriate in this context but inductive action research can be effective (Braa, Hanseth, Heywood, Mohammed, & Shaw, 2007; Braa, Monteiro, & Sahay, 2004). Below, we suggest empirical methodologies that are potentially well suited for most ICT4D empirical research:

- **Case study methodology**: case-based research involving face-to-face interviews, archival records, and observation is particularly well suited for investigating topics for which little pre-existing theory exists; thus, this methodology is appropriate for ICT4D research. Observation can be particularly enlightening during ICT4D research endeavors because relying solely on interviews or archival records could result in researchers' losing rich insights about the context or inter-play among actors. Participants, for example, may be so accustomed to various practices or processes that they will group certain steps or skip over steps during interviews. Similarly, participants may not be aware of intangible factors (e.g., cultural evolution) that slowly shift overtime and, thus, not communicate them during interviews. Consequently, gathering observational data allows researchers to capture important information such as insights about every step in a process (e.g., harvesting crops) or if and how the dynamics changes among members in a village when ICT4D projects are deployed.
- **Evaluation of secondary or observational data**: while rare, there are instances where partner organizations have existing data on beneficiaries, suppliers, and outcomes via their IT systems or through their monitoring and evaluation efforts. When this data is of reasonable quality, it can be a valuable resource for evaluating the effect of ICT4D related interventions on organizational effectiveness and outcomes for beneficiaries. The challenge with this data is that selection concerns often persist for most independent variables of interest, which results in considerable endogeneity concerns. For instance, NGOs or regions that adopt technology systems that enhance ICT4D efforts may be different in other ways that also influence the benefits their beneficiaries realize. Moreover, if omitted variables exist, it is often prohibitively costly (if not impossible) to retrospectively collect these data.
- **Randomized controlled trials (RCTs)**: RCTs are an increasingly popular (albeit costly) empirical approach in medicine, economics, and other disciplines. With ICT4D research, RCTs remain the gold standard for causal empirical research. Ideally, researchers should collect data

before and after they initiated the intervention to assess the effectiveness of their randomized intervention. While ideal, such an approach is often not feasible because scholars widely acknowledge that data typically does not exist before research projects are conducted in developing countries. The RCT, by and large, addresses the endogeneity concern associated with most dependent variables of interest in ICT4D research. This approach's downsides include requiring a considerable financial investment, determining available interventions that can be randomly assigned, controlling for differences between samples, and finding a partner organization interested in rigorous empirical research with potentially uncertain short-term results. In addition, some have argued that RCTs are not suitable for broad policy changes since they are typically limited in scope to small-scale projects]. Further, there is an open question whether withholding an intervention from potential recipients is ethical. These issues do not mean that RCTs are impossible to execute in developing countries or that researchers should not undertake them. To the contrary, one cannot discount the advantages of random assignment, control over the study, and true insights into cause and effect, and these approaches can still have high external validity if they represent other contexts of interest well.

The particular approach that researchers choose should reflect their research objectives and constraints. Across these methodological approaches, researchers need to carefully weigh the benefits and risks of longitudinal versus cross-sectional data collection. Developing countries have a unique and complex context, which may cause the change process to evolve much slower than in developed countries. For example, to capture a holistic understanding of ICT4D's true impact, researchers may need to capture insights over an extended period of time that takes years rather than months. On the other hand, multi-period longitudinal projects allow for a plethora of events to arise that could bias the data and lead to inaccurate conclusions. In the case of our sustainability research in Indonesia (Khatiwada, 2014), we returned to the region almost seven years after we implemented the project. When designing a multi-period longitudinal project, we hoped to capture rich insights on the project's lasting effect on the population. However, after seven years, we could not detect significant differences between the treatment and control villages, and we could not conclude if this lack of difference was positive or negative. It could be positive if the target population improved so much that they were no longer at a disadvantage. Conversely, it could be negative if they had an advantage during the project implementation that was simply lost over time. Additionally, with so much time passing between project implementation and returning to the villages, there could be intervening factors that altered the effects of the study. Determining the ideal time between implementing a system and returning to the site in developing countries is fraught with tradeoffs: projects need to be long enough to capture the true impact of designed interventions but short enough to mitigate the probability of unintended events that could contaminate the data.

