The Evolving Braid: An Ethnography of Technology Change in Uganda

By

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A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Information Management and Systems

in the

Graduate Division

of the

University of California, Berkeley

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Spring 2012

Abstract

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If there's one thing one can expect from information technology deployments in developing countries–it's the unexpected. From 2007-2010, I combined my skills as a software developer with ethnographic methods to observe the use of information technology in a non-governmental organization (NGO) in Southwest Uganda. This NGO subsidizes health facilities by paying for sexually transmitted infection treatment on the basis of claims submitted after the patient consultation, targeting treatment of 99,000 clients between 2006-2011. The program addresses a real need - in the program area, a household survey found that while 39% of the population reported STI symptoms, only 1/3 sought care. However, management of this program is information intensive. As part of my studies, I implemented and tested Claim Mobile, a smartphone-based data collection application intended to reduce claims processing delays and improve health facility engagement. I successfully tested Claim Mobile in Summer 2008, processing 35 claims for two health facilities, and then discontinued its deployment six months later, when I decided that integration and scale-up of the technology would be problematic for the changing context the NGO. New priorities and new program management practices revealed 'invisible constraints' that a redesign of Claim Mobile would not accommodate.

This dissertation addresses the ways in which I as a researcher, an NGO, and their beneficiary health service providers deal with and understand social and technological change. I discuss how the NGO program staff 'braided' communications together to address their communications needs, the ways in which choices in design can affect stakeholder relationships, and reflect on the reasons for Claim Mobile's 'failure'. I find that 1) designs must account for all stakeholders, not just users, 2) ICTs are used in co-evolving and co-dependent braided ways, 3) affordances and constraints change over time, as well as in relation to the different user contexts, and as a result 4) designs are subject to changing context.

This dissertation is dedicated to God, who gave me the courage to try something new, and to Alex, who is my partner in continuing to step out in courage and faith.

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ACKNOWLEDGMENTS

It is with great appreciation and relief that I write these acknowledgements. So many things have changed since I embarked on this journey, and yet my goals remain the same. I want to be a part of and to understand how technology innovation can contribute to the alleviation of poverty in developing countries. I want to be a part of educating the next generation of well-meaning and optimistic students, whether in the United States, in Africa, or in other developing countries.

One day in particular, I was sitting at Actional's Mountain View offices writing code for their web application interface. I had just gotten back from Montreal, where I was working with their engineers to put the first release of the software out. I came to the realization that I wanted to do more with my computer science skills than to just be employed - I was sure that there was some way I could apply computer science towards needs in developing countries.

Just a year later, I was starting my masters project at University College London, working on routing algorithms for communication in developing countries. My experience there, and the recommendation of Prof. Srinivasan Keshav, led me to Intel Research Berkeley, where I began an internship working for Kevin Fall on Delay Tolerant Networking. At the time, Kevin was also working with Prof. Eric Brewer on the ICT for Billions (ICT4B) project - which gave birth to the Technology and Infrastructure for Emerging Regions (TIER) Group. Through TIER, I met Dean Anno Saxenian, and learned about the School of Information. Over that year, I came to realize that I wanted to develop skills and experience beyond computing, to learn methods for understanding the social structures that surround information technology, and to take time to build a better understanding of development issues. Several years later, I have had the privilege to see the field of Information Communications Technology and Development (ICTD) grow from a few dedicated researchers to a full-fledged community of social scientists and technologists endeavoring to work together.

I want to take this space to thank the people that helped me along the way. To Lisa Hwang for giving me the inspiration to dream beyond what I had to have the courage to do what I feel called to do. To Alice, for years of answered prayers (in hot tubs, and otherwise) for both of us. Thank you to both Lisa and Alice for encouraging my faith. Jeff and Vina, you have been constant and steadfast friends through this all. To Lina and to Jason, your encouragement and support have meant the world to me. To all my friends from Ensim, I am grateful for your friendship, for the many nights of strategy games, and for giving me a fun start to my post-college career. To S. Keshav, especially, thank you for encouraging me to dive into ICTD research, and giving my first push towards UC Berkeley. Thank you Kevin Fall, Sushant Jain, Mike Demmer, and all the Delay Tolerant Networking group. The TIER group has been my research family for many years now: RJ

contributions to this work. To my research group from MUST, Phaisal, Sam, Ronald, Martin, and Ivan - it was a privilege to work with you.

I feel like there are so many people to thank and not enough time. I am thankful for my small group and church community at First Presbyterian Church of Berkeley, and especially all the people that have been a part of the work we do in Goma.

Above all I thank God for opening the doors to the PhD, for always being faithful, and for being the ultimate source of my strength and direction.

Melissa Densmore
May 11, 2012

INTRODUCTION

> *Globalization, as defined by rich people like us, is a very nice thing... you are talking about the Internet, you are talking about cell phones, you are talking about computers. This doesn't affect two-thirds of the people of the world.*

> *—Jimmy Carter*

1.1 Information, Communication Technology and Development

In 2009, I spent some time teaching object-oriented programming (OOP) at Mbarara University of Science and Technology. Many of my obstacles were typical. The program had unstable funding - lecturers were sometimes paid late, and teaching assistants and graders often went unpaid (I was a volunteer, so wasn't paid). In fact, for my 220-student class, I had no graders or teaching assistants since they were still waiting for funding to pay teaching assistants from the prior semester. The power would often go out during my powerpoint and demo-driven lectures. My 15" laptop screen served as an inadequate backup for the battery-less projector. I tried using the whiteboard, but available dry erase markers didn't work; I bought my own and hoarded them from potential overuse. Students struggled to hear me over the sounds of construction outside, and struggled to see my notes from the back of the room, which was so crowded they were sitting in the aisles. It was difficult to counter a culture of cheating: firstly because students saw sharing homework as a means of supporting their community, secondly, most instructors simply did not have the time to investigate and manage plagiarism. I tried to address the shortage of textbooks and intermittent Internet connectivity by providing access to electronic books on Object Oriented Programming and Java on the local hard drives of the computer labs. However, since these labs were shared by the upperclassmen, even access to those computers was limited. Many of my students were not prepared for a class on OOP; they struggled with the basic programming concepts of variables, loops, and conditional statements. I also experienced more mundane problems - students would play solitaire on the computers in the lecture hall (which made me appreciate power outages) and my office hours were filled with students trying to understand the concepts in my lectures and assigned readings or complaining about their grades.

While not research, this experience highlights the type of situations that information, communication technology, and development (ICTD) research hopes to understand and address. Intermittent power, insufficient resources, limited network connectivity and training contribute to a challenging environment in which innovative approaches are required, whether initiated by a researcher or the people within the community. At the same time an unfamiliar baseline standard and culture make it more difficult for us as foreign researchers to evaluate the situation, or develop, deploy, and test new technologies (for example, my syllabus). And yet, the situation does not have to be alien. Good research methodologies enable us to observe people and explain the ways in which they interact with in situ technologies and technological interventions.

While mobile phones receive most of the attention, other information technologies like radio, broadcast television, postal service, in-person communication, newspapers, and Internet are all important components of how people and organizations share information and build relationships with one another. What happens to these relationships and information sharing processes when new technologies are introduced, whether through market forces, deliberate development efforts, or in the context of testing a research-based intervention?

In America Calling, Claude Fischer documents the emergence of the (wired) telephone. The telephone not only enabled distance communication, but it enabled casual communication, with homebound women socializing over the phone. These conversations helped families maintain stronger ties even as they began to live further apart. (Fischer, 1994). Fischer argues that the advent of the phone did not cause these changes. Rather, these societal needs pre-existed the phone, and its evolution and adoption were instead governed by these needs.

Horst and Miller examine this idea with respect to Jamaican phone usage in
The Cell Phone, in which they depict how the usage of the mobile phone is deeply embedded in the socio-economic needs of the users. The mobile phone resides in a wider 'communicative ecology' in which people extend social networks, manage remittances, and in general, 'cope' with their daily lives. As with the telephone, the Jamaicans used activities like 'link-up' to help maintain stronger ties with their friends and family (Horst and Miller, 2006). As Donner observes, these activities do not occur randomly, but are embedded with a rich set of norms and practices (Donner, 2007).

In setting up part of the foundations of ethnographic action research, Tacchi states that information technologies exist as part of a *communicative ecology*: communications are processes, involving a mix of media and a mix of people, that change over time:

> In the case of ICTs, where the aim is multi-media capability, focusing on the complete picture (ecology) and on social networks is vital. These are new media that do not yet have a fixed form. We need to, and can, adapt them to local ways of communicating. Moreover, in the case of multimedia, we have to bring together media with different histories and institutions, creatively adapting them to make something new and effective, and - importantly - locally relevant and appropriate. ((Tacchi et al., 2003), p. 17)

Consider the implications of this approach. Firstly, any information technology intervention is ultimately *embedded* in existing communications processes, involving a mix of

available media. For example, mobile data collection platforms like Open Data Kit (Jeffrey Coker et al., 2010), EpiSurveyor (Selanikio, 2008), or RapidSMS (Asiimwe et al., 2011) enter into pre-existing contexts of data collection needs and practices, often involving paper-based surveys, data entry clerks. In addition, the deployers must consider existing practices around mobile phone use. Speaking from a public health/medical perspective, Haberer et al (Haberer et al., 2010) admit that lack of experience with interactive voice response (IVR) and phone-sharing practices interfered with the successful use of mobile phones for encouraging antiretroviral adherence, suggesting that more training and personal mobile phone ownership would alleviate their problems. Significantly, they were only able to conduct the study with 19 of the 121 caregivers in their program due to lack of phone ownership. The future success of the system entails either more widespread ownership, or distribution of mobile phones as part of the program:

> Other potential limits to the feasibility include the low prevalence of mobile phones in this population at the current time (19 of 121 caregivers) and the fact that not all participants had the phone with them at all times. Mobile phone ownership, however, is rising rapidly and proper training and incentives as discussed above may encourage constant possession of the phone by the participant. (Haberer et al., 2010)

Whether or not this optimism is warranted, the success of this intervention hinges on societal factors such as those influencing widespread mobile phone ownership and infrastructural and organizational support for training, in addition to the 'technical' ability to build the system. The question of *appropriate design* stretches beyond inventing or making changes to technical approaches, to how and why people use technologies.

The development and trials of new information technology interventions in developing regions exist upon the notion that largely non-technical *existing* practices are inadequate in ways that can be addressed by new approaches. Existing practices may be too expensive to be scalable, or inadequately address unreliable transportation, electrical, or communications infrastructure. Too often, bureaucracy and lack of transparency lead to corruption as people rely on lack of or inaccessibility of information to hide their tracks. 'Access to information' through the use of mobile phones, the Internet, or literacy-aware kiosks will eliminate these problems (Bhatnagar, 2003; Jenkins and Goetz, 1999; Plauche et al., 2006; Sey and Fellows, 2009). Indeed, projects like ITC Parry's e-Choupal program have provided sugarcane farmers more trustworthy price information through their Internet-enabled kiosks (Bowonder et al., 2003). At the same time, projects like Bhoomi show that access is not always equal. Digitization of land records led to consolidation of land ownership amongst the already-advantaged, to the disadvantage of tenant farmers who had been on the land for generations (Acharya, 2003). The digitation of 'right to land' and not 'right to farm' records benefits the land-owners and overlooks the landless (Prakash and De', 2007). The goodness, badness and even neutrality of technology reside not only in the *affordances* of the technology, but also the surrounding contexts of existing practices, relationships, and intents of the developers, deployers and the potential users (Kranzberg, 1986; Toyama, 2011).

Indeed, *technology affordances*, in and of themselves, are a product of activities, context and perception. Gaver (Gaver, 1991) characterizes affordances as "properties of the world
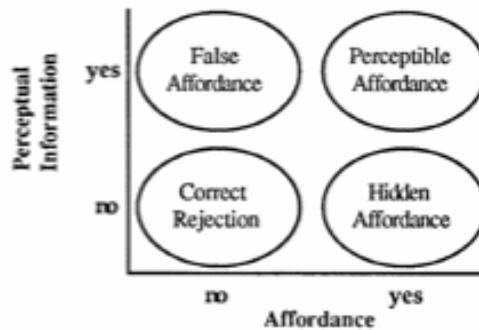
Figure 1.1: Affordances are independent of perception. Gaver categorizes affordances based on the relationship between perceptual information and whether the affordance actually exists. Taken from (Gaver, 1991).

that are compatible with and relevant for people's interactions". He extends Gibson's ideas on visual perception (i.e. affordances that can be seen), suggesting that the *perception* of affordances extend beyond the visual, reminding us that interaction with technologies involve tactile, audible, and many other sensations beyond the visual. Furthermore, he suggests two new types of affordances (See Figure 1.1). *False affordances* are activities that it seems like a technology might be able to accomplish, but do not. *Hidden affordances* must be inferred - instruction manuals, or even other users discovering innovative ways to approach a technology. It is these hidden affordances that often prove to be the most troublesome in ICTD studies. Context and time affect both how people perceive and fail to perceive the potential uses of information technologies.

Affordances can be layered and complex, especially with respect to non-specific technologies like mobile phones and the Internet. A mobile phone affords calling, but only when the phone is charged, the account is active, and signal is available. Based on calling rates and the respective location of the caller and the recipient, the monetary affordability might differ. As more mobile service providers enter the market, competition might cause prices to drop and encourage deployment of more base stations for increased coverage area. Likewise, the concept of the Internet is dependent on a variety of nested components – web browsers, operating system, device, content, and implementation of the interface. Furthermore, the affordances each component differ widely for people from different geographies, socio-economic status, and education level. Worse, *hidden affordances* and *false affordances* (Gaver, 1991) are harder to anticipate when the developers, the users, and other stakeholders bear these differences for the same artifacts. Wood points out:

> To an experienced user, a PC affords a great many things–communication, creation, sharing–but to someone who has never seen one before, a PC is an anonymous box that affords nothing at all. (Wood and Skrebowski, 2004)

So, what are the key affordances that influence the success or failure of new technologies in developing region contexts? In order to identify these affordances, it is necessary to understand all the stakeholders involved in the use of the technologies. In addition, the specific *activities* and goals of the stakeholders influence both the perception around technolo-

gies and the ways in which they are eventually used. Furthermore, as *hidden affordances* become apparent, whether good or bad, the ways in which technologies are used change over time. As it turns out, the design and application of *appropriate technology*[1] entails more than understanding the context of use; deployment of 'strong' appropriate technologies requires bringing technology affordances together with stakeholder needs, priorities, and relationships.

1.2 Information Technology for Health Financing in Uganda

In this dissertation I examine the use of information technologies in the Reproductive Health Voucher Project (RHVP), a health-financing program based in Southwest Uganda. In this program, a non-governmental organization (NGO) [2] reimburses private health facilities, hospitals, and not-for-profit health centers (a.k.a. Health Service Providers, HSPs) for treatments rendered to patients. This program addresses a key gap in health provision – the cost of treatment causes patients to seek alternative, traditional treatments, or to fail to seek treatment at all. While healthcare in public, or government-funded, health facilities is free, they often fail as resources due to long waits, shortage of supplies or lack of personnel (Nuwaha, 2006). The RHVP program enables private providers to provide needed services to people in their local community, maximizing the use of donor contributions for non-capital expenditures through a pay-for-performance model (Mumssen et al., 2010). However, this program is information- and communication-intensive, involving the exchange of massive amounts of paperwork and maintenance of relationships between many organizations. Over time, the stakeholders in this project adopt, discontinue, and evolve the uses of available information technologies to improve program administration and relations within the program. In the remainder of this section, I provide background information on the context and scope of my research.

1.2.1 Healthcare in Southwest Uganda

In theory, healthcare in Uganda is free. Patients can go to government health facilities, see a health worker, and receive drugs for treatment. If necessary, they are referred to a local hospital for specialist treatment. However, in reality, seeking treatment at a government health facility entails walking up to 10km, only to find that the health worker has gone for training or then waiting several hours to find that the facility is out of stock. As an alternative, many Ugandans choose instead to seek treatment from private alternatives –

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[1]Here, I am using the word 'appropriate' in its most general sense, not referencing Schumacher's conception of intermediate technologies (Schumacher, 1973).

[2]The NGO shall remain unnamed in this manuscript, in part for anonymity, but primarily to enable focus on observations and findings instead of on the specific program. In reality, details about this particular NGO do pertain to how they make decisions, set priorities, and operate. I have done my best to include those details that have significance. For example, the NGO is primarily a health organization, with little technical background. They also operate several private not-for-profit health facilities, one of which participated in the pilot of the described program (2006-2008), but was withdrawn later due to perceived conflict of interest.

Mbarara, Uganda
• HIV prevalence: *10% of adult population (15-49 years)*
• Syphilis prevalence: *about 5-7% of adult population*
• *1 in 4 households had at least one phone.*
• *39% reported STI symptoms*
• *only 1/3 sought care*
• *54% of respondents who sought any STI treatment reported using private clinics.*

Table 1.1: Some background STI statistics about Mbarara, Uganda (Bellows and Hamilton, 2009).

either herbal remedies during lean times, or from private health facilities when more money is available (Nuwaha, 2006; Nydomugyenyi and Magnussen, 2003). The result is that many health conditions, such as syphilis, go untreated for long periods, or mothers or infants die unnecessarily in childbirth.

In a household survey, Bellows et al found that 39% of the population around Mbarara, Uganda (a trading town 250km west of Kampala) reported sexually transmitted infection (STI) symptoms, 5-7% of whom tested positive for syphilis (Bellows et al., 2008). Out of those with symptoms, only 1/3 sought care. Despite the availability of government (public) and NGO-funded health facilities, this study highlights a large gap in health-seeking and health care provision. While many people may *prefer* to get treatment at private health facilities, they instead turn to traditional medicine or fail to seek treatment at all, simply because it is too expensive. Private health providers in rural areas find that many of their potential client base cannot afford their services - and to give them away for free would bankrupt them. In spite of their willingness to work in places in desperate need of more trained medical practitioners, their impact is hampered by simple economics.