3.1.8 Step 8: Apply for Grants, Get Institutional Review Board Approval, and Seek Authorization from Partner Organization to Publish Findings

Conducting ICT4D research can be extremely resource intensive, and, thus, grants are often necessary. The business school context is unique in that professors are not as accustomed to seeking funding as are professors in other disciplines. When we began to see the need for financial support, we investigated internal funding mechanisms in our business school. Many researchers may not have that option, so it might be necessary for them to partner with others who are familiar with grant writing and seeking funds from external agencies. If the research team requires one to collect data in remote locations (e.g., African villages), third party data collection firms will often charge in excess of US$100,000 for a single wave of data. Although this alternative is more financially demanding, it offers benefits when the sample size or the geographical area that needs to be covered is extremely large; it is also a good alternative when enumerators are unreliable or deceptive (e.g., enter fake responses). A less expensive alternative is for the research team to collect the data themselves; this approach can be orders of magnitude cheaper than third party data collection but will require significantly more time and effort on the research team's behalf. The latter approach, however, allows the researchers to be more involved in the process, and, thus, they often have more confidence in the data and better understand the context. Each alternative offers benefits, and, therefore, the research team members have to decide which approach is most appropriate for them depending on resources they have available and their time pressures.

Scholars who conduct research with human subjects understand they need to get approval from their university's institutional review board (IRB) before beginning the project. Scholars new to ICT4D research, however, are often unaware that they may also need IRB approval from the country in which they plan to

conduct the research project. Consequently, Figure 2 shows, this step in the research process straddles three dimensions: country, partner organization, and research team, which can significantly complicate and lengthen the review process.

The final part of this step is to obtain authorization from the partner organization to publish findings even if the research team discovers that certain interventions do not have the intended results. An IT system, for example, designed to enhance output could, in fact, reduce output. If this is the case, the partner organization may not want the research team to publish their findings. If the research team does not get authorization from the partner organization to publish their findings (whatever they may be), the partner organization can actually prevent the researchers from doing so. Consequently, it is critical to get authorization sooner rather than later. We believe this is the appropriate step to ask for such authorization as the researcher team has developed a certain level of trust with the partner organization. If researchers ask for this authorization too early in the research process, it can damage the relationship; however, if they ask for it too late, the partner organizational may realize their program does not have the intended benefits and, thus, may not authorize the researchers to publish their findings.

Getting IRB approval at the university level is typically a well-understood process that requires few resources. IRB approval at the country level, however, can be resource intensive (some countries assess an application fee) and take 9 months or more to get approval. Consequently, the in-country IRB paperwork needs to be submitted well in advance; if not, it can significantly delay the project. Researchers should also be aware that several countries such as Burkina Faso or Haiti do not have an established IRB process and that, instead of an IRB, one may need a permit to conduct research as is the case in Indonesia. If conducting research in these countries, the research team must find a local expert who can review the research protocol and determine if the research team can execute the project. If the research team is unable to find a local expert to review the protocol and/or the IRB guidelines are unclear, the research team will need to acquire a research permit from a local authority. In sum, there is no universal approach to obtaining in-country IRB approval, and, thus, the best approach may be to contact several people in the country where the research will be conducted to ensure one follows the correct procedures.

3.1.9 Step 9: Collect and Analyze Data

After researchers design the study and gain IRB approval at the university and country levels, they can begin collecting data. As we previously note, a large majority of researchers should be involved (at least to some degree) in collecting data because it enhances their confidence in its integrity. Their involvement will depend on their knowledge of the local customs and their ability to communicate with the subjects. Scholars new to ICT4D research should be aware that one can identify most data-collection errors at specific steps during the data collection process, which include: 1) while training enumerators, 2) during pilot tests, and 3) during discussions with local experts. Local experts or people from the area who give their opinions on what might work and what might not can significantly enhance a research project's instruments, protocols, and analysis. Respondent bias, which occurs when enumerators and/or researchers unintentionally influence the respondent's answers to questions, could also be problematic when collecting data. Researchers can try to minimize this bias by rigorously training enumerators, precisely wording questions, and carefully constructing consent forms.

However, researchers need to also consider the propensity of interfacing directly with foreign researchers of different racial and cultural backgrounds to interfere with data collection. For instance, when researchers from the United States or other Western countries are visible during the data collection, participants (especially in developing countries) may have an increased desire to provide socially desirable answers. More pragmatic considerations can also drive limited direct involvement on behalf of the research team in collecting data (e.g., limited knowledge of local slang). It may be beneficial, however, for at least one of the principal researchers to be on site yet non-obtrusive during the data collection to help train enumerators and to oversee the data-collection process. If no one from the research team is present, enumerators may be more likely to contaminate the data by entering false responses or by other means.

Depending on the research methodology employed, one can begin analyzing data as they collect it (e.g., case-based research) or afterwards (e.g., survey research). If employing case-based research, one should let the emergent themes surface from the data without relying on preconceived notions. At this point in the research process, scholars have almost reached a new, modified research schema and, thus, have a much better understanding of how research in developed countries differs from research in developing countries. Even with this modified schema, however, researchers will naturally approach data

analysis (particularly with case-based research) with certain core assumptions on which past studies rely. However, common attributes and relationships among attributes in developed countries may not transcend to developing countries, and, thus, researchers need to approach the data analysis without any preconceived biases. When conducting survey research, data cleaning and quality controls are prerequisite steps to data analysis. Similar to survey data collected in developed countries, survey data gathered in developing countries often has errors that need to be dealt with prior to analysis.

Note that, once in-country data collection begins, the research team may realize that they may not be able to perform the study they designed in step 7 (see Figure 2) or that they may have a particularly low probability of successfully completing it. Thus, researchers should perform a pilot of the study first so that they can make adjustments if necessary. If the research team can conduct a pilot, they will either 1) revert back to step 7 (if they have sufficient resources) to redesign the study or 2) adjust their expectations and/or research design on the fly to accommodate the new or non-optimal circumstances.

Data collected in developing countries tends to require significantly more cleaning than data collected in developed countries partly because most surveys are paper based or interview based, which use more unstructured data. There are also issues of legibility and language interpretations, lack of experience working with surveys, and discrepancies due to contextual differences. For example, questions that require an answer in the local currency are often not consistently recorded due to rapidly changing currency values and differences in local slang when referring to otherwise identical amounts of currency (e.g., 2500 Ugandan dollars may be referred to locally as 25). Age is another area where errors can occur either because of input problems or because people do not keep track of time in the same way as in Western cultures, which results in the reported age of a person not corresponding to their actual birthdate.

This step is another junction in the research process in which it can be beneficial to partner with local experts who can "validate" the study's results and, thus, increase the research findings "face validity". This approach is similar to "member checks" (Guba & Lincoln, 1982) in the interpretive research context, which is a process researchers use when analyzing data to help them verify their projects' overall results (Morse, Barrett, Mayan, Olson, & Spiers, 2008).

3.1.10 Step 10: Prepare the Manuscript

As we noted above, humanitarian research has seen increasingly interest. Specifically, in 2011, *Interfaces* published a special issue on humanitarian applications of operations research and management science and another special issue. Moreover, in 2014, *Production and Operations Management* published a special issue on humanitarian operations and crisis management. These special issues along with other efforts to promote more research in this nascent area will likely pay dividends in years to come. Beyond the scholarly publications that academics seek, partner organization will commonly request a white paper or practitioner-focused report. The organization we partnered with, for example, requested that one of the deliverables of our research partnership was a report they could distribute to their donors that showed the impact they were making in developing nations around the world. Although writing these non-academic papers may be time consuming, it is an excellent way to establish lasting relationships for future research partnerships.

Donors and funding agencies strongly encourage that researchers write papers in collaboration with local researchers to retain some of the knowledge in the region after international scholars leave projects. It is always a good idea to share manuscripts with local organizations before publishing, especially when the findings might negatively affect a project. It is also good practice to let them comment on the manuscript since they might have insights that researchers missed. We have also run into situations where data contractually belongs to the partner or local organization. In situations such as this, clauses in the contract must clearly establish the rules about reviewing and publishing results from the research. Finally, as with any multi-disciplinary research team, members should agree on the types of journals that will be targeted prior to beginning the study. The choice of journals can influence the research method(s), the theoretical basis, and the type of study conducted.

3.2 Modified ICT4D Research Process

Research teams can modify the 10-step research process if the team includes someone (e.g., a local expert) with a modified research schema during the beginning stages of the process. In this situation, the research team can circumvent various steps (e.g., step 5) and can shorten other steps (e.g., steps 2, 6, 8). For example, a research team can significantly shorten step 2 (interpret and analyze environment) if

the team has an individual with a modified research schema because they can clarify and provide additional information while the other researchers are engaging in sensemaking. In these situations, however, there is a high probability of sensegiving, and, thus, the researcher with the modified research schema needs to recognize that they are providing clarifying facts rather than encouraging other members of the research team to adopt a preferred redefinition of reality. Similarly, research teams can eliminate step 5 (trying to apply accepted research norms) because a researcher on the team already understands that conducting research in developed countries differs considerably from conducting research in developing countries. Consequently, the team can bypass this step. As we note above, the research team can also shorten the next step (assess feasibility of research project) because a member is well aware of what is feasible in developing countries and what is not. The last step that one can condense is step 8 (apply for grants, IRB approval, and get consent from partner to publish results). Scholars who have a modified research schema also, most likely, have experience writing grants for ICT4D research and getting in-country IRB approval and, thus, can streamline both tasks in this step of the process.