1.2.2 The Reproductive Health Voucher Project

The RHVP project was first launched in 2006 as a pilot, funded by a European aid agency, and managed by the Ugandan arm of a multi-national NGO in collaboration with the Uganda Ministries of Health and Finance. While the main NGO offices are located in Kampala, the capital of Uganda, the NGO opened a second office in Mbarara, a trading town located about a 5-6 hour drive (283 km) from Kampala. Over the next two years, the program financed treatment of sexually transmitted infections (STIs) in 12 non-governmental health facilities, providing diagnosis and treatment to 19,000 clients in four districts surrounding Mbarara in Southwest Uganda.

Based on the success of the STI pilot, the NGO and the European aid agency brought on a transnational funding agency to finance an expansion of the program. From 2008-2011, this additional funding was to finance the expansion of the program into 18 additional districts, encompassing the entire Western region of Uganda, with a population of almost 8 million (See Figure 1.2). In addition, the NGO expanded services to include maternal
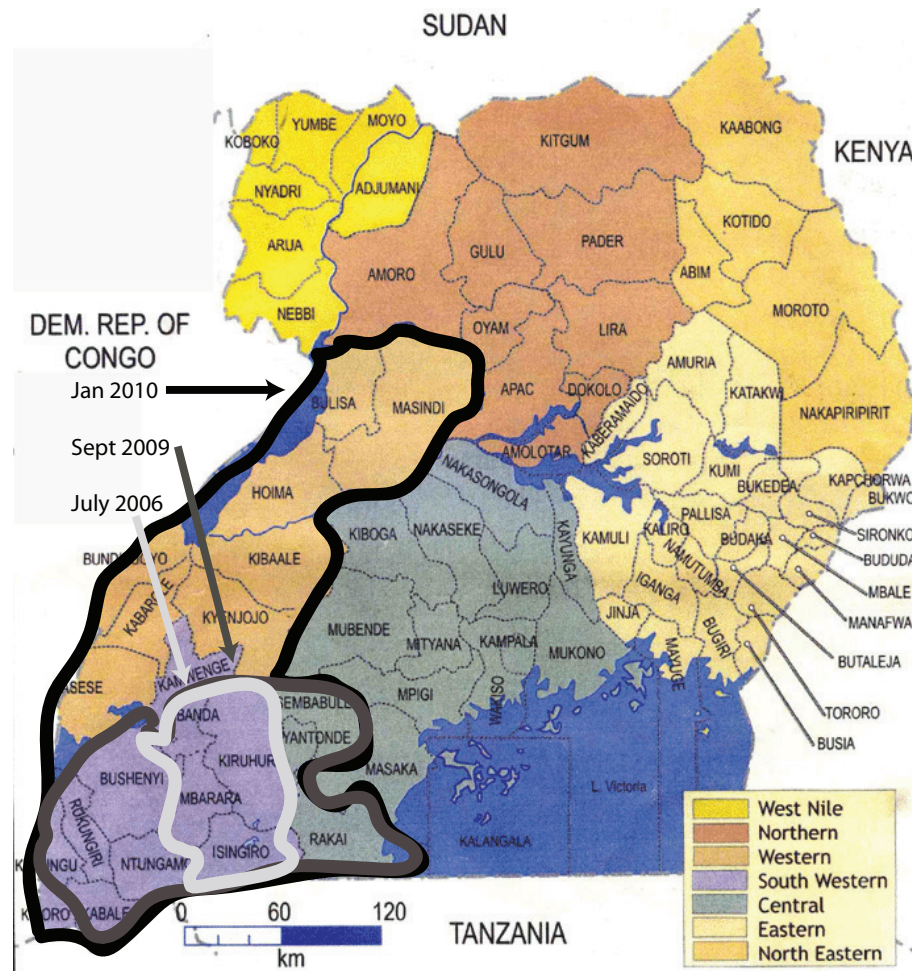
Figure 1.2: Map of RHVP program coverage. Map source: The Electoral Commission of Uganda, http://www.ec.or.ug/

health care, providing antenatal, delivery, and postnatal services to low-income expectant mothers. Between August 2008 and August 2011, the RHVP project served 80,000 patients (30k STI, 50k MHC). To achieve this goal, they expanded health facility enrollment from the original 12 to over 100 health service providers (HSPs).

Where in traditional models, donors typically finance capital infrastructure and other inputs, this program worked on a performance-based finance model. Rather than paying for service provision up front, they paid participating HSPs based on the number of clients they actually saw. Potential patients purchased vouchers for 3000 UGX (1̃.50 USD) from authorized pharmacies and community-based distributors, then brought them to a participating HSP. At the health facility, they were then given appropriate treatment: a lab test and treatment for STI patients, and prenatal care for mothers, including lab tests, nutrition supplements, and health education. For each visit, the HSP filled out a claim form, including the visit findings, a bar-coded sticker from the voucher, and signatures of the patient and the clinician. Once or twice a month, the HSP submitted the claim forms in batches to the NGO, who sent the claims to a third-party claims management agency (CMA). Real-
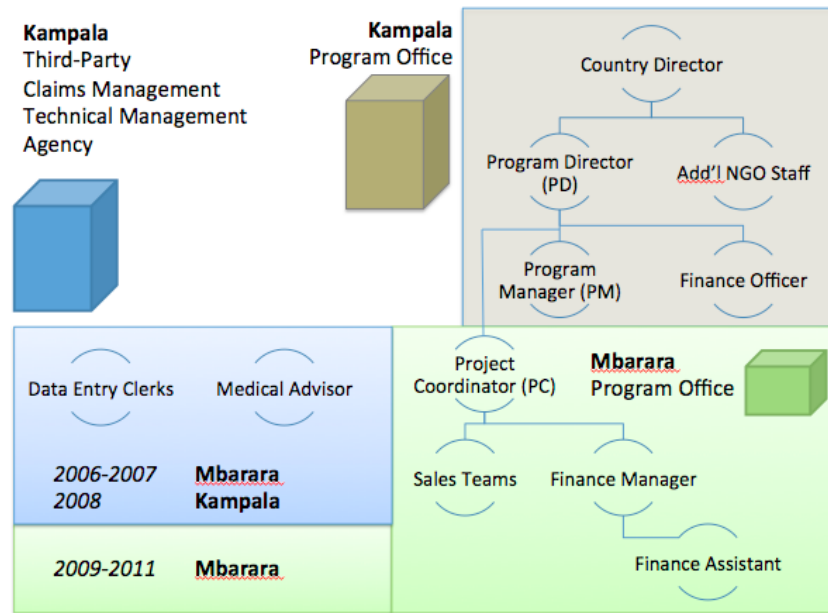
Figure 1.3: Program staff locations and organization hierarchy when claims processing was outsourced to a third party technical agency, during 2006-2008.

izing that their primary expertise was in health interventions, not information technology, management of the claims database and data entry was outsourced to a local insurance company, with established experience in claims management. The CMA then spent the following weeks processing them. Each claim was reviewed by a medical advisor for validity, and then entered into a database. Information about the claims was then sent to the finance officer (FO) in the Kampala offices (HQ), who then made payments directly to the HSPs' banks by electronic funds transfer (EFT).

The management of the program is divided between multiple locations. Key program staff include the program director (PD), who manages the entire project, and the project coordinator (PC), who manages the program office in Mbarara. From the head office in Kampala, the program manager (PM) assists the PD in Kampala-based tasks, including drafting reports for donors, approving payments, and arranging for the printing of the vouchers. The finance officer (FO), one of several based in the head office, finalizes the payments, transferring the appropriate amounts to the HSPs by electronic funds transfer (EFT) to their bank accounts. The program office houses another finance manager and assistant, who manage the expenses and paperwork associated with administration the project: paying expenses to the sales team during their field visits, and allocating vouchers for labeling and distribution. The sales teams are each composed of a sales person and a driver, spend most of their time in the field, but are primarily based out of the Mbarara office. The claims vetting process is managed by medical advisors, who verify claims for treatment validity, and data entry staff, who enter data from the paper claims into Excel spreadsheets and the claims database. Their location varied over the course of the project. They were initially based in Mbarara, employed by the CMA, but moved operations to the offices of the CMA in
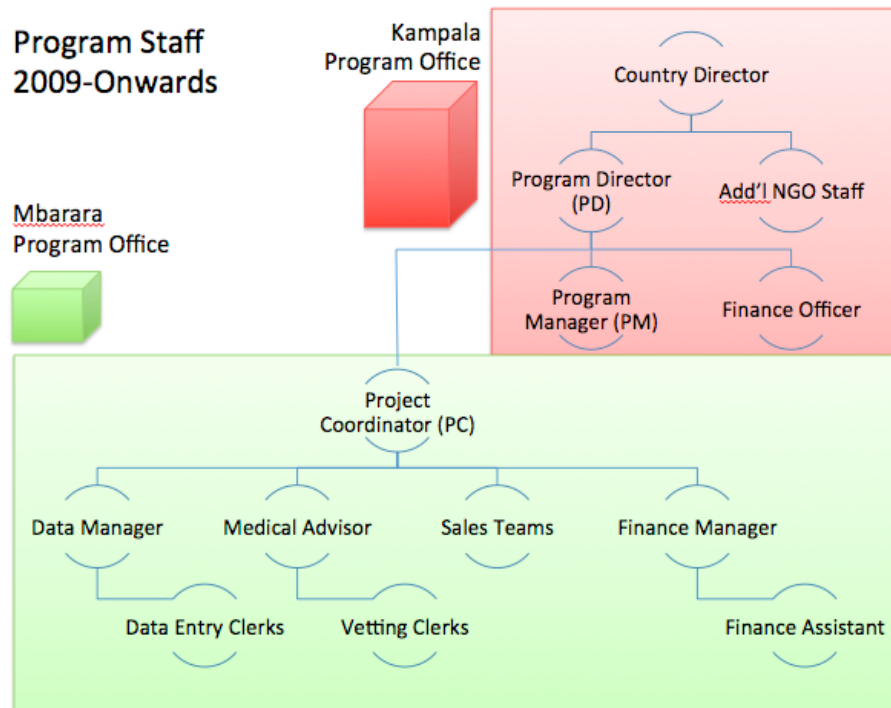
Figure 1.4: Program staff locations and organization hierarchy after October 2009, in-house claims processing.

Kampala during 2008. By 2009, the data entry staff were back in Mbarara, and employed directly by the NGO. Figures 1.3 and 1.4 illustrate changes in geographical distribution of the program staff, and management hierarchy.

Managing this program was information intensive, necessitating much paperwork to track and reimburse payment claims, as well as constant communications between program office, head office, and other program stakeholders. HSPs often felt disengaged from the program due to barriers in communication; poor roads, long distances, and expensive calling rates all discouraged adequate interaction between the NGO and the HSPs. Coordinating activities from different offices also introduced management overhead. As the project progressed (2007-2010), I endeavored to study how changing and advancing information technologies played a role in the constantly evolving relationships of the RHVP project.

1.2.3   Claims Processing

STI patients purchased their treatment vouchers from *distributors* (usually local pharmacies) for 3000 UGX ($\approx$1.50 USD[3]). Each voucher was good for one consultation (generally a lab test to diagnose the STI) and three follow-up visits (See Figure 1.5). The maternal

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[3]USD to UGX dollar conversions are given throughout this manuscript at a rate of 2000UGX:1USD, except where otherwise indicated. During the study period the actual exchange rate ranged from 1700 to 2250 UGX:USD. Source: Bank of Uganda, http://www.bou.or.ug
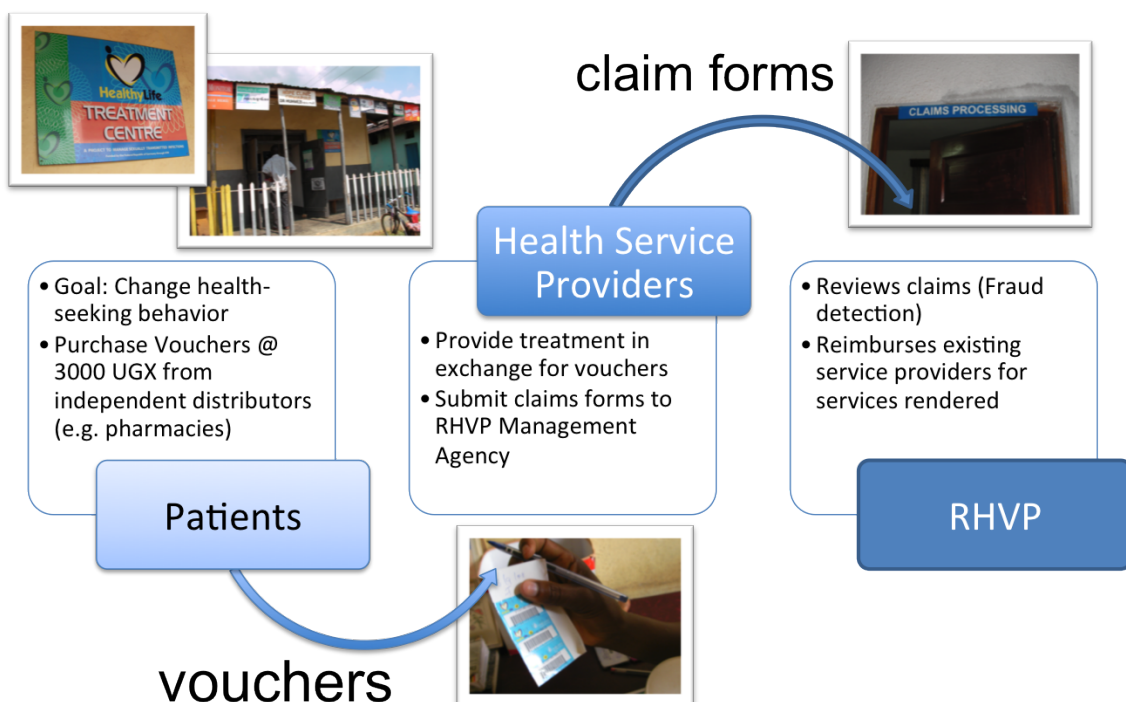
Figure 1.5: Flowchart illustrating the performance based financing model, in which health service providers (HSPs) are reimbursed for treating patients on the basis of voucher-validated claim forms.

health voucher also cost 3000 UGX, but was only available through *community based distributors (CBDs)* to mothers who scored under a specific poverty baseline, assessed using a paper form by the CBD. Each voucher covered four pre-natal (a.k.a. antenatal) visits, the delivery (including the cost of a caesarean if necessary), and a post-natal visit.

During the consultation, the provider completed a claim form recording the client's demographics, the medical history, the examination and laboratory results, a diagnosis and details of the course of treatment prescribed. Every 2-4 weeks, the health service provider prepared a summary report, and sent the completed claims forms to the voucher management office in Mbarara. At least another two to four weeks were spent reviewing the claim, cleaning improperly completed forms, and verifying that the service took place among suspect claims. While the NGO was contracted to pay the HSP within 15 days, two months or more often went by before the provider was reimbursed for service provision.

In Uganda, private providers traditionally operate on a fee-for-service model receive prompt payment, and do not have a large operating margin. In many cases, payment is provided prior to service. Delays in payment result in delays in procurement of replacement prescriptions and medical supplies, often leading to a temporary hiatus in service. Encouraging provider involvement in the RHVP program requires a great deal of confidence on the part of the providers to participate. If a system to shorten claims processing could be devised, more providers could join the program and more patients could be provided the life-saving STI treatment voucher subsidy.

Figure 1.6: The facility owners, doctors, midwives, and other health workers that provide services in HSPs all owned at least one phone.

1.2.4 The Health Service Providers

There were 116 health service providers participating in the program by the end of this study, with a wide range of characteristics, including both rural and urban, as well as both NGO-financed and private-for-profit health facilities. The health facilities range in size from small clinics to hospitals that serve as referral centers for their localities.

Over the course of the project I found myself serving as an advocate for many of the HSPs I visited, relaying concerns and complaints from them to the NGO as a returned from each field visit. As an independent entity, the NGO also perceived that I was able to spend more time with the NGOs I visited, and to visit them more frequently, and thus able to offer them a different perspective on the HSPs.

My observations of the HSPs concentrated mainly on HSPs providing services through the STI voucher program, although I interviewed and surveyed HSPs in both programs. I spent extensive time with HSPs that participated in my technology pilots, first with two HSPs that piloted Claim Mobile, then with another eight that learned to use netbooks and Palm Treos for email and Internet research.

It should be noted that while these health facilities are all located in Uganda, they are not *typical* Ugandan health facilities. Instead, they characterize private-for-profit and private-not-for-profit (i.e. not government-run) health facilities that have been pre-qualified by the RHVP program to meet a certain standard of health care. For example, all of the HSPs participating in the STI voucher program were required to have a minimum refrigeration capability, to conduct lab investigations, and all maternal health voucher providers were required to have birthing facilities. The RHVP NGO conducted periodic inspections to verify that facilities were up to standard. In addition, as participants in the RHVP program, these HSPs had a regular flow of income, amounting to 200,000-2,000,000 UGX (1,000 - 10,000 USD) monthly or more. While there was high variability in income levels and available resources, these research participants were more advantaged than typical community health workers (Lucas, 2008; DeRenzi et al., 2008; Ramachandran et al., 2010) due

Figure 1.7: Private health facilities use placards and posters on their storefronts advertise their partnering NGOs and services, including Injectaplan, AAR, and in this case, ultra sound and dental services.

to their status and income levels. These factors all pose an advantage for uptake of new technologies, and for the research context. Regular income makes it plausible for HSPs to purchase smartphones and laptops, and take on related maintenance costs around repairs, recharging, and fees – provided that the expense is deemed worthy by the HSP proprietors. In addition, although I did learn some phrases in the local languages (primarily Luganda and Ruyankole), the high levels of education in these HSPs meant that this research was conducted in English. Working without the need for translators, combined with long field-work periods to help assimilate cultural nuances enabled better understanding between me and my research subjects.

However, even though these facilities are not typical, they are common; these private health facilities provide most of the evidence-based primary care services in Uganda (Nuwaha, 2006). Furthermore, while this particular performance-based financing mechanism is not yet widespread, it is common for such health facilities to seek subsidies from donors through NGOs. Indeed, most of the surveyed health facilities participated in one or more programs in addition to the RHVP program, using these funds to provide services in rural areas to community members that would not otherwise be able to afford the cost of diagnosis and treatment (See Figure 1.7). In addition, the proprietors of many of these institutions represent a class of educated entrepreneurs; information technologies provide some of the mechanisms by which they are able to finance and support their endeavors to profitably serve their communities.

1.2.5   The Evolution of Claim Mobile

Claim Mobile began as an idea for a mobile phone based claims processing system, intended to reduce the time that it took for the claims to be processed. After an initial needs assessment (semi-structured interviews and document collection conducted over two site visits in 2007), I conducted a five-week pre-pilot deployment of a mobile phone system

for processing claims in two health facilities. In this pre-pilot, I simulated the proposed process, and the HSPs submitted claims on the phone in parallel with paper claims (See Chapter 3). Each visit entailed semi-structured interviews with stakeholders at various levels of the RHVP, as will as direct observation of the claims form entry and processing.

Following this initial pre-pilot study, I returned to the field for a period of fifteen (15) months for extended observation, conducting a survey with all of the participating health facilities in the RHVP prior to expanding a full pilot program. During this time, I took on a role of a visiting researcher and IT consultant at the collaborating NGO, assisting with the evaluation of hardware and software proposals related to the RHVP program.

While the initial pre-pilot was largely successful, I realized in early 2009 that integration of the mobile claims processing software for just 8-12 of the (at the time) 83 HSPs into the claims process of the NGO would be disruptive to their own programs. As with many development projects, the RHVP was constantly evolving; it was necessary also for my research to evolve in response. The reasons for this decision are detailed further in Chapter 6.

At the same time – there was interest in and demand for a better mechanism to manage SMS (text) message communications between the HSPs and the NGO staff. While this was initially a feature in Claim Mobile – the time frame, scale of the deployment and platform did not match the needs of the NGO, and they decided to outsource an independent bulk SMS platform to a third party vendor in Uganda. Thus this research also incorporates the study of the development and deployment of a third party bulk SMS platform (Chapter 4), designed based on recommendations and requirements co-crafted with the collaborating NGO.

1.3   Research Question

My broad agenda is to tell the story of information technology usage within the RHVP program that reflects on the larger picture of social and technological change. However, the objective of this research is to understand the relationship between organizational processes and use of old and new information technologies. Necessarily, participants renegotiate social dynamics in response to new information technologies. Thus my primary research question is:

1. How do people renegotiate formal and informal processes around the introduction of new information technologies?

Building on the idea of communicative ecologies (Tacchi et al., 2003), information technologies, including new information technologies, exist in complex ecologies interweaving many aspects of the context together. New information technologies necessarily disrupt this ecology. By introducing and studying the introduction of new technologies, I choose to examine what happens. In this research I document the process by which RHVP's communicative ecology resettles. While continuing to pursue research interventions, I use ethnographic methods to reflect on larger questions around their deployment and to help inform future research endeavors.

In this instance, I developed Claim Mobile, a 'new information technology', and tested it in the context of the RHVP. Using ethnographic methods and a process of iterative design, I developed an understanding of both experienced and anticipated perturbations occurring as a result of Claim Mobile's deployment. In addition, I observed the ways in which communication between the program NGO and the health service providers changed, as mobile phone and Internet-based interactions became more prevalent. I examined both *research interventions*, that is, innovative platforms developed by researchers to mediate communications needs (i.e. Claim Mobile), and *emergent technologies*, that is, systems adopted to fulfill program objectives within the non-research-based organization, independently of my research agenda (e.g. e-mail, Bulk SMS). While research interventions and emergent (or even 'in situ') technologies may or may not radically disrupt the ways in which an organization communicates, the changing availability of technology services and changing context work together to produce new and often unexpected processes for navigating the needs and overcoming the challenges of pursuing development in places with unreliable road and communications infrastructure.

New information technologies are never inserted into a social vacuum. Indeed, the purported role of adopted technologies is to supplement and possibly replace existing and complex social processes (Tettey, 2000; Peterson, 1998) represented by both formal (i.e. official and documented) and informal (i.e. undocumented, inconsistently applied, and sometimes necessary) document and work flows (Cooper and Urquhart, 2008; Pratt et al., 2004; Fitzpatrick, 2000). At the same time, new processes arise from new modalities of technology use and communication. These new technologies (or merely new uses of technologies) *disrupt* existing processes. The relationship dynamics inherent to these processes are subject to these disruptions. As a result, designers of ICTD interventions should consider conflicting stakeholder priorities in addition to other needs of the program, responding to the changes in dynamics, as well as addressing functional technology issues. This is discussed further in Chapter 3. Over time, stakeholders adopt new processes, or fall back to their prior practices. The complex and interlinked ways that people integrate old and new technologies to achieve the goals targeted by these processes constitute new modalities that I refer to as *braided communications* (See Chapter 5 for a full explanation). By understanding technology as naturally disruptive, I can be more reflexive about the use of technologies I observe.

1.4   Looking Ahead

In the remainder of this document, I consider the roles of information and communication technologies in the RHVP program. Over the approximately four years spanning my observations, the participants in this project use a multitude of different communications technologies, to fulfill the wide range of tasks required by the project. Importantly, their uses of information technologies change over time, as new technologies and techniques become available, and as they adapt available technologies (both new and old) to their needs. Also importantly, they achieve their goals by 1) using available communications channels in synergy with one another, and 2) working together to find processes that meet the varying needs of the participants effectively. Strength in systems, as well as design, comes from

working together.

While researchers are often depicted as either 'social scientists' or 'technologists,' often their educational and ideological backgrounds are much richer than the two simple terms might imply. Chapter 2 describes my methodology and approach, situating it in my background as a ethnographic researcher with a computer science background. Given the variety of contexts, I found that iteratively using both qualitative and quantitive methods was the best means of conducting this research. In addition my use of technological interventions enabled me to develop a deeper understanding of the relationship between new technologies and processes in this context.

In Chapter 3, I show how the same technology can have different affordances for different stakeholders. I depict the findings from the initial deployment of Claim Mobile, a platform designed to support claims submission for the RHVP program. As with many development projects, the RHVP program involves a number of stakeholders: the service providers, the project implementers, the financiers, and the Ugandan government. Design of an appropriate solution requires meeting the various and conflicting requirements of all of these stakeholders. In this chapter I detail the rapid design and testing of a pilot implementation of a mobile and web-based system for processing claims forms, based on two prior field visits to Uganda. Based on a comparative device study, semi-structured interviews, health clinic surveys, and a brief deployment, I affirmed the selection of the mobile phone as a platform from the health clinic perspective, and further suggest that effective design for development requires more than addressing requirements of the the "users" of the mobile phones but also all the other stakeholders involved, who may have conflicting requirements.

Short message service (SMS, aka text messaging) is a low-cost and effective means of communication for organizations attempting to maintain contact with many people. In Chapter 4 I look at the deployment and adoption of a bulk mobile text-messaging platform (Bulk SMS), conceived and commissioned by a health non-governmental organization (NGO) for use in communicating with the 100+ private health facilities. I show how the Bulk SMS platform emerged from existing practices, the features and expectations of the system, and the ways in which it was used. Common failure points include infrastructural limitations, human error, and unexpected use cases. I find that 1) the use of the Bulk SMS platform enables new types of communication, and 2) Bulk SMS alone is not sufficient for maintaining relationships within the NGO's program.

I delve deeper into the concepts around affordances in Chapter 5, putting forth the concept of *braided communications*, in which project stakeholders use multiple information technology channels together, leveraging the affordances of each to augment the weaknesses of the others. I depict how participants in the RHVP program use voice conversations, paper exchange, emails, SMS, and other media, to achieve effective communications in spite of local limitations. Due to the wide geographic span of the HSPs, the HFO faces a number of structural limitations, including poor road infrastructure, intermittent power, and unreliable mobile network coverage. By using multiple different communication channels, they can overcome the limitations of each individual mode. Furthermore, over time, as individual uses of technologies change, the nature of the braided use will evolve as well. This chapter describes the activities of participants in the RHVP project, and the ways in which *braided communications* enable them to achieve their goals. I describe the different modes

of communication adopted by the HFO and HSPs, how they evolved, and how the use of the individual technologies and the technologies together served to address the structural limitations imposed upon the program as a whole.

Chapter 6 looks back at the deployment of Claim Mobile. I successfully tested Claim Mobile in Summer 2008, processing 35 claims over two weeks, and then discontinued it six months later, when it became apparent that integration and scale-up of the technology would be problematic for the NGO. In addition, many issues I hoped to address through technology had been addressed through program management changes instead. I examine Claim Mobile's relationship to these program changes in terms of braided communications, concluding that ultimately, Claim Mobile failed to 'braid' into existing and emerging patterns and constraints of information sharing. I find that a) the context motivating the technology changed over time, b) simpler solutions can be as effective as new technologies, and c) prioritizing the needs of the NGO required abandoning the deployment of Claim Mobile.

Through a process of iterative design and investigation, I have sought to build a better understanding of the ways in which participants in the RHVP project assimilate new technologies. I have found that, in addition to *research interventions*, that is, innovative platforms developed build a better understanding of how to mediate communications needs, such as mobile phone-based data collection, the program renegotiates processes around *emergent technologies*, and changes in *in situ technologies*. *Emergent technologies* consist of systems adopted to fulfill program objectives within the non-research-based organization, independently of my research agenda. *In situ technologies* are those that are already in use, sometimes in changing ways. Perceived affordances and constraints motivate adoption of new processes, often integrating a blend of communications channels. In addition to being different from stakeholder to stakeholder, affordances change over time in response to advancing technology and changing social and economic constraints. In order to continue using new and old technologies, NGOs need to be able to adapt and integrate them into both current and future contexts.

For me, I have endeavored to immerse myself in the lives and work of the NGO and HSP staff. Through interviews, surveys, and ultimately working together, I have developed a deeper understanding of the day-to-day concerns of my Ugandan research subjects. Together, we encountered the affordances and constraints of mobile, paper-based, Internet, and other communications, as well as the affordances and constraints of the society making use of these technologies. My background as a computer scientist helped me to understand the technologies I studied more deeply, and also to be a resource to the NGO and the HSPs as they endeavored to use information technologies more effectively to achieve their goals. This manuscript is ultimately a documentation of and reflection upon many of our shared experiences.

METHODS: A MULTIDISCIPLINARY APPROACH

It's not what you look at that matters, it's what you see.

—Henry David Thoreau

When I began this research in 2007, I imagined that I would be deploying 'smartphones' in several health facilities, helping a non-governmental organization (NGO) to improve the efficiency of their program, and empowering their partnering health facilities to better understand and analyze the ways in which they were benefiting from the NGO's program. In addition to considerations about how to appropriately design an application for this context (i.e. how to change the design to match the context), I was interested in how the deployment of this system would *change* relationships between the NGO (i.e. how design changes context), the HSPs and other system stakeholders.

One of the main questions I faced addressed how I would resolve apparently conflicting goals of *developing technologies* and *studying the use of new technologies*. Certainly, each one on its own would be time-consuming, and at least one might corrupt the context of the other. Maybe, it was suggested, it would be better for me to focus on the technology, or to collaborate with someone else developing the technology. In the end I did both. I adopted iterative methods that allowed me to integrate study of context with development of technology, and as I tapered off my study of Claim Mobile, I also participated in the selection of a Bulk SMS system, enabling me to study a Bulk SMS system developed by a third-party SMS gateway provider. My interest was (and is) in the interaction between both *research interventions* and *emergent technologies* in the larger picture of the NGO's objectives and needs.

Ultimately, it was the larger picture that caused me to discontinue the deployment of Claim Mobile. Indeed, in November 2009, I made a conscious decision to continue studying the RHVP project, despite the rapidly deteriorating appropriateness of Claim Mobile for the context (see Chapter 3 for details.). As an alternative, I could have continued in partnership with the third party CMA, developing mobile claims processing for their health insurance business and micro-insurance partners. However, by choosing to continue working with the RHVP project, I was able to build a deeper and more longitudinal understanding of why Claim Mobile failed. In the process, I came to realize that in addition to Claim

Mobile, the NGO and the HSPs were in the process of adopting many other communications technologies (e.g. Bulk SMS, e-mail), all of which affected relationships within their program. This manuscript addresses the research intervention of Claim Mobile, as well as where it fits in the scheme of other information technologies being used by the RHVP stakeholders.

As a software designer and an ethnographer doing research in Uganda, I balanced different research objectives, as well as a variety of perspectives of my identity, both as a researcher, and in my 'IT consultant' role for the NGO. In addition, I considered the sometimes conflicting goals of research and (economic) development. In the remainder of this chapter I reflect on these issues, and their influence on my chosen methods of investigation and findings.

2.1 Personality and Placement

In this section, I discuss several methodological choices with respect to this 'personal role', including the tensions between software development, research, and economic development, and my placement as a researcher.

Since this document details my observations, personal experiences and choices as a researcher, I choose to write in the first person. While a royal 'we' absolves me of responsibility for my actions, decisions and findings, the use of the 'I' acknowledges my personal role. On occasion, I will use 'we' to acknowledge instances in which colleagues and research assistants also contributed to this study, or to call to attention the broader field of like-minded ICTD researchers.

2.1.1 An Ethnographer in a Software Developer's Clothing

In 2004, when I started doing research on new technologies for developing regions, I started out as a computer scientist. I have a B.A. in computer science and an M.Sc. in Data Communications, Networks, and Distributed Systems, as well as work experience in networked applications and user interface design. If I saw a problem, I immediately turned to ways in which information technologies might be turned to solve it. However, as a user interface designer, I have learned that the most immediately functional solution does not always result as one expects. Human-computer interaction methods, such as user-centered design (UCD) and participatory design (PD) go a long way towards making time and effort to understand the people and communities that actually use the information technologies, and not just the technologies themselves. They draw on qualitative research methods like participant observation and interviews to inform the design of user interfaces.

While the work in Chapters 3, 4, and possibly 6 follow this tradition, my over-arching goal is a broader one. I sought to observe participants in the reproductive health voucher program as they used and experienced information and communications technologies, both new and old. In the case of Claim Mobile, I observed their interactions around the introduction of a new technology, and how the nature of Claim Mobile's design influenced the nature of those interactions.

My background as a computer scientist, and my position as an IT Consultant within the NGO gave me a unique perspective into the relationships between the inner workings of Claim Mobile, the Bulk SMS system, and relationships within the RHVP program. First, it provided a context for my access to the program participants, and a clear means by which I could make a contribution to their efforts. Each interview was a mutual education process: I learned about the program, their communication practices, and their information technology struggles, and they learned about the range of solutions available, tricks to improve their mobile and Internet experiences, and, in the case of the NGO, the ICT ownership and usage characteristics of the HSPs. As a researcher from the US, I often assisted the NGO staff with purchase of electronics, bringing phones, cameras and computers when I arrived for each field visit, I even provided the wireless routers for both the HQ and PMO offices. This relationship was a double-edged sword. When the e-mail server went down for several days, I was blamed, despite the fact that I had not interacted with the server at all. While that situation resolved itself, I also learned to leave interactions with system-critical operations with their paid IT consultant and the data manager. For them, the mysteries of information technology services combined with the ambiguity of my role in the organization to produce uncertainty about the work I was doing. Even so, the NGO staff looked to me as an available and, well, free source of information technology expertise.

In my role as an IT consultant, NGO asked me to participate in evaluation of information technology provider bids on three separate occasions. In November 2008, we evaluated companies invited to implement a new claims management system for the project; I flew to Uganda during that time specifically to participate in this process, also hoping to evaluate these companies as potential Claim Mobile collaborators. In February 2009, we evaluated networking firms for the provision of computers, servers, and local area network within the PMO. In July 2009, we met yet again to evaluate providers for the Bulk SMS gateway. These meetings generally included the program manager (based in Kampala, reports to program director), the project coordinator (head of operations in Mbarara PMO), the NGO lawyer, a paid IT Consultant, and me, as a visiting researcher and IT consultant. In addition, I worked with the paid IT consultant and the PC to select a new Internet Service Provider, also in February 2009. These experiences, as well as interaction with the systems deployed by the successful bidders, gave me additional insight into how the NGO staff integrated new technology and new technology infrastructure into their program. Furthermore, the availability of two IT experts in the decision-making process gave the NGO a better awareness of trade-offs entailed in each system. This bid process is discussed further with respect to the Bulk SMS system in Chapter 4.