4 Implications for Scholars, NGOs, and Government Agencies

This research offers implications for scholars, practitioners, and government agencies alike. From a research perspective, this study provides a rich lessons learned guide for conducting ICT4D research (Table 2 summarizes the key challenges ICT4D researchers face). With this tutorial in hand, we hope that scholars will avoid common pitfalls and overcome unique challenges inherent in ICT4D research. Moreover, discussing the challenges most scholars face while doing ICT4D research and providing prescriptive guidance on how to overcome these challenges may increase the likelihood of successful ICT4D research projects in the future. It is particularly critical given the need to encourage scholars new to ICT4D to undertake research in this emergent area.

Table 2. Summary of Key Challenges Faced by ICT4D Researchers at Each Step of the Research Process and Guidance about How to Overcome Challenges

ICT4D research process steps	Key challenge(s)	How to cope with the key challenge(s)
Step 1: Gain access to ICT4D projects	• Partnering with organizations that have access to ICT4D research projects.	• Partner with an organization whose objectives are aligned with the research team's. • Clearly communicate with partner organization about goals and timelines. • Be aware of research projects by other organizations in the surrounding region.
Step 2: Interpret and analyze environment	• Understanding societal norms. • Interpreting the specific idiosyncrasies and nuances relevant to this "new" research context.	• Begin sensemaking process.
Step 3: Refine research question	• Selecting interesting and relevant research question(s).	• Identify a subset of research questions that are of mutual interest to the partner organization and research team. • Select "final" research question.
Step 4: Use theories to help guide predications	• Drawing on extant theories to help frame/guide research.	• Look to modify theoretical frameworks from different disciplines to help guide research.
Step 5: Try applying accepted research norms to ICT4D research	• Adapting to new research customs.	• Modify research schema.
Step 6: Assess feasibility of research project	• Collecting high-quality data. • Determining travel requirements and available resources.	• Determine if project is feasible in chosen region with allotted resources.
Step 7: Design research study	• Selecting empirical methodology that is well suited based on the research question, context, researcher expertise, objectives, and constraints.	• Weigh the benefits and risks of a longitudinal versus cross-sectional research design.

Table 2. Summary of Key Challenges Faced by ICT4D Researchers at Each Step of the Research Process and Guidance about How to Overcome Challenges

Step 8: Apply for grants, IRB approval, and consent to publish results	• Deciding which grants are available and appropriate for the research study. • Obtaining authorization from partner organization to publish results (regardless of findings).	• Obtain IRB approval from the university and country in which the research will be executed (the latter can be particularly challenging and costly).
Step 9: Collect and analyze data	• Deciding how much the research team should be involved with collecting data.	• Depending on the research method selected in step 7, researchers may encounter issues of legibility and language differences if using survey or case research. • Allow additional time and resources for cleaning data. • Do not approach the data analysis with the same core assumptions that exist in research conducted in the developed world.
Step 10: Prepare the manuscript	• Writing academic and non-academic papers.	• Prepare academic manuscripts for journal submission. • Write white papers and/or practitioner-focused reports for partner organization.

For NGOs and government agencies, we provide insight into the support and access scholars need to conduct rigorous research investigations. For example, conducting a RCT in which certain regions are provided access to a technology solution and others are not may be undesirable from an NGO's perspective because it puts people in certain regions at a short-term disadvantage. However, such a design can provide more rigorous insight into the true value of certain technology solutions and can allow the NGO and/or government agencies to make more educated decisions about which projects to terminate and which projects to allocate more resources to. Similarly, people that have worked in developing countries for an extended period of time on behalf of an NGO and/or government agency may not be aware of the cognitive schema-transformation process. By highlighting this process, NGO and/or government agency representatives may be able to facilitate a researcher's cognitive schema evolution, which may reduce the frequency of feedback loops and may help streamline the overall research project.