In one sense, I masqueraded as software developer as a means/context of entering into my field site. The premise of Claim Mobile gave me a reason for working with the RHVP project, and my ICT skills provided a way for me contribute. At the same time, the goal of the ethnography was, in part, to inform better software development. Through that work, I designed and redesigned Claim Mobile, learning about the ways in which design can influence stakeholder relations (Chapter 3). Indeed, even in my decision to ultimately 'fail' Claim Mobile, I sought to understand the underlying factors that influenced the appropriateness of the system for the context. So in that respect, I was am a software developer using ethnographic methods to achieve more grounded findings. However, by also studying in situ and emerging technologies, and continuing to study the RHVP context after failing
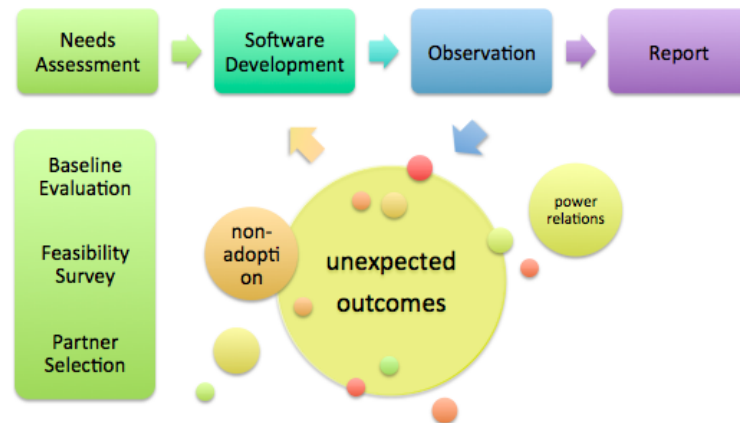
Figure 2.1: Iterative investigation enables me to respond to unexpected outcomes by changing software strategies.

Claim Mobile, I prioritized my ethnographic objectives over my software development interests.

2.1.2 Iterative Mixed Methods

In the *Case for Technology for Developing Regions* paper, my co-authors and I suggested the "co-design, co-deploy" strategy, in which the design of technology entailed working with local partners in both the design and the deployment of research interventions. This echoes existing research approaches - action research (Lewin, 1946; Susman and Evered, 1978), participatory design (Braa et al., 2004), and even software engineering (Beck, 1999; McConnell, 1996) emphasize the importance of iterative and interactive processes. More specifically targeting technology research, ethnographic action research emphasizes a cycle of doing and reflection. Indeed, the challenges of doing technology research in developing regions (Brewer et al., 2006a; Anokwa et al., 2009) make it even more necessary to use an iterative approach in this research. As illustrated in Figure 2.1, I began with an initial needs assessment, then moved into an iterative cycle of software development, observation and reporting.

In software development, cycles are important because prototypes play a role in helping users articulate their needs and preferences. Using the traditional, waterfall model, testing was often pushed until it was too late to make significant changes. By taking smaller development steps and iterating, testing cycles were pushed earlier, allowing critical changes to be made in the next cycle. Rapid Programming and Extreme Programming take this to an extreme, systemizing elicitation of needs, iteration and testing to produce code that better matched the customer's needs in as short a time as possible (Beck, 1999; McConnell, 1996). Rapid ethnography applies similar principles, using short, focused goals and interactive strategies to conduct ethnography over short periods of time (Millen, 2000; Brand and Schwittay, 2006). However, the focus entailed by rapid ethnography can often hide broader issues. For a longer study like mine, with a broad research question, more traditional approaches are required. I use surveys, interviews, and observation together to
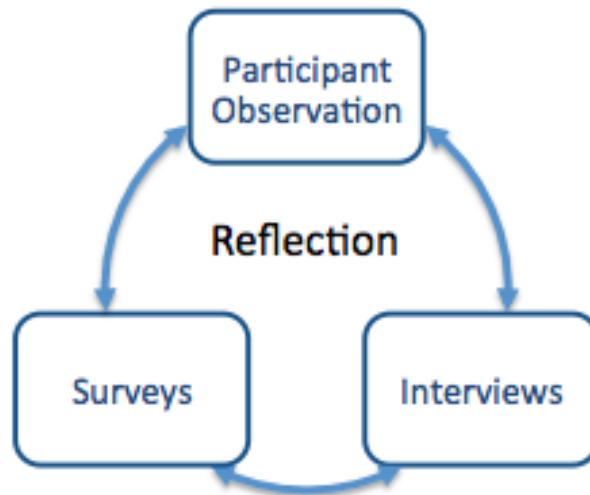
Figure 2.2: Constant reflection enables each of the methods used in my investigations to inform questions and observation in other methods.

gain insights from multiple perspectives. However, as in software development, I emphasize the importance of an iterative approach. Surveys, interviews, and observation are not merely used sequentially, or in isolation. Instead, surveys provide a broad overview that can inform more focused interviews, and highlight outliers and unexpected findings for further observation. Likewise, interviews might point out inadequacies in framing of survey questions, and help provide context for observations. Observations, in turn, do the same, reinforcing, expanding upon, and sometimes contradicting interview and survey findings. As illustrated in Figure 2.2, this interactivity between methods is enabled by reflection on research findings and implications for the next set of fieldwork activities.

This is practically illustrated in my fieldwork, which is described in Section 2.2. Semi-structured interviews somewhat combined interviews and surveys - and were especially helpful for learning ways to revise and improve questions for future surveys. In response to observations in 2007 and 2008, I expanded the initial survey instrument used in 2007, for use again in 2009. After pre-testing the survey with two additional HSPs, I clarified some questions. For example, modified a question about power sources, adding a 'rechargable lamp' option and changing 'gas lantern' to 'paraffin lamps'. As I discussed mobile phone and Internet use with the NGO and HSP staff, I also came to realize that I needed additional questions, adding an appendix to the survey to elicit more information about mobile phone service usage and Internet access. Interviews and observation influenced changes in software implementation. In turn I conducted additional interviews and observation to assess the new changes. As software development became less dominant in the study, interviews, observation, and surveys continued to reinforce one another.

2.1.3 Triangulation

The mixed methods approach also enables *triangulation* of data. This is especially important in the context of research in developing regions, in which gender, status, and race

lead to generally positive responses from research subjects and users. As noted in (Anokwa et al., 2009), some African men feel culturally obligated to answer positively to women, especially foreign women. Other studies also observe that survey respondents respond more positively to users of technical devices, and to non-local researchers (Cheng et al., 2008a, 2011; Dell et al., 2012) Although I am ethnically Chinese, Ugandans considered me to be a white *muzungu* – clearly my skin was not as dark as theirs. In addition, they distinguished me from the Chinese laborers sent to work on building projects contracted out to China, *mu-china*.

As a researcher, especially a 'white' researcher in Uganda, my presence implied a certain level of wealth and privilege. I lent status to my research subjects merely by being present at their facilities. It is only natural that the HSPs would encourage me to keep returning by telling me how much they needed and appreciated knowledge and technology. Furthermore, my placement as an IT consultant for the NGO placed me in a position of additional authority. For the HSPs, I was strongly connected to their source of income. For the staff of the NGO, I was an independent consultant explicitly authorized by their superiors in the organization. Status and position have a great influence on how people communicate in interviews. Perceived potential benefits, whether tangible or intangible, also increases potential bias.

How does one then avoid the pitfalls entailed by virtue of how I look? First of all, it was important to design survey instruments such that the answer bias would be minimized . In addition, I made consent forms which explicitly acknowledged the goals of the research and clearly stated that the HSPs relationship with the NGO, and the position of individual NGO staff, would not be affected by their answers or even choice not to participate. I changed the name of my mobile application from 'SmartForms' to the more neutral name of 'Claim Mobile'. Would you rather use the 'SmartForms' or the traditional, effectively 'not smart' paper forms? I also carefully balanced interview time with observation time, to minimize interference with their daily work. In the end, how I looked was less important that what I was doing, and the length of my relationship with the project participants.

Using participant observation enabled me to validate and better understand findings generated from interviews and document analysis. For example, the first interviews (July 2007) revealed the HSPs' dissatisfaction with the claims process, due to delayed payments, lack of information, and confusion about what was permissible or not on claims (See Chapter 3). The second, broader, set of interviews (September/October 2009), with virtually the same questions, revealed that the HSPs were communicating more frequently with the NGO, and were more satisfied with their relationship with the NGO. However the two studies were conducted differently. In the first case, I personally conducted qualitative interviews, often accompanied by the project coordinator (PC) of the RHVP program. The second interviews were a mix of surveys conducted by a research assistant traveling with the NGO staff and semi-structured interviews conducted by me traveling with my own vehicle. It is possible that surveys conducted in the more 'official' manner (e.g. by Ugandan staff ostensibly sent by the NGO) will generate more positive responses than a more conversational setting, in which participants are able to qualify their responses. Some of the ongoing dissatisfaction re-emerges in the Bulk SMS messages (November 2009 - June 2010) – many of the communications constituted complaints about delayed payments (See Chapter 4). In addition, observation and casual conversation with the HSP staff were often

punctuated by complaints that they expected me to relay to the NGO. By drawing on all of my collected data, I am able to *triangulate* findings, and understand better the differences and similarities between what people say and what they do.

However, for all of the complex issues resulting from my identity, it is ultimately my identity as an information technology researcher that gave me entrance into this field site. I discuss these issues in order to identify the ways in which elicitation of a 'ground truth' is much more complicated than simply asking questions and making observations. By using mixed methods, I am not trying to *technically* triangulate the 'truth'. Ethnography is not some mathematical method in which one can draw circles and lines and find the answer. Instead, these methods together help provide a richer picture, and reflecting on my role and relationships with my subjects as well as relationships between the subjects enables me to better understand how all of these findings fit together.

2.1.4 Mbarara vs. Kampala

In pursuit of this research, I travelled between the CMA and NGO offices in Kampala, the PMO office in Mbarara, and the health service providers in the districts surrounding Mbarara. During my extended fieldwork (2009) I chose to make the PMO office the base of my operations, visiting the NGO headquarters for a few days approximately once a month, and spending 1-3 days per week visiting the health service providers in the clinics. In many ways, I explicitly aligned myself as an HSP advocate. Since I was visiting them during my surveys and for observations, I could spend more time learning about their experiences and problems than the NGO staff, whose visits often consisted of inspections and feedback on errors in claims. My in-person interactions added to the pool of available knowledge about the HSPs for the NGO.

However, in order to visit with the HSPs on a regular basis, I initially depended on the NGO staff to transport me to the clinics. This dependency was not a problem for my short fieldwork trips. When I was only in the country for a few weeks at a time, they prioritized and scheduled my field visits. However, during my extended fieldwork, their field visit schedules often conflicted with my teaching schedule at Mbarara University, or were too rapid for me to do adequate observation. To surmount this obstacle, I finally purchased a car in July 2009, a little less than halfway through my extended fieldwork. Using this car, I could spend the entire day at health facilities, or make a round visiting multiple clinics, without occupying the time of the NGO staff. This freedom was an incredible change for me - it was not until this time that I could visit the HSPs on a regular basis.

When not visiting HSPs, I worked out of the PMO offices. Initially I sat at a desk in a room shared with the data entry staff. I worked on my own activities, but also observed the staff at work, and the regular interruptions. Once more data entry staff were hired, I moved to the "monitoring and evaluation" room on the other end of the office. This gave me additional space to sort through laptops, surveys, and for my research assistants[1], who shared the office with me. While this new arrangement was convenient, it also changed the nature of my participant observation forcing me to be more explicit in my interactions with the data entry staff. While we shared office space, and ate lunch together, I shifted to

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[1]one research assistant was later hired by the NGO as a data entry clerk

the use of interviews, conversations, and office meetings as a means of learning about their daily work.

The choice to work primarily from Mbarara also influenced my access to stakeholders in Kampala. This was problematic since project decision-making primarily occurred in the headquarters. Furthermore, the claims management agency, and its subsequent replacement were also based in Kampala. Being a six-hour journey away limited the frequency of my interactions with these organizations. Despite being in Uganda for an extended period, I could not be available for all significant meetings, and only interacted with the claims database developers when they were in Mbarara. However, by being in Mbarara, I could be a party to interactions between the NGO Headquarters and the PMO, as well as interactions between the PMO and the HSPs. Even as an ethnographer, one cannot be and observe all things all the time. The choice to place myself in Mbarara reflected my interest in hearing the voices of people doing work on the ground, further down on the power chain. Where decisions were made in Kampala, contention and development occurred in Mbarara.

2.1.5 Multi-disciplinarity

One of my struggles as a multidisciplinary researcher centers on how to produce research that appeals to both social scientists and technologists. I often hear two-sided complaints that the work of either one group or another is not relevant. Michael Best summarizes the rift: "In Doha, some computer scientists felt that the conference overly favored social scientists' work, and for their part, the social scientists complained that the technical work lacked sophistication, was weak in evaluation, and was not grounded in the needs and realities of the users. (Best, 2010)" Where social scientists build theory and explanations about interactions between people, between people and technology or between people as mediated by technology, technologists instead seek out 'implications for design' (Dourish, 2006). Burrell and Toyama characterize this in part as a tension between the need for *generalizable results* and a danger of compromising accuracy by *overgeneralizing* (Burrell and Toyama, 2009). In this research I have both very specific findings as well as some ideas that are generalizable - both with the caveat of the context in which these findings have been derived. It is important to understand the particular wealth, occupational, and other related social contexts when considering how to apply these findings.

In attempting to do both research interventions and research of interventions, I bring my own ideologies into my research. I believe that innovation in technology has a significant role to play in forwarding development (Brewer et al., 2005), but only if it is grounded in the realities that will not necessarily be revealed in a few weeks of fieldwork. I believe that while motivations for technology are often simple, the contexts that lead to success and failure are complex. Power infrastructure to support information technology use may vary in availability, reliability, and cost. Supporting stakeholder structures may change over time. Particular information technologies are suited for some contexts (e.g. short forms) but not others (e.g. long forms). In addition, I seek egalitarianism out of technology, believing that access to information and information tools should reach the beneficiaries as well as the administrators. I pursue a depth of understanding about the RHVP context because I know that flows of information, and the factors that influence them are complicated, unequal, and changing. Observing these enabled me to improve the design of Claim Mobile, and to

build a better understanding of other technology uses in this context. Likewise, by explicitly introducing Claim Mobile, and trying different designs, I developed a better understanding of the ways in which new technologies successfully and unsuccessfully disrupt these flows.

But by trying to speak to people from multiple domains, my work does not automatically draw on all domains - I cannot be all things to all people. For example, organizational theory is an entire field. So is management science. ICTD work, especially, is often evaluated from an information systems perspective (Richard Heeks, 2002). Building on my background in entrepreneurship, I considered analyzing my findings from a diffusion of innovations perspective (Rogers, 1995), and my approach has some basis in ideas drawn from Clayton Cristensen's The Innovator's Dilemma (Christensen, 1997). Indeed, I can draw from literature in public health, human-computer interaction, computer-supported cooperative work, and even computer-mediated communications. Unfortunately, while I do on occasion draw on these the scope of my experience and education is not quite so broad. Instead I draw primarily on literature dealing with information technology and health, with brief incursions into literature from other fields. My writings have thus far been intended to speak to the interdisciplinary ICTD research audience, and the HCI4D community.

2.1.6 Where's the 'D' in RHVP?

Now I come to the question of development—economic development, not software development. Why go into ICTD if not to 'do good'? Kleine and Unwin discuss information and communications technology *for* development (ICT4D) in historical context, noting that technological innovation has always been a part of development, but technological and knowledge diffusion has been highly uneven. Moreover, "ICTs can be used to reinforce the position of those in power... but they can also be used to subvert that power.. externally imposed, top-down and supply-led programmes usually fail to bring significant and lasting benefits for the world's poor" (Kleine and Unwin, 2009). Kleine, like Best, is concerned that there is a disconnect between the implementers and development discourse. There are some structural issues at work, (Kleine and Unwin, 2009) was published in a development journal, rather than presented in an interdisciplinary conference such as ICTD. Where journals hold prestige for social scientists, computer science researchers look to conferences for innovation and advancing knowledge. Ultimately, there needs to be literature that bridges the audiences, grounded in needs and realities while addressing *innovation* for developing countries, and not just technologies (Best, 2010).

To be clear, not all research around ICTs and development or even ICTs for development will constitute *computer science research*. And yet, just expecting market forces and existing technologies to drive ICTD is not sufficient, despite the facile transfer of Internet and mobile phones to developing countries. Transfer of existing technologies, and first-world driven innovations are more likely to exacerbate existing inequalities, worsening the so-called digital divide (Warschauer, 2002). This issue is discussed briefly with respect to SMS gateways and mobile phone advances in Chapters 4 and 6 respectively. Instead, I argue that, in addition to the building of an understanding of transplanted technologies in developing regions, there is a need for research into technologies explicitly designed for the realities of developing regions, whatever they may entail (Brewer et al., 2005). In Chapter 5, I further demonstrate that these two are deeply intertwined; new information

technologies are not adopted in isolation of other technologies. However, there remains a gap between computer science interests and '4d' interests. Research is rewarded for being innovative, not for achieving development objectives. Ideally, ICTD research would be rewarded for innovative ways of achieving development objectives. Unfortunately we have found that measuring development objectives is difficult, instead targeting secondary objectives like usability of designs presumed to facilitate development goals. For this reason, the human-computer interaction community has become a useful locus for research in developing countries. Human Computer Interaction for Development, or HCI4D, seeks both to understand in situ technology use, and implications for design of new systems for developing region contexts (Ho et al., 2009; Toyama, 2010).

The RHVP program provides clear measurement of development metrics. In addition to having provided facility-based treatment to 99,000 patients who would have not sought treatment otherwise, household surveys demonstrate reduced prevalance of STIs, as well as increased interest in health-seeking (Bellows and Hamilton, 2009). What part of this, however, can be attributed to information technology innovation? Well, as will be shown, very little can be attributed to Claim Mobile. However, it is arguable that the changing use of information technologies enabled the NGO to improve and maintain communications with the HSPs. Where four out of 16 resigned from the program in 2006, subsequent years saw a steady increase in the number and geographic distribution of the participating health facilities. Information technologies and information technology innovation were an integral part of program management. The ways in which ICTs were successfully integrated or not contributed to smooth or disruptive running of the program. At the same time, ICTs were not everything. Politics, funding, and logistics all contributed to periodic slowdowns of payments and a structural change in how data was managed (See Chapter 6). This larger picture is highly relevant to both practitioners and researchers in ICTD. Design and usability of systems is not sufficient; sustainability and resiliency of relevance are also critical in bridging the gap between innovations and development. Human interest also— that is, champions and thought leaders—plays a key role in successful innovation. The loss of the CMA as a champion contributed to Claim Mobile's failure as much as the inspiration of the project support manager led to the development and use of the Bulk SMS system. It is my hope that a better understanding of information technologies an the way they integrated into the RHVP program will be help inform similar endeavors in the future.

2.2   Research Activities

In this section I discuss the methods and reasoning for my various fieldwork activities. Table 2.1 and Figure 2.3 provide an overview and timeline of these activities in relation to RHVP events. This research has spanned a period of about four years, with 17 months spent in Uganda over five visits.

2.2.1   Initial Site Visit (June 2007) and Needs Assessment (Nov 2007)

In Summer 2007 I did an initial two-week visit to establish a relationship with the project, and to establish their suitability as a potential project partner. In general this visit con-

	Dates	Duration	HSPs	Methods
Initial Site Visit	June 2007	2 weeks	12	Structured Site Survey Partner Assessment
Needs Assessment	Nov 2007	2 weeks	7	Participant Observation Semi-Structured Interviews Document Collection
Claim Mobile Pilot	July – Aug 2008	4 weeks	2	Participant Observation Rapid Prototyping Interviews Document Collection
Extended Fieldwork	Nov 2008 Jan 2009 – April 2010	1 week + 15 months	60+	Participant Observation Periodic Interviews Periodic Surveys Technology Training Document Collection
Baseline Survey	Sept – Oct 2009	2 months	59	Semi-Structured Interviews Qualitative + Quantitative GPS Mapping Mobile Signal Mapping
Netbook Pilot	Dec 2009 – July 2010	6-8 months	8	Semi-Structured Interviews Participant Observation Rapid Prototyping Technology Training
Bulk SMS Study	October 2009 – June 2010	7.5 months	118	Participant Observation Semi-Structured Interviews Document/Data Collection Statistical Analysis

Table 2.1: Overview of methods used, duration, and the number of participating HSPs in fieldwork activities.
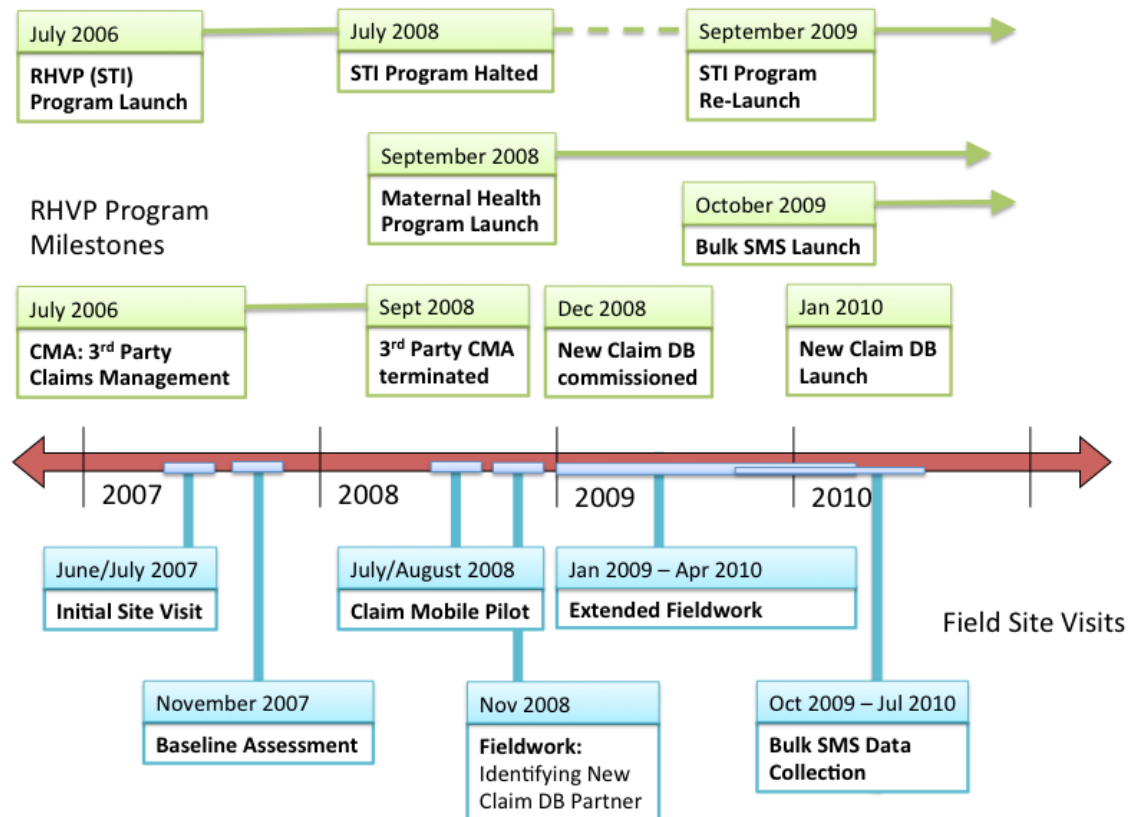
Figure 2.3: Timeline of program events and fieldwork activities conducted in Uganda.

sisted of formal and informal meetings with various stakeholders. In addition, I conducted interviews and directly observed daily interactions and processes surrounding the claims process. When given permission, I did audio and video recording of interviews, so that I could review them later. Primarily I sought to understand the mechanics of the RHVP program. In addition, the interviews gave me insight into the baseline of how the HSPs and the NGO communicated with one another, and helped me to to understand where they encountered difficulties. I also used the interviews to gauge NGO, CMA, and HSP interest in a mobile forms application, and to better understand how a collaboration might function.

As part of this initial visit, I worked with two other visiting researchers, and conducted a structured survey of the participating health facilities, in conjunction with their own. My section of the facility survey ascertained their current perceptions of the RHVP, health information management practices, and queried about various aspects of available infrastructure (e.g. power, size of facility). At this time the program had 12 participating facilities, and this survey incorporated all 12 facilities. Using this information I was able to get a broad idea of mobile phone and computer usage, and to quantify some of the complaints and difficulties encountered by the HSPs. I also collected claim summary reports from the management agencies regarding the performance of each clinic, and copies of training materials used to explain how to fill out the claim forms. These materials, and the claim form, formed the basis for the design of Claim Mobile.

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Figure 2.4: A patient affixes his thumb print onto a claim form. November 2007.

This visit provided enough information for me to get a better idea of the program operations, and to determine the feasibility of Claim Mobile as an intervention in this context. However, in the survey, some HSPs reported not receiving communications at all. In response I decided to return in November 2007, to formally discuss a collaborative partnership with the NGO and the CMA, and to interview a few of the HSPs more in depth. In two weeks in the field I visited seven health facilities, conducting in person interviews accompanied by the project coordinator of the RHVP. As before, these interviews were audio-recorded, and supplemented with photographs. In some cases I also observed patient intake (form processing, Figure 2.4), although due to privacy reasons I did not observe patient examinations, which usually occurred behind a screen or in another room.

These two visits formed the basis for my original design of Claim Mobile. The surveys highlighted the delays and difficulties experienced by both the NGO and the HSPs. However, it was not until the deployment in August 2008 that I recognized the role of between-stakeholder interactions in Claim Mobile's deployment.

2.2.2 Pre-Pilot Deployment (Aug 2008)

Based on my findings, I did initial prototyping of a mobile application while in Berkeley, which is described in detail in 3. I returned to Uganda in Summer 2008 to do a three stage pilot deployment:

1. Test the functionality of the software in situ: Since the software entailed using mobile Internet to submit claims I needed to ensure that the software functioned well in Uganda
2. Review the proposed claims process with the partner NGO: This entailed conducting demos of the mobile application, and securing support for conducting the pre-pilot.
3. Test Claim Mobile in the field.

During all stages, I followed the iterative software development methodology, trying

out new features and developing new tools as they were merited by findings in interviews. During my interviews, I also shared my findings with the various stakeholders, using their insights and opinions to inform the next iteration of Claim Mobile. This iterative approach ultimately led to a redesign of Claim Mobile, including a web interface to mediate equal access to claims data.

As with prior visits, I recorded interviews with various stakeholders. In addition, I repeated the semi-structured interviews with my pilot participants to re-establish the baseline, since the study was conducted a year after the first survey.

I selected two HSPs for the pilot, a rural facility and an urban facility. The initial deployment entailed 2-3 hours of training with each facility, working all of the staff normally engaged with the RHVP. As part of this study, I also spent three nights overnight in the rural HSP, supplementing interview data with direct observation. After the initial deployment, I returned to the NGO offices (approximately 6-8 hours drive away, 1 day's travel) to review the claims submitted via the pilot with the NGO staff, gathering feedback on the system, and also providing feedback to the HSPs on the claims via Claim Mobile. From there I returned to the health facilities to review the claims status feature with them, and to follow up with them on any questions they may have had in the intervening 7-10 days.

In total, the first three visits (June 2007–August 2008) comprised approximately 30 hours of recorded audio, a survey of 12 HSPs, detailed interviews in 7/12 HSPs, and intensive observation in two health facilities, the NGO offices, and the CMA.

2.2.3   Extended Fieldwork: Participant Observation

I started my extended fieldwork in January 2009 with a disaster. The NGO had just given me a ride to from Kampala to Mbarara in a new truck, accompanying the next three year's worth of claim and poverty qualification forms, and immediately had a program meeting. Unfortunately, despite having prepared backups and backups for my backups, my audio-recording equipment was not working. I had my audio recorder, but the batteries were dead. My digital pen was powered, but my digital notebook was packed away in a suitcase that drove off just as the meeting started. My laptop battery was dead from a power mishap the night before. I tried a backup voice recording application on my android phone, but it did not work—instead I have about 90 minutes of silence recorded. In the end, I had the minutes from the meeting, and my written notes. This episode, for me speaks to the logistics of conducting research in the field. I was constantly struggling to have power available to charge my phone, my digital pen, and my batteries. Internet was available, but not all of the time, and not necessarily at usable speeds. People operated on their own schedules, not mine. Furthermore, even supposedly simple things like getting a ride were actually quite complex, as people worked through ways to avoid traffic, roadblocks, and even juggling the available trucks between trips to the field, and errands for the Mbarara and Kampala offices.

My extended fieldwork spanned January 2009-April 2010, officially working out of the NGO offices as an 'IT consultant', in addition to my acknowledged position as a visiting researcher. I assisted as necessary to help make information technology (IT) related decisions, and to facilitate communications with the HSPs. I used my time to engage in observation of NGO life, the interactions of the staff with one another, and with the HSP staff.

I also worked with the doctors, midwives, and other health practitioners that were in charge of the HSPs (ICs), observing their work, and training them on the use of ICTs. I conducted periodic interviews with the ICs and NGO staff, both conversational and semi-structured, to elicit a better understanding of my observations.

As detailed in Chapter 1, the NGO has two major offices: the headquarters in Kampala, and the program management office (PMO) in Mbarara, approximately 6 hours drive away. During this period, I resided in Mbarara, with approximately monthly visits to Kampala, to participate in software bid evaluations and to converse with the Kampala-based staff. In general I recorded only selected staff meetings, business meetings, and private meetings with individuals, when given permission, taking notes instead of day to day operations and on casual communications. Key components of my fieldwork included interactions with the HSPs, the NGO staff, a comprehensive facility survey (and pre-testing activities), implementation, evaluation of prior Claim Mobile deployments, evaluation of a Bulk SMS system deployed by the NGO in October 2009, and intensive work training the NGO and HSP staff on computer and Internet use.

2.2.4   Extended Fieldwork: HSP Survey

The purpose of this survey was to 1) to inform the technology pilot following, 2) to understand current uses of information technology within this population. Portions of this survey have been repeated in prior surveys with the initial 12 HSPs, and the full survey was pre-tested with two HSPs in March 2009, who were not approached again for the full survey.

At the time that the HSP study was conducted (September - November 2009) there were 83 facilities participating in the RHVP project, 37 treating patients for STIs through the STI treatment program, and 52 overseeing mothers through the maternal delivery program (6 facilities are participants in both programs). Although my research assistant and I visited most of these facilities, I was only able to acquire survey data from 59 facilities. As a result of geographic expansions in service coverage area, there were 106 facilities participating in the RHVP project (81 Maternal, 25 STI) as of April 2010. The additional facilities were not approached again for the survey.

Out of the 59 surveys, 20 were accompanied by qualitative data in the form of recorded interviews. During each of these interviews, I also evaluated mobile phone coverage, checking for signal strength and mobile Internet coverage for each of the mobile providers in Uganda. The remainder of the interviews were conducted with the assistance of my trained research assistant. My research assistant was a trained laboratory assistant who was recommended by, and used to work for, a health service provider who also participated in the RHVP program. As a result, he was familiar with the RHVP program, but not with research methods prior to becoming my assistant. He also served as a translator during interviews when helpful, although all of the participants were English speakers. However due to time and training constraints, the surveys he conducted only included structured data. Shortly before my departure he was hired by the NGO to work as a lab assistant in one of their NGO-managed health facilities.

The surveys covered a broad range of information and information technology-related questions. The first six questions dealt with basic demographics: interviewer name, time

and contact info, facility location and GPS coordinates. In semi-structured interviews, the query for an email address often triggered discussion about email adoption and use. The next eight questions addressed paper record-keeping practices. The third section dealt with mobile phone ownership, coverage and usage. The next section addressed electricity infrastructure, and phone charging practices. I found that health service providers expected phone to last at least 3-5 days in order to last through power outages and be useful. In semi-structured interviews, I also learned that the need to charge phones at work, combined with inconvenient locations often meant that phones were inaccessible when they were being charged. I also asked seven questions about computer availability, usage, skills - finding that many HSPs had little to no experience with computers, but were interested in the potential of computers for accounting and patient record-keeping. The financials section asked about airtime spending in general and on RHVP-related calls, access to credit, income, and time spent on paperwork. Another section comprised 30 questions on HSP interactions with the RHVP project, often comparing actual experiences to preferences. In this section, I used semi-structured interviews to elicit explanations for preferences and difficulties experienced. Finally I added an appendix including additional questions about the facilities, mobile Internet and service usage, distance to and cost of Internet, and perceptions about Internet usage obstacles. This work draws primarily on basic statistics around mobile phone ownership, Internet usage, and the RHVP-NGO relationship, with deeper analysis planned for future work.

Three key limitations influencing the baseline study were *1) timing within the RHVP* and *2) availability of transportation* and *3) availability of the HSPs*. While the study was initially timed for Spring 2009, during the beginning of extended fieldwork, it soon became apparent that it would be impossible to travel to each of the health facilities without an independent vehicle and/or additional research funds. Furthermore, although the primary focus of the study was the STI voucher project, it had been halted from October 2008, and did not resume until September 2009 (See Figure 2.3). This extenuating circumstance resulted in a delay in both the survey and the projected pilot deployment. Ultimately, I drove to the first 20 interviews, and the research assistant reached the remainder of HSPs by accompanying the sales team on their field visits. In 24 cases, the health facility staff was not present when the sales team visited, or simply chose not to participate in the survey. Since these tended to be more remote facilities and facilities that did not operate throughout the week, the survey represents generally less remote and ostensibly more 'connected' facilities. As a result, the data from the survey is probably slightly inflated with respect to information technology use, and may represent HSPs with potentially greater engagement with the NGO. This divergence can be proxied in part by the difference between findings between the STI HSPs, which were primarily located within 6 districts closest to Mbarara and the maternal delivery HSPs, which were distributed throughout Uganda's Western Region. Braided communications (discussed in Chapter 5) addresses some of these geographic differences by acknowledging that affordances of different communications technologies differ from HSP to HSP. Consistently, This also further highlights the more opportunistic nature of paper communications delivery; out of 63 facilities targeted by my research assistant, only 39 were actually visited during the sales team's monthly visit. Availability of transportation often did not overlap with the availability of the HSPs. The consequences of these opportunistic visits are also further discussed in Chapter 5.

2.2.5 Bulk SMS Study

In addition to the above studies, I also look at the third-party bulk-SMS platform deployed in October 2009. The initial work was primarily participant observation, in which I participated as a bid evaluator, and discussed the request for proposals with RHVP staff. Later, once the software was deployed, I conducted interviews with each of the RHVP staff that interacts with the software directly, and with the pilot participants to understand the workflow around the bulk SMS system and their perceptions of it. In addition, I have a full download of all the messages that have been sent to and from the system and are performing an analysis on the data. The methods used for this study are detailed further in Chapter 4.