5 Conclusion

The allure of conducting research on ICT4D can be profound because it allows academics to help others in developing countries by discovering ways they can enhance their way of life. Research in this area does not often lend itself to traditional research norms, and, thus, scholars who are eager to do research in this area are often left confused, overwhelmed, and, ultimately, discouraged. In this paper, we shed light on "the process" of conducting these studies and provide guidance on how researchers can overcome common challenges encountered along the way. We hope this lessons learned guide can serve as a catalyst for more research in this extremely important yet underdeveloped research area.

References

Altay, N., & Pal, R. (2014). Information diffusion among agents: Implications for humanitarian operations. *Production and Operations Management*, *23*, 1015-1027.

Ancona, D. G. (2012). *Sensemaking: Framing and acting in the unknown the handbook for teaching leadership* (1st ed.). Thousand Oaks, CA: Sage.

Balcik, B., & Ak, D. (2014). Supplier selection for framework agreements in humanitarian relief. *Production and Operations Management*, *23*(6), 1028-1041.

Bhattacharya, S., Hasija, S., & Van Wassenhove, L. N. (2014). Designing efficient infrastructural investment and asset transfer mechanisms in humanitarian supply chains. *Production and Operations Management*, *23*(9), 1511-1521.

Bleck, J. (2013). *USAID Mali political trust, tolerance, and public goods study*. Final Report to USAID.

Braa, J., Hanseth, O., Heywood, A., Mohammed, W., & Shaw, V. (2007). Developing health information systems in developing countries: The flexible standards strategy. *MIS Quarterly*, *31*(2), 381-402.

Braa, J., Monteiro, E., & Sahay, S. (2004). Networks of action: Sustainable health information systems across developing countries. *MIS Quarterly*, *28*(3), 337-362.

Cassell, E., & Johnson, P. (2006). Action research: Explaining the diversity. *Human Relations*, *59*(6), 783-814.

Dedrick, J., Kraemer, K. L., & Shih, E. (2013). Information technology and productivity in developed and developing countries. *Journal of Management Information Systems*, *30*(1), 97-122.

DeTombe, D. J. (2002). Complex societal problems in operational research. *European Journal of Operational Research*, *140*(2), 232-240.

Ergun, O., Gui, L., Stamm, J. L. H., Keskinocak, P., & Swann, J. (2014). Research and management insights: Improving humanitarian operations through technology-enabled collaboration. *Production and Operations Management*, *23(*6), 1002-1014.

Fiske, S. T., & Dyer, L. M. (1985). Structure and development of social schemata: Evidence from positive and negative transfer effects. *Journal of Personality and Social Psychology*, *48*, 839-852.

Fiske, S. T., & Taylor, S. E. (1991). *Social cognition*. New York: McGraw-Hill.

France-Presse, A. (2013). Digital divide still wide in developing world. *Globalpost*. Retrieved from http://www.globalpost.com/dispatch/news/afp/130410/digital-divide-still-wide-developing-world

Gioia, D. A., & Chittipeddi, K. (1991). Sensemaking and sensegiving in strategic change initiation. *Strategic Management Journal*, *12*, 433-448.

Gould, P., & White, R. (1974). *Mental maps*. New York: Pelican Books.

Guba, E. G., & Lincoln, Y. S. (1982). Epistemological and methodological bases of naturalistic inquiry. *ECTJ*, *30*(4), 233-252.

Guzman, J. C. (2013). Clean water wells: building and evaluating the impact of wells in Burkina Faso. *Notre Dame Initiative for Global Development.* Retrieved from http://ndigd.nd.edu/assets/175331/cs_burkina_faso.pdf

Guzman, J. C. (2014a). *3IE climate change adaptation: Mozambique* (working paper).

Guzman, J. C. (2014b). *Mobile literacy for health: Enhancing communication, mobile literacy, and monitoring applications to improve health service delivery in Uganda* (working Paper).

Hayes-Roth, B. (1977). Evolution of cognitive structure and process. *Psychological Review*, *84*, 260-278.

Holguín-Veras, J., Jaller, M., Van Wassenhove, L. N., Pérez, N., & Wachtendorf, T. (2012). On the unique features of post-disaster humanitarian logistics. *Journal of Operations Management*, *30*(7), 494-506.

Howard, P. N., Duffy, A., Freelon, D., Hussain, M., Mari, W., & Mazaid, M. (2011). *Opening closed regimes: What was the role of social media during the Arab Spring?* Retrieved from http://pitpi.org/wp-content/uploads/2013/02/2011_Howard-Duffy-Freelon-Hussain-Mari-Mazaid_pITPI.pdf

Eder-Parker, C., & Khatiwada, L. (2016). Sustainability of a community-based CHOICE program to improve the health and nutrition of mothers and infants in Indonesia (working paper).