This particular study provides insights into the type of intervention I classify as *emergent technologies*. While I was involved in the selection and design of the Bulk SMS system, and may have had influence on the project support manager who championed the project, it was ultimately inspired internally, and developed and deployed by a third-party SMS gateway provider. Perhaps even more than *research interventions*, emergence is the primary way that most organizations will take on new technologies. They represent lower risk innovations than research projects, and often are accompanied by better local support infrastructure. However, as new technologies, they also play a role in the ongoing disruption of communications processes and stakeholder relationships. By studying the Bulk SMS system, I am able to learn more about the renegotiation of social processes

2.3 A Study of Change

Context matters. How, then, do we reconcile the idea that design concepts can be generalizable and replicable with the understanding that every case, every context, is unique? Participatory design (PD) practice suggests that combining expert knowledge with interactive user feedback yields better systems. However, context is never static. Needs, priorities, and even stakeholders often change over time. Once the PD researchers cease interacting with the users, and the intervention is declared complete, receiving institutions are often powerless to adapt the intervention to suit their new circumstances.

At several points during my fieldwork, I introduced new technologies, or the idea of new technologies. In particular, I piloted Claim Mobile to two HSPs in August 2008, and provided netbooks and Palm Treos to eight HSPs in January 2010. In both cases, the decision to deploy the technology involved extensive discussion and study with the parties involved beforehand, during, and after. I also observed the adoption of in situ technologies, including increased use of mobile phones, SMS (text messaging), and the deployment of a web-based bulk SMS system.

While all ethnographies entail some level of disruption (Stacey, 1988), I chose to explicitly disrupt the context of the NGOs and the HSPs by introducing new technologies and observing the resulting perturbations. While Claim Mobile put forth as a means of improving the efficiency of program management, it was also for me a mechanism by which I could better understand what it meant for the RHVP program to participate in a research project.

Many researchers have previously proposed the necessity of involving the local community – the users – in the design process of ICTD interventions. Participatory methods are central to Braa's work in deploying health information systems (Braa et al., 2004). Tacchi further suggests ICTs exists in a communicative ecology of many interrelated people, media, and relationships (Tacchi et al., 2003). Likewise, I conducted my research involving Claim Mobile with the understanding that it would exist in a rich ecology of stakeholder relationships and practices. Iterating over the steps of planning, interaction with the users, and implementation are important aspects of developing projects grounded in reality and user needs. However, as a key difference, the project, while important, does not form the basis for the research. Instead, the basis for this research was the changing NGO context as I introduced and they approached new information technologies. The project, in this case, was a tool by which I could trigger a specific type of change, and examine the results. The conditions around Claim Mobile's introduction and non-adoption helped me develop a richer understanding of the role of new information technologies in Ugandan healthcare.

This chapter endeavors to reflect on some of the issues revolving around the methods used in the study. I have chosen a iterative mixed methods approach as a means of effectively adapting to the rapidly changing nature of our investigative context. As a result, I have been able to adjust this study to better meet the needs of our stakeholders, and to investigate questions that are relevant to the ICTD community and to my study participants.

As detailed in Chapter 1, the remainder of this document depicts findings based on my observations of the RHVP program and its participants. Each chapter draws its strength from the multiplicity of methods used, as well as the innovativeness of the research subjects.

CLAIM MOBILE: ENGAGING CONFLICTING STAKEHOLDER REQUIREMENTS

3.1 Introduction

Mobile phones are frequently touted as being **the** appropriate and sustainable platform for rural healthcare in Africa. They are relatively cheap, durable, consume less power than laptops and desktops, and incorporate a battery that makes them more amenable to use in places with intermittent or no power. Commonly proposed uses are for data collection (Cheng et al., 2008b; Cynthia Casas and William LaJoie, 2003) and decision support for rural health workers (DeRenzi et al., 2008; E.S. Berner and M.J. Ball, Editors, 1998). Some projects also use mobile devices as a platform for information dissemination as well as data gathering (Lucas, 2008). However, these are all generally "closed loop" systems in which researchers are able to control all aspects of the system design and operation, focusing their research primarily on the rural health workers that will be using the mobile phones.

Other applications have even more potential for large-scale impact. In the agricultural sector, we have observed how the introduction of transparent market prices and subsequent hiring of "middlemen" to purchase from farmers has reduced fraud and transformed supply-chain management for the E-choupal project (Bowonder et al., 2003). While health information is critical to the improvement of healthcare in developing regions, *financing* health-care also remains a significant unsolved problem. Can we take lessons from e-Choupal and apply them in the healthcare sector? The design of usable, reliable, and fraud-resistant tools for management of these aid flows is an area with potential for very significant impact.

However, in the case of healthcare, the financial models are very different from commercial markets – financing of healthcare typically comes through transnational aid agencies like the World Bank and International Monetary Fund (IMF), and is implemented by non-governmental organizations (NGOs) and the local government. Since the NGOs are typically experts in health, not technology, data processing is often outsourced to third-party information technology (IT) vendors. Relationships between the vendors, the NGOs, the local governments, and the transnational aid agencies are not always smooth - and limitations in communications infrastructure means that the information flows between them

are scattered at best.

In this chapter I suggest that the "closed loop model" generally used by researchers in deployments of mobile health applications does not map onto the financial and political realities of the mainstream of healthcare provision in Africa, and limits the ability of pilot programs to increase their scale and impact. In Chapter 2, I describe an innovative, IT-based, NGO-run healthcare access program in Uganda. In this chapter, I describe my initial experiences designing and deploying Claim Mobile, a mobile-phone based system intended to address its inefficiencies and help the program scale to additional districts. I argue that in addition to addressing the needs of the primary users in the system, the health workers, the design must consider the requirements, motivations and concerns of the other stakeholders: the IT vendors, the NGOs, the government, and the aid agencies. Designs must consider the larger order ramifications of how one may positively and negatively impact both the "users" who will be generating the data, and the entities that will be engaged in managing and using the information in the resulting database. Just as the e-Choupal project assimilated the middlemen by hiring them as kiosk operators (Bowonder et al., 2003), I propose that one can design applications structured to accommodate conflicting stakeholder requirements, while also alleviating information inequalities resulting from limitations in the system prior to the introduction of the information technology.

3.2   From Vouchers to Payments

As described in Chapter 2, the claims process includes many steps and individuals. As a result, there are many opportunities for error and fraud. In this section we describe the claims process in more detail[1].

Patients buy treatment vouchers in pairs, one for the client and a second one for the client's sexual partner (See Figure 3.1). Each voucher is good for one consultation (generally including a lab test to diagnose the STI) and three follow-up visits. During the consultation, the provider completes a claim form recording the client's demographics, the examination and laboratory results, a diagnosis and details of the course of treatment prescribed (See Figure 3.2), placing the appropriate visit sticker from the voucher at the bottom of the form. The provider then has the patient review the form, sign it, and place his thumbprint on it (Figure 3.4).

Completed claims forms are sent to the voucher management office in the city of Mbarara, the main urban center of Western Uganda. Depending on geographic location, and frequency of visits to Mbarara, it can take two or more weeks before the provider will have an opportunity to deliver the claims to the management agency. The current data management system requires all claims to be submitted on paper forms to the management agency. At least another two to four weeks are spent reviewing each claim, cleaning data from improperly-completed forms, and verifying that the service took place among suspect claims. Once claims are officially processed, the payments themselves are often delayed,

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[1]While the RHVP program later made available for maternal delivery services, only STI treatment were provided at the time of this study. As a result all details in this chapter pertain to the STI component of the RHVP program.

Figure 3.1: A STI treatment voucher. The 'M' in the top left is a note written by the health service provider to indicate that the first client voucher on the left was given to a male client, and that therefore the partner vouchers on the right should be given to a female client.

as the banks take 2-3 additional days to process electronic funds. Two months or more can go by before the provider is reimbursed for service provision.

In Uganda, private providers traditionally operate on a fee-for-service model, receive prompt payment, and do not have a large operating margin. In many cases, payment is provided prior to service. Delays in payment result in delays in procurement of replacement prescriptions and medical supplies, often leading to a temporary hiatus in service. Encouraging provider involvement in the RHVP program requires a great deal of confidence on the part of the providers to participate. If a system to shorten claims processing could be devised, more providers could join the scheme and more patients could be provided the life-saving STI treatment voucher subsidy.

The remainder of this chapter details the system we are currently piloting, in which claims are submitted via Internet from a mobile phone directly to all the parties in the management agency. In addition to describing our user studies and how this has informed the design of the system, I discuss the problem of negotiating conflicting stakeholder requirements. I find that in projects with multiple stakeholders, the introduction of a system may disrupt balances of power, particularly around the flow of information and money. As a result, the design of this system, in order to secure positive support from all parties involved, must carefully balance stakeholder incentives.

3.3 Methods

The research described here involved an iterative process of field research and prototyping. The fieldwork and deployments have been done over the course of three visits to Uganda: an initial two-week visit in Summer 2007 to establish a relationship with the project, in which we also conducted a survey of the clinics in the program; a followup visit for three weeks in November 2007; and a five-week pre-pilot deployment in August-September 2008. During all three visits we conducted semi-structured interviews with the
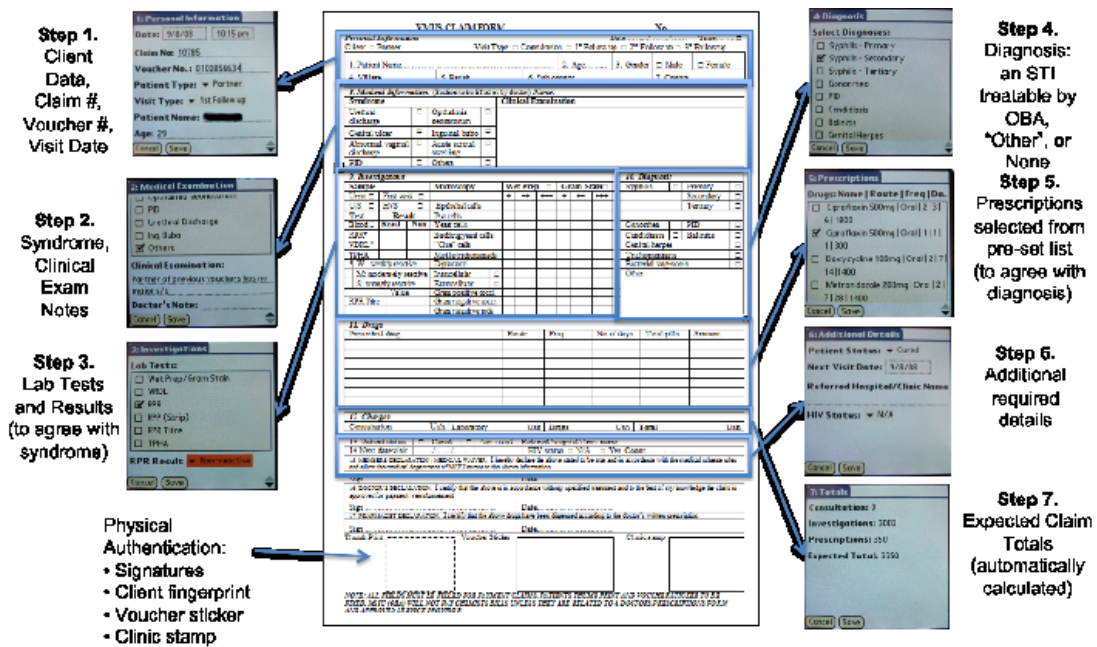
Figure 3.2: From paper form to mobile phone: a mapping of the mobile phone interface equivalents for each section of the paper claim form.

various stakeholders, and directly observed claims form entry and processing. When given permission, we did audio and video recording of interviews and user study activities. In all, we have approximately 30 hours of audio, and have done detailed interviews in seven of the 12 participating clinics (in addition to the initial survey of all of the clinics), as well as intensive observation in two clinics, a rural, high-claim-volume clinic with very little exposure to computers, and an urban low-claim-volume clinic with its own computers. The last visit entailed a comparative user study as well as deployment of the mobile phones in the latter two clinics.

3.3.1 Clinic Surveys

The clinic survey was conducted in conjunction with a larger survey of available infrastructure at contracted clinics. We asked 14 questions, assessing familiarity with computers and mobile phones, but primarily gathering feedback from the health clinics on the claims process (e.g., how long it takes them to fill out the paper forms, and what their priorities might be for improvement of the process). We also collected various documents from the management agencies regarding the performance of each clinic, including all available financial reports on processed claims, and in November, we returned to seven of the clinics to do in-depth surveys and to follow-up on the survey findings.

3.3.2 Rapid Development and Pre-pilot Deployment

Initial prototyping occurred in early 2008, and we returned to Uganda in Summer 2008 to do a three-stage pilot deployment, first testing the functionality of our software, second re-
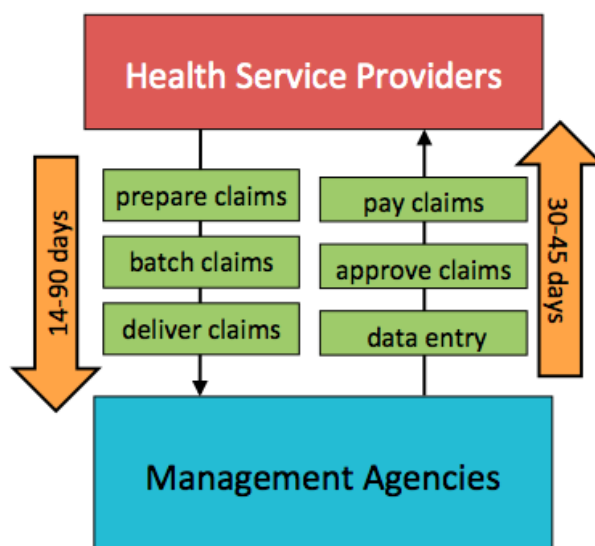
Figure 3.3: This flow chart illustrates the steps entailed in preparing, processing, and paying voucher claims. During this evaluation period in 2007-2008, most of the processing time is consumed in data entry and validation.

viewing the proposed claims process with the management agencies, and finally taking the phones to the health clinics to test the mobile phone interface in the field. During this time we also conducted another round of semi-structured interviews to gather information on changes in the claims submission process (for example, claims processing had moved from Mbarara to the national capital, Kampala). We did iterative development based on feedback from the various stakeholders, trying out features as they were suggested, and developing new tools as seemed merited by findings in our interviews. To gain a more in-depth under-standing of health clinic life, we stayed overnight for three days in the rural health clinic, thereby supplementing the the semi-structured interviews with direct observation of actual practice.

The primary purpose of this last field visit was to conduct a pre-pilot demonstration, using the mobile phones to submit actual claim data to the management agency, have it reviewed, and have the management agency provide feedback to the health clinics via the mobile phones. We simulated the proposed process, physically following the claims forms from the time the patient comes into the health clinic, through the preparation of the claims summary forms, physically transporting the forms to the management agency where we observed the claims approval, and data entry into the existing database. We simultaneously had the service providers submit the claims form via Claim Mobile, enabling the manage-ment agency to provide feedback to the service providers through the system. The pre-pilot is still operational, with mobile phones remaining in the two clinics, and the full pilot will be conducted in May 2009, with mobile phone-based claims processing expanded to 8-10 additional clinics.

Figure 3.4: A voucher client validates his provider's claim by providing his thumbprint on the form next to the voucher sticker.
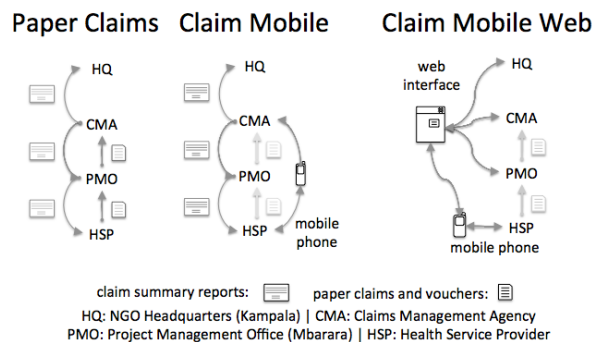
Figure 3.5: This diagram illustrates the flow of money and information between selected stakeholders in the OBA project, both currently, and how it will be once the Claim Mobile system is fully deployed.

3.4 Stakeholders

In this section I describe the funding, management and service provider organizations to which I alluded in Section II. Fundamentally, all stakeholders want to improve STI treatment and reduce the prevalence of STIs. Each stakeholder also has a financial interest in the success of the overall project – staying afloat for the health service providers, and staying within the aid agencies' target budgets for the management agency partners. The discussion highlights the ways in which the various stakeholders have competing as well as common interests. While I will detail several stakeholders in this section, there are six key stakeholders: the aid agencies who fund the RHVP project, the NGO Headquarters (HQ) which receives the funds from the government and disburses them, their program management office (PMO) in Mbarara which runs the program and interacts directly with the health service providers, the technical management agency (CMA) that manages the

claims processing, the health service providers (HSPs), and us, the mobile platform developers (MPDs). Figure 3.5 illustrates some of the relationships between these entities which I will describe in detail in the remainder of this section, based on qualitative fieldwork and document analysis.

3.4.1   Aid Agencies

As the funder of the HealthyLife STI treatment program, the involvement of the European aid agency is more than apparent. Their role in the management of the program is more supervisory – a consultant goes to Uganda at irregular intervals to help with planning of the program, and they do some monitoring. They also have commissioned another non-profit, affiliated with a North American university, to conduct an evaluation of the program. Ultimately, however, they control the flow of money to the financial management agency, which then pays the IT vendor to handle the technical aspects of the operation.

In the past year, the European aid agency has worked with an additional transnational aid agency to fund the expansion of the project into additional districts. While they may not have a direct impact on the information processes in the project itself, the funders' internal actions have direct impact on the project as a whole. In one example, a delay in payment to the European aid agency resulted in a delay in payment to the two management agencies. As a result the IT vendor ceased processing of claim forms until payments were received. However, not only did the voucher program grind to a halt, but reimbursement to the participating providers for patients already seen was delayed as well; the management agencies ended up with a backlog of claims forms to process, exacerbating the length of time it takes to process claims and further delaying payment for services.

3.4.2   NGO Headquarters (HQ)

The local NGO partner that acts as the NGO Headquarters (HQ) is the Uganda office of a multinational non-profit sexual and reproductive health organization with a goal of reducing unintended pregnancies and unwanted births through family planning and other methods. Their role in this project is to receive the funds from the aid agencies via the Ugandan government, using these funds to pay the health clinics and to pay for other program costs, including the database software development and management. The main office in Kampala runs this program (as well as others) and manages several clinics throughout Uganda, one of which was a participating clinic in the HealthyLife program until Summer 2008. In addition, they have a program management office (PMO) in Mbarara which is directly in charge of coordinating the the RHVP project. In the claims process, the FMA disburses payments to each of the service providers, based on claim reports from the Claims Management Agency (CMA).

3.4.3   Program Management Office (PMO)

The HealthyLife PMO in Mbarara has five full-time staff, in addition to two people that help with cleaning and cooking, and the FMA staff that come in and out of Kampala for related programs. There are two computers in the office, one in the project coordinator's

office, and another in the finance office, shared by the Behavior Change Campaign (BCC) coordinators who go out into the field to run community radio advertising programs and to distribute vouchers. Their Internet connection was down when I arrived, but was repaired the same day and largely functional for the remainder of my four weeks there. They share a 56kbps dial-up connection over a local area network.

It became clear through my interviews in this office that, while the PMO is the nominal clearinghouse for information between the CMA and the health clinics and is primarily responsible for communication with the health clinics, they actually have the least information of all of the stakeholders in the RHVP program. At the point in which the database processing moved from Mbarara to Kampala, all of the claims information moved there as well. They have been able to change the claims process such that the health clinics submit two copies of each claim to the management agencies, one for the PMO, and one for the CMA. However, the copy that remains in the PMO does not have the voucher number, a critical piece of information, and with stacks of hundreds of claims per month, the information is not in a format actually accessible to the program office until the CMA sends back claims summaries. However, even this is stripped-down and only includes the value of the claims, without any patient or diagnostic information from the claims.

This poses a problem for the PMO staff's interaction with the health clinics. They lack sufficient information to effectively counsel and train the clinics, and often feel like they do not know what is going on with the program because they do not have access to the claim data for the long claims processing cycles.

In the version of Claim Mobile developed in early 2008, I intended to make the claims process more efficient by enabling the mobile phones to submit claims directly to the database (originally co-located in the PMO, now located in Kampala). In the Summer 2008 interviews it became clear that having the claims data bypass the PMO staff would deny them even more of the information they need in their interactions with the clinics. Based on this realization, I discussed the possibility of an intermediary application, a website in which the project coordinator in the PMO would be able to view claims as they are submitted, as well as any status updates. Furthermore, Claim Mobile could facilitate another of the project coordinator's key roles in the RHVP ecosystem: as the primary interface between the health service providers, the project coordinator would also be able to send messages to the service providers through Claim Mobile, either as individual messages, or broadcast announcements.

3.4.4 Claims Management Agency (CMA)

The CMA is a for-profit health insurance agency based in Kampala, providing conventional employer-based health insurance for the formal private sector as well as conducting non-profit health management for targeted low-income informal sector populations. That is, their work for the HealthyLife program is in addition to their private health insurance program, and is part of a company effort to help deliver quality affordable healthcare to the poor. Their business is highly technical, and they have a wholly owned software company based in Chennai, India. As the IT vendor, the CMA's responsibility in the program is to provide the claims forms, and the Voucher Management Unit System (VMUS), the database implemented by their software company to cross-check the claims and to gener-

	FORM DETAILS			ACCEPTED CLAIMS				REJECTED CLAIMS			QUARANTINED CLAIMS		
CLAIM DATE	SL. NO	FORM NO	EXPECTED AMT.	FULLY PAID AMT.	ADJUSTED AMT.	VARIANCE	REASON	REASON	AMOUNT	VARIANCE	REASON	AMOUNT	VARIANCE
Second Half of August 2008													
29/Aug/2008	1	10786	6,920	6,920									
29/Aug/2008	14	10800	9,400		4,400	5,000	11						
29/Aug/2008	15	19101	19,200	19,200									
29/Aug/2008	16	19102	8,000	8,000									
29/Aug/2008	17	19103	13,700				11				NO PREVIOUS FOLLOW UP	8,700	5,000
29/Aug/2008	18	19105	19,200	19,200									
No. of Claims Submitted :	18		251,320	214,520	13,100	10,000				0		8,700	5,000

Figure 3.6: This is a sample summary sheet prepared for one health clinic, showing a partially paid claim (QC11=Wrong consultation fees), and another claim quarantined for having the wrong voucher. While these summary reports can be informative, most clinics are not familiar with the quarantine codes, and they often don't reach the health clinic for several months after the original claim has been submitted, often too late for the clinic to rectify any errors indicated on the report.

ate reports. The CMA also prints (through another agency) the glossy color vouchers that the patients purchase in exchange for subsidized care.

Although the data entry clerks and the database engineer were initially located in the FMA's PMO in Mbarara, they are actually employees of the CMA, and moved when the CMA shifted claims operations to their offices in Kampala in March 2008. They carefully enter each claim into the database, later updating its status with information from the clinical officer (a doctor) who "vets" the paper claims[2]. They then produce two reports: a summary report for all clinics, and an itemized report (see Figure 3.6) for each clinic detailing the status of each claim, as well as any quarantine codes (Table 3.1) or rejection reasons for any partially paid or rejected claims.

In addition, when required, the CMA produces reports (based on the information in the database) for the FMA, the European aid agency, and the aid agency's evaluating partners. Although these reports were not part of the original specified mandates for the operation, they have proved necessary for the program's external evaluation, and there has been much friction over the work involved in the creation of reports.

The relationship between the CMA and the FMA in this program is highly contentious. While initially they were equal partners in the program, both reporting directly to the European aid agency, changes in funding have led to a situation in which the CMA reports to and is paid by the FMA. On top of this, the funding for the expansion of the program has been delayed a number of times, from October 2007 to April 2008, and again to September 2008. While the CMA has received some payment, both the CMA and FMA have been operating without pay (but with promise of pay) since April 2008, just to keep the program running while the aid agencies work out the details of the new grant and the expanded program. This is part of the reality of dealing with aid-funded projects – unexpected delays in funding are common, and projects are subject to the vagaries of arbitrary rebudgeting. While the FMA is often powerless to address the issue, in this case, the CMA often chooses to respond by cutting off program access to the database, ceasing claims processing and refusing requests for reports, until their problems have been resolved.

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[2]The clinical officer is employed by the FMA, and was terminated in March 2008 due to temporary lack of funds.

Code	Description
QC01	No indication of date of treatment
QC02	No indication of time of treatment
QC03	Wrong visit type: Consultation or follow-up, etc
QC04	Wrong demographic information: no age and name of client
QC05	Wrong/No syndrome, no diagnosis
QC06	Wrong Clinical examination / not applicable to OBA
QC07	Wrong/Poor diagnosis
QC08	Wrong investigation/poor lab reporting
QC09	Wrong drugs prescribed/invalid treatment
QC10	Over prescription: more than enough
QC11	Wrong consultation fees
QC12	Wrong patient status: cured or not cured
QC13	Next date of visit: wrong or not filled in
QC14	Wrong voucher attachment/interchanged vouchers on followup visits
QC15	Unclear claim/uncharged claim and treatment contradicts other visits
QC16	Partner treated on client form
QC17	Exceeded VMUS ceiling limit
QC18	Treated syndromically and asymptomatically
QC19	Unclear/wornout/blank attached vouchers
QC20	Claim without patient thumbprint
QC21	No voucher attachment
QC22	No doctor's signature
QC23	Diagnosis contradicts clinical examination
QC24	Used drugs not on OBA list
QC25	Undercharged/overcharged drugs, double lab charged
QC26	Patient free/normal from STI or cured not allowed for next visit
QC27	Diagnosis not catered for by project
QC28	Follow-up contradicts previous visits

Table 3.1: Codes used by the management agency to indicate reasons for partial payments.

Perhaps in response to these database shutdowns, but officially as part of the aid agency's project policy and the Ugandan government's policy on software developed for government-funded projects, there is an expectation that the CMA's VMUS software should be turned over to the project. However, since the CMA outsources development of this software to its partner company in India, this IT vendor considers its software to be part of its key assets, and sees its role in the project as a software licensor and service provider, not a software vendor. Again, while this situation is being resolved, the CMA asserts its control over the project by processing the claims, but refusing to pass on the summary reports to the FMA. While the project continues running, and the service providers continue to see patients, this introduces additional delays into the claims process, and frustrates the health clinics, whose payments are delayed without explanation.

3.4.5   Service Providers: Health Clinics/Hospitals

Service Providers are selected on the basis of a number of factors (e.g., services offered, capacity, personnel, geographical location). In one respect, they are the origin of the primary information in the claims management process, producing the claims records, which are then used to determine reimbursement. At the same time, as is perhaps typical, they are information-poor, because they are not given tools to use this information effectively. At the point of claims submission, they are no longer agents in the process, and must wait passively for both payments and any feedback reports produced from the information in their claims.

Providers are expected to follow a rigorous course of diagnosis and treatment — they must select a lab test based on symptoms presented, and prescribe particular medications on the basis of the results of the test. Any deviations from this treatment are penalized; the service providers are not paid for medications given that are not prescribed by the program. This is reasonable by public health and insurance standards, and necessary for
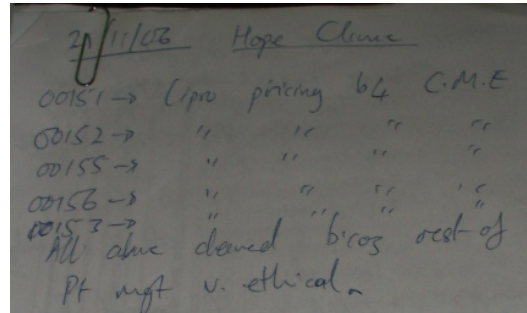
Figure 3.7: "All above denied b'cos rest of P[atien]t mgt n[ot]. ethical": this is a sample medical advisor review of a claims summary, occurring often well after the original mistake has been made several times, before it could be caught and corrective measures could be made, as noted in the first line: "Cipro pricing b4 C[ontinuing] M[edical] E[ducation]"

the cost-effectiveness of the program. However, despite educational illustrative posters, training sessions, and on-site continuing education provided by the PMO's clinical officer and project coordinator, the learning curve on the exact protocol to be used is high, and the subsequent errors are costly for the service provider. Figure 3.7 illustrates a particular problem in which costly errors are caught well after their first occurrence, often after the provider's staff has have made the same mistake for a month.

A few months into the program, there had been so many "quarantined" claims (claims that had been held for review due to discrepancies from the treatment protocol) that the management agencies and the service providers were required to do a financial settlement, in which the service providers were paid some percentage of the value of the disputed claims. Subsequently, the approval process was modified such that deviations from the protocol were partially paid (e.g., minus the cost of the incorrectly prescribed drug), and could be disputed in later reviews with the PMO's clinical officer. Here are some figures on the value of the disputed claims for one of the rural service providers for a randomly selected month of the program:

Claims submitted: 294
Approved: 259 (88%), $1379
Approved, but adjusted: 27 (9%), $149
Quarantined: none
Rejected: 8 (3%), $51
Total Requested: $1642
Total Paid: $1526 (difference: $114)

Thus the claims submission process, while nominally a simple information flow between cooperating organizations, becomes a site of financial contention. Claims are disapproved for a number of reasons (see Table 3.1), which could be disputed but in practice are not. However, due to the change in policy, many claims are approved with incomplete data (e.g., missing demographic information for the patient). In any event, the claim form and its contents are the object of much dispute between the service providers and the management

agency. Often, the service providers (especially more distant providers) feel disempowered to address this dispute and choose to accept the given variance in payment as the cost of participation in the program.

The health clinic survey I conducted in July 2007 explains some of their extreme disengagement from the RHVP program. Out of the twelve clinics surveyed, three said they had not gotten feedback from the RHVP program at the time of the survey (July 2007), and 4 said they *did not know* how many claims had been rejected. While they were receiving payments on a regular basis (albeit late - 9/12 clinics defined "timely processing" as less than 15 days, half of the current processing time of 30 days), there was no mapping between the claims they submitted and the payments they received.

> *I don't know. I don't know how I are performing. I don't know how I are faring. And of course my staffs are also complaining. They are overworked, they don't get any benefit from the project, and of course it takes a lot of time... They need to be motivated as individuals. All that will depend on – are I making any profits?*

This has deeper ramifications than inability to follow up on quarantined, partially paid, and rejected claims. This communications gap between the health clinics and the RHVP program leads to continued errors in adherence to treatment protocol, a feeling of lack of control over health clinic finances, and discouragement on behalf of the participating service providers.

At the time of the second field visit in November 2007, I were able to follow up with the PMO and the health clinics, and noted that this situation had improved. The then-informal practice of passing on copies of the itemized clinics reports to the service providers was formalized, and clinics are receiving more feedback on their claims. However, there are physical limits to a paper and in-person based communication system, and it remains to be seen how this practice will scale as more clinics join the program.

It should also be noted that the service providers differ greatly, in number of clients, setting, and availability of resources. While some clinics have computers and use them regularly, in one clinic, my smartphones were greeted with enthusiasm because they were the "first computers I have seen."

3.4.6 Patients

Patients are the real target beneficiaries of the HealthyLife program. They purchase vouchers from distributors (at a heavily-subsidized price) and then go to the service provider for diagnosis and treatment. After an initial consultation with the health worker, they are directed to the lab technician, who performs the requisite test and sends them back to the health worker with a slip of paper indicating the lab result. The health worker then fills out the remainder of the form, writes a prescription, affixes the appropriate stub from the voucher, and has the patient sign and fingerprint the form, at which point their participation in the claims form process is complete, until they return for a follow-up consultation. For the follow-up, the service provider checks recovery progress and prescribes additional medication if necessary. In some clinics, patients are given a copy of the claim form, which they are directed to keep and bring back for the follow-up. However, most clinics do not

depend on the patient copy of the claim form, and just go back through their time-ordered record book, finding the prior consultation manually. Sometimes patients either accidentally swap vouchers with those of their sexual partners, fraudulently give their own voucher or the partner's voucher to someone else, or simply choose to go to a different clinic for follow-up. Claims are quarantined or rejected if any of these potential errors are detected, but not until the claim has been processed by the CMA, and the fraudulent patient has already been treated. Since the original voucher is attached to the submitted claim, the clinics do not always have a way of verifying these external aspects of voucher validity. Although their direct involvement in the claims process is minimal, it is their identity that is often contested in the vetting process.

3.4.7 Mobile Platform Developer (researchers)

As ICTD researchers, I am of course also stakeholders the claims management process – initially as outside observers, later as designers interested in using technology to measurably improve the process, and finally as researchers interested in watching the mechanisms by which the process changes over the course of the project. From an outside perspective, my role is most allied with CMA, the technical partner in the project; however, since the aid agencies and FMA are interested in replicating the mobile device system in other RHVP projects, there is a vested interest in the new technology from other stakeholders as well.

3.5 Design

Claim Mobile is a two-part system, including a web-based PHP/MySQL application and a Java-based mobile application running on Palm (GarnetOS) phones. For the pilot program, the web-based application has a single level for all users, but the final implementation will be tiered, having appropriate access levels for service providers, management agency users, medical advisors, etc. Both the web and the phone applications require user login to protect patient data.

The two applications are paired, designed such that the phone-based application uploads claims to the web site, and downloads configuration information (drug lists, status feedback, claim form backups) from the web site. Eventually, the web application will also connect to the CMA database, sharing the cross-checked and validated claims form data directly so the CMA's staff do not have to do redundant data entry.

To facilitate end-user training, both of the applications are based on the original claim form and largely retain the same structure, titles, and information. Figure 3.2 illustrates some of the mappings between the phone-based user interface and a revised version of the claim form. In addition, all of the codes and tables in the web application database also include mappings to their equivalents in the CMA database, so the information can easily be transferred between the two databases.
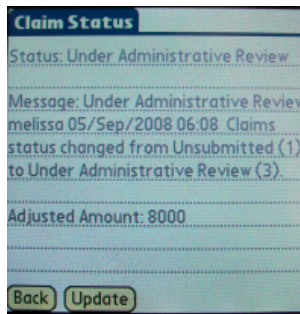
Figure 3.8: On this screen the service provider can view the current status of their claim, as well as any annotations or feedback from the management agency made in response to their queries.

3.5.1 Claim Mobile

The web application is designed primarily with three functions in mind: claims submission, feedback/communications process, and in-clinic claims management.

Claims Submission: This is the bulk of where the service providers will spend their time. In this case, I adopt common design strategies such as (1) using pre-filled checkboxes to reduce the amount of required text entry, (2) limiting answers to valid options to reduce coding errors (see QC01,02, 04-09, 27 in Table 3.1), (3) downloading logistical data such as drug prices into the application to eliminate pricing errors, and (4) calculating dependent values such as expected claim amount to eliminate arithmetic errors and save time. However, I must counter-balance potential fraud by also introducing cross-checks that are not clarified explicitly. That is, to encourage accurate clinical reporting (as opposed to clinical reporting that has been "fiddled" to make electronic claim submission more convenient or favorable), providers are allowed to submit inconsistent claims but are *warned* that they should clarify any discrepancies from normal RHVP treatment protocol.