Kling, R. (Ed.). (1996). *Computerization and controversy: Value conflicts and social choices* (2nd ed.). San Francisco: Morgan Kaufmann.

Lotan, G., Graeff, E., Ananny, M., Gaffney, D., & Pearce, I. (2011). The revolutions were tweeted: Information flows during the 2011 Tunisian and Egyptian Revolutions. *International Journal of Communication*, *5*, 1375-1405.

Martens, B. J., Scheibe, K. P., & Bergey, P. K. (2012). Supply chains in Sub-Saharan Africa: A decision support system for small-scale seed entrepreneurs. *Decision Sciences*, *43*(5), 737-759.

Matopoulos, A., Kovács, G., & Hayes, O. (2014). Local resources and procurement practices in humanitarian supply chains: An empirical examination of large-scale house reconstruction projects. *Decision Sciences*, *45*(4), 621-646.

McKenna, L. (2012). The big idea that can revolutionze higher educations: “MOOC”. *The Atlantic.* Retrieved from http://www.theatlantic.com/business/archive/2012/05/the-big-idea-that-can-revolutionize-higher-education-mooc/256926/

Montealegre, R. (1999). A temporal model of institutional interventions for information technology adoption in less-developed countries. *Journal of Management Information Systems*, *16*(1), 207-232.

Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2008). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, *1*(2), 13-22.

Pedraza Martinez, A. J., Stapleton, O., & Van Wassenhove, L. N. (2011). Field vehicle fleet management in humanitarian operations: A case-based approach. *Journal of Operations Management*, *29*(5), 404-421.

Pick, J. B., & Azari, R. (2011). A global model of technological utilization based on governmental, business-investment, social, and economic factors. *Journal of Management Information Systems*, *28*(1), 49-84.

Riggins, F. J., & Dewan, S. (2005). The digital divide: Current and future research directions. *Journal of the Association for Information Systems*, *6*(12), 298-337.

Sodhi, M. S., & Tang, C. S. (2014). Supply-chain research opportunities with the poor as suppliers or distributors in developing countries. Production and operations management, *23*(9), 1483-1494.

Starbuck, W. H., & Milliken, F. (1988). Executive perceptual filters: What they notice and how they make sense. In D. Hambrick (Ed.), The executive effect: Concepts and methods for studying top managers (pp. 35-65). Greenwich, CT: JAI Press.

Starr, M. K., & Van Wassenhove, L. N. (2014). Introduction to the special issue on humanitarian operations and crisis management. *Production and Operations Management*, *23*(6), 925-937.

Tallon, P. P., & Kraemer, K. L. (2007). Fact or fiction? A sensemaking perspective on the reality behind executives' perceptions of IT business value. *Journal of Management Information Systems*, *24*(1), 13-54.

Thomas, A., & Kopczak, L. R. (2005). From logistics to supply chain management: The path forward in the humanitarian sector. *Fritz Institute.* Retrieved from http://www.fritzinstitute.org/pdfs/whitepaper/fromlogisticsto.pdf

Tolman, E. C. (1948). Cognitive maps in rats and men. Psychological Review, 55, 189-208.

Toyama, K., & Dias, M. B. (2008). Information and communication technologies for development. *IEEE Computer*, *41*(6), 22-25.

Van Wassenhove, L. N., & Pedraza Martinez, A. J. (2012). Using OR to adapt supply chain management best practices to humanitarian logistics. *International Transactions in Operational Research*, *19*(1-2), 307-322.

Waterman, R. H., Jr. (1990). *Adhocracy: The power to change*. Memphis, TN: Whittle Direct Books.

Weick, K. E. (1995). *Sensemaking in organizations*. Thousand Oaks, CA: Sage.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (2005). Organizing and the process of sensemaking. *Organization Science*, *16*(4), 409-421.

Whiteman, G., & Cooper, W. H. (2011). Ecological sensemaking. *Academy of Management Journal*, *54*(5), 889-911.

Woodard, L. L. (2012). Massive open online courses revolutionizing higher education. *Yahoo*. Retrieved from http://news.yahoo.com/massive-open-online-courses-revolutionizing-higher-education-203000235.html

Zhu, K., Kraemer, K. L., & Dedrick, J. (2004). Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry. *Journal of Management Information Systems*, *21*(1), 17-54.

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