Closing the Feedback Loop: Based on our primary finding from the clinic surveys and follow-up interviews, I have also included the ability for the clinics to send queries to the management agencies about particular claims and to receive live updates on the a claim's status (e.g., whether it has been approved, the amount for which a claim has been approved, and explanations why the full amount may not have been approved – see Figure 3.8). Any changes to a claim's status are included in this annotation audit trail, and anyone with access to the claim can respond to and receive queries.

In-Clinic Claims Management: In the phone application, the service providers can also link between consultations and follow-up visits, as well as between client and partner visits, so they can easily check to see if the valid voucher is being used by a returning patient, and that treatment of a partner or during a follow-up matches the medical history. For new phone installations, or if the claims data is lost, the mobile application will automatically download all prior claims data from the web application. Future versions of the application will also include financial summaries, outpatient statistics, and other reports that may be useful to the clinics.
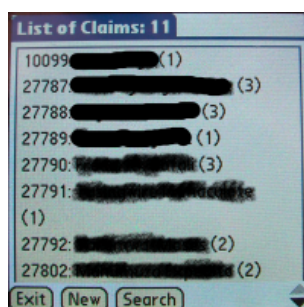
Figure 3.9: This is the list of claims currently entered or downloaded to the mobile phone. The first number is the claim form number, followed by the patient name, and then a number indicating the current status of the claim. (1-unsubmitted, 2/3-under review, 4-preliminary approval, 5-quarantined, 6-approved, 7-rejected)

3.5.2 Claim Mobile Web

The web application, having been commissioned in the middle of the fieldwork in response to program office findings (see Section IV.C) has two main functions: receiving claims and displaying them for review.

Much of the claims receipt is invisible to the web application user, and written as a backend for the mobile phone application. The login user for the mobile application and the web application is the same – and the login information given to the mobile application is used to authenticate with the application when submitting claims and annotation data.

There are three primary views in the web application. The claims list can be filtered by service provider and is modeled on the claim summary report (Figure 3.6). From each claim in the claim list, the user can either (1) click on the claim number to access the individual claim (and annotation/status update functions, see Figure 3.10) or (2) click on a patient name to view all consultations and follow-ups for the both the client and partner associated with that particular voucher. This allows the viewer to correlate treatments, lab tests, and diagnoses across visits.

3.5.3 The Modified Claims Process

In the modified claims process, the service providers continue to complete and submit the claim forms. However, in order to receive faster payment, as well as the immediate cross-checked feedback from the phones on claims completion, they also enter the data on the mobile phones, submitting each claim to the web application as it is completed. Prior to claims submission the status of the claim is "Unsubmitted (1)," after which it can progress through a number of stages. The service provider can verify that a claim has been successfully received if the claim status has been updated to "Under Medical Review (2)" or "Under Administrative Review (3)" for medical advisor review or database cross-checking (validation of voucher) respectively. If a digital claim has been verified, the CMA will set its status to "Preliminary Approval (4)" until the paper form with the voucher has been received. Once preliminary approval has been received, the clinic can be paid. If no voucher is received, or the wrong voucher is attached to the form, then

Figure 3.10: Claim Mobile Web: the web-based view of the submitted claim forms is also based largely on the original claim form, split into several sections, and ending with annotations for the claim, and a form for adding additional annotations.

the preliminary payment is subtracted from the next month's payment until the error is resolved. In the meantime, the service provider can view status updates as they are made to the web application and sent to the mobile phones, and can send annotations on each claim, which then appear in the web application and in the status update window (Figure 3.8) when they are received.

3.6 Pre-Pilot Results

Having detailed the claims submission process, our findings with respect to the various stakeholders in the RHVP project, and the design of the Claim Mobile system, I now discuss some specific results from our user studies.

The pre-pilot demonstration was designed to last one claims cycle, following claims for one week (submitted in parallel through Claim Mobile and on paper) for two clinics through the claims submission process. A total of 35 claims were submitted to the web application, including the full complement of 18 claims from the urban clinic, 12 out of the 86 paper claims from the rural clinic, and 5 additional claims from the urban clinic following the pre-pilot study.

The claims from the rural clinic spanned August 9, 2008 to August 27, 2008. We observed three patient consultations during our two visits to this clinic, as well as the preparation of the summary sheets for the 86 claims, taking careful note of what the service provider verified on each form. Notably, although "syndrome" is a required field (see QC05 in Table 3.1), it was left blank in almost all of the claim forms. In one case, the drug was entered correctly, but with the wrong reimbursement value, and in another case, a drug was entered, but no reimbursement was claimed either in the subtotal or the total. At the

50

Figure 3.11: Rural clinic staff entering data from claim forms into two of the phones.

time of the claim approval process, they were not reimbursed for the drug, because it had not been claimed in the amount, although it had been listed. Another inconsistency is in lab reporting – some lab tests require a value to indicate the result, and where not included, the data entry clerk just changes the lab test in the database to one which does not require a result. This is an error, which never gets communicated back to the service providers because only errors which accompany a payment change are reported in the claim summary sheet.

The 18 claims from the urban clinic spanned dates from February 16, 2008 through August 25, 2008. During the process of simultaneously entering some of the claims into Claim Mobile with the service provider, I were able to identify some problems: missing personal information, missing next visit date, and wrong consultation fees. However, not all claims were entered into and reviewed via Claim Mobile, and, as can be seen from Figure 3.6, three paper claims were submitted with wrong consultation fees, an error that would not have occurred with an electronic submission. In addition, a fourth claim was submitted with the wrong voucher. I were able to catch this while entering the claim into the mobile phone, noting that the voucher number did not match the consultation type, but too late to change the submission and retrieve the correct voucher. As a result, the claim has been quarantined until the correct voucher is given to the program office in Mbarara.

With regard to the digitally-submitted claims, I spent about a day training the staff in the rural clinic on how to submit the claims, and returned later to spend another day in training. They were very enthusiastic, and although only one person was actually responsible for submitting claims, they were all training each other (Figure 3.11). However after the the researchers' departure they have still not submitted any claims. It is unclear whether this is from technical difficulties or lack of time to enter the claims into the phone. The urban clinic has continued to submit claims, with five new claims arriving in the two weeks since the pre-pilot study.

An interesting outcome from our observation of the claims review process is that there are many errors that are made that affect the quality of the data, but are never communicated to the service provider, in part because they have no attached financial consequences. The annotation feature (see Section V.A) enables attachment of quarantine codes to any claims that were in error without affecting the payment of the claim, providing feedback to the service providers on how to better complete the claims in the future.

One concern that emerged from this proof-of-concept study, however, was with the reliability and the speed of Internet access in the CMA office where the claims processing was occurring. Accessing individual claims took a long time, and the online database was completely inaccessible when the Internet connection was down, which occurred infrequently

but noticeably often. It may not be desirable for the claims submission process to introduce a dependency on Internet connectivity where it is unreliable.

Unfortunately, the financial and claim review aspect of the pre-pilot was halted early due to administrative and political reasons, the result of which is that payments in the RHVP program as a whole have been halted; so, while the technical feasibility of the system has been demonstrated, the logistical details are still in process. I found that while the CMA's database entry staff were enthusiastic at the prospect of spending more time reviewing claims and less time doing just data entry, their participation in the pre-pilot was limited by two factors: the press of other claims that still needed to be processed, and pressure from the CMA to be secretive about the data being processed until certain political issues had been sorted out.

3.7 Discussion

3.7.1 Understanding Delays in the System

Delays can occur in a number of places in the claims process, not all of which can be accounted for by the introduction of mobile phones. However, there are three key bottlenecks: 1) the delay in the health clinic between when the health clinic sees the patient and when the claim is submitted, 2) the time it takes to process the claims, entering each on into the database, and 3) administration of feedback to the health clinics, especially in case of errors.

Claim Mobile is able to address all three of these cases by 1) encouraging providers to submit claims as they see patients, 2) reducing the data entry burden through the use of digital claims, and 3) eliminating the possibility of a number of errors, and providing a digital feedback mechanism to supplement the infrequent in-person feedback.

However, another source of delay is the administrative and political dynamics by which program administration halts, although health distributors continue to sell vouchers, and health clinics continue to see patients. During these times payments are delayed unexpectedly for undetermined lengths of time, as can be observed from the early termination of our pre-pilot study. Understanding this particular delay is key: the CMA halts the program by withholding information, specifically claim reports, from other stakeholders in the system. This is possible because the database is owned and controlled entirely by the CMA. What happens when another outside database is introduced, with independent control? In this case, the data was not so much the key as the data entry staff that were responsible for approving the claims and validating the vouchers. At the same time, it is unclear where Claim Mobile Web fits in with the political strategy of the CMA.

3.7.2 Information Poverty

In addition to trying to address delays, I have also tried to address information asymmetry and information poverty within the system, identifying where stakeholders are disadvantaged by lack of information, or lack of tools with which to use the information.

This past year's move of the data processing from Mbarara to Kampala especially has further exacerbated the gap between the people that have the information and the people that can make use of it. While limited remedies have been made to rectify the situation, with a paper-based process, these remedies have been ineffectual, leaving the PMO without access to necessary claims data, including voucher numbers.

Through extensive stakeholder interviews, in particular with the program management office in Mbarara, I have identified the need for a transparently accessible database, with the ability to generate reports based on the submitted claims data. While control over access to the database is a key means by which the CMA asserts itself in the RHVP project, this practice is highly disruptive to the RHVP program, causing deep difficulties for the health clinics and the program office, rather than affecting the financiers or the FMA.

The initial design of Claim Mobile, reflected the paper-based process, and directly submitted claims from the mobile phones in the health clinics to the CMA, bypassing the PMO entirely. In response to our findings, I developed Claim Mobile Web as a means of re-engaging the staff of the PMO in the mobile claims process. The integration of the new web application database is specifically meant facilitate resolution of information gaps, not only sharing the information with the people that can make use of it, but also giving them the tools they need to make sense of the information.

Likewise, for the mobile-phone application, I also specifically do not design one-way system in which claims data is going out and only money returns. Instead, the claims data created in the clinic is also used within the clinic to help them improve patient care, as well as the accuracy of future claims.

3.7.3   Related Work

There have been a number of recent technical projects on the use of ICTs for healthcare in Africa (Braa and Hedberg, 2002; Edejer, 2000; Luk et al., 2008; Lucas, 2008), and specifically on mobile devices for healthcare in Africa (DeRenzi et al., 2008; Parikh, 2006; Parikh and Lazowska, 2006). However, many of these projects are design-focused and technology-driven, reflecting on designing a working technological solution to complete a particular task, rather than reflecting on the role of the technology in the system and how various solutions or approaches might affect social processes within the system.

Braa describes two action research projects to deploy the Health Information System Program (HISP) in Cuba (Braa et al., 2004) and in South Africa (Braa and Hedberg, 2002), using Actor Network Theory (ANT) to think about how human and non-human (e.g. documents, events, software, standards) interact. He specifically addresses the challenges of designing for the multiple levels of entities involved in district health information systems, able to compare deployments across Mozambique, India, South Africa, and Cuba. However, these entirely government-based contexts are much more hierarchical than the highly disparate multi-organizational context described here.

3.8   Conclusions

The outcomes from this study were three-fold. Firstly, the choice of the mobile phone as a platform was affirmed by the health clinics, for reasons of battery life, design for readability, portability (susceptibility to theft), and ease of data entry. Where I was concerned about introducing "qwerty" keyboards to novice users, my fears were alleviated, and all of my users assured us that "we can learn," which they did, quickly. Secondly, the mobile platform is not a sufficient solution for this program, and alone has the potential to exacerbate information asymmetries between the stakeholders. To address this issue, I complement the mobile phone platform with a web application. However, Internet accessibility issues may require further development to enable local hosting and synchronization of the web application (Luk et al., 2008; Demmer et al., 2008).

In the first version of Claim Mobile, the NGO renegotiated the mechanism by which claims were shared by explaining additional roles of previously informal processes. I found that design can influence the ways in which social processes are renegotiated. The initial design reinforced existing information inequalities and the new design provided equal access to all stakeholders. In addition, formal and informal processes are not only disrupted by the research intervention. They are subject to evolving changes in requirements as well as changing affordances and availability of emergent and in situ technologies.

My final point is related – I consider the plethora of stakeholders in this project, and note that as technology providers we are not coming in as naturally neutral players. ICTD projects are necessarily disruptive, and equally potentially disrupted by other dynamics within the program as a whole. As a result it is necessary for us as researchers to position ourselves and our designs carefully, making sure to take into account the needs of all of the stakeholders, and not just our primary users.

UGANDA TEXTING: TECHNOLOGY ADOPTION IN PRACTICE

Healthcare and communications often go hand in hand as development agencies attempt to deliver effective services to a broad range of people. More recently, practitioners and researchers have suggested that mobile phones, will increase the scalability of health services. Specifically, SMS (text) messaging can be used to overcome barriers of cost and poor infrastructure. In Uganda, SMS-based text-messaging offers an effective platform for reaching rural users, in places where e-mail and even voice-based mobile communications can be difficult (Danis et al., 2010; Lucas, 2008).

However, as an informal practice, SMS messages can be difficult to organize on mobile phones. As an alternative, organizations use third-party web applications developed by a SMS gateway companies based in Uganda. The Reproductive Health Voucher Program (RHVP) regularly used mobile voice and SMS to communicate with their beneficiaries. For donor and liability purposes, the program administrators wanted a way to effectively and efficiently track these communications. To that end, they commissioned and deployed a web-based bulk SMS messaging platform (Bulk SMS) with the assistance of a third-party organization. The RHVP project sent out their first message in November 2009, subsequently using the application for tracking payments, confirmation of contract revisions, and handling other types of program communication.

While the system was well received by both the NGO managing the RHVP, and their beneficiaries, they encountered some unexpected issues while using it. Many health service providers (HSPs) never received the SMS-based announcements, or even received messages addressed to other HSPs. Although it was hoped that the HSPs would respond to certain types of messages by SMS, the response rate remained low. In addition, external influences made it necessary for the NGO to use the Bulk SMS system in unexpected ways. These inconveniences need to be weighed against the benefits of the system.

In this chapter I chronicle the deployment and actual use of Bulk SMS in the context of this NGO's management of a health-financing program. In spite of unexpected difficulties, the system met the NGO's needs successfully. I show the ways that trade-offs between costs and capabilities influence the utility of the system, new types of communication enabled by SMS, and the ways in which SMS alone is insufficient for mediating communication between the NGO and their beneficiary HSPs.

4.1 Motivating Context

In this section, I describe the use of SMS within RHVP, and discuss related work in mobile Health (mHealth).

4.1.1 SMS in the NGO

The RHVP project was naturally information intensive. In addition to processing hundreds (and later thousands) of claims forms each week, the NGO was in constant communication with the HSPs. For each payment made, the project coordinator (PC) in Mbarara was required to secure confirmation from each of the HSPs that they successfully received the correct payment in their bank accounts. The project management office (PMO) also coordinated yearly training sessions, handled questions regarding the treatment protocol, and settled disputes regarding unpaid claims. The PMO sales staff traveled to each of the HSPs once or twice a month to deliver blank claims to the HSPs as they ran out, pick up claim submissions, and relay messages from the NGO.

As the project's catchment area expanded from four districts to twelve, it became less feasible for HSPs to visit the PMO in person. As described in 5, mobile phones began to play a larger role in managing relationships between the HSP and the NGO. In 2008, the use of mobile phones helped them more effectively *scale up* to a larger geographic coverage area and more participating HSPs. The medical advisor and the PC would often receive phone calls or text messages from the HSPs, asking about reimbursements and how to handle complicated claims. However, voice-based interactions were often subject to the fallibility of memories. As a result, the NGO introduced a policy of maintaining a written record of the outcomes of their discussions with the HSPs. Despite its informal nature, SMS messages served as a primary record, since e-mail use was not convenient for many HSPs, and it served as a medium by which both the HSP and the NGO would retain a copy of the message. Each phone call was followed up with a confirmation SMS. When HSPs called, the project coordinator asked them relay requests for forms or other communications by SMS. Thus, decisions made orally could be verified later.

At the same time, the informal nature of SMS communication became unmanageable. While saved SMSes now constituted a written record, they were distributed over the many different phones of key staff in the NGO. It was difficult to find important messages on individual phones. Furthermore, if a particular staff member was not available, their records of SMS transactions were not either.

In May 2009, the project support manager (PSM) suggested the idea of using a Bulk SMS system. Earlier that year, the NGO had worked with another organization, providing healthcare content for an SMS-enabled health education system. I had also previously had discussions with the NGO about using Claim Mobile for sending announcements and verifying payment of claims (See Chapter 3). The PSM asked me for advice, and contacted the supporting aid agency to see if implementing the system might be financially feasible. Shortly thereafter, the NGO put out an official request for proposals, and by late July 2009 I was evaluating three bids from four organizations for the implementation of a Bulk SMS system, to be paid for by the funding agency that financed the RHVP project.

4.1.2 SMS at Large

As a result of the growth in mobile phone ownership, sending out mass message and announcements via SMS has become a low cost and convenient way for reaching large numbers of people with minimal effort. SMS plays both formal and informal roles in Uganda. Newly engaged couples might send out text messages to all of their friends, asking them to attend wedding meetings. During holidays, especially Christmas, many people will send greetings to all of their contacts, wishing them well. Mobile service providers allow phone users to subscribe to news, sports scores, and other information services. The popularization of SMS for these types of usage and advertising has enabled the birth of an SMS gateway industry, with Ugandan owned-and-operated companies like SMS Media, DMark Mobile, Beyonic and others. (Hellström, 2010)

Meanwhile, numerous applications use SMS to address issues around healthcare and public health education. FrontlineSMS is a downloadable open source application, first released in 2005, which can be customized to help any organization use their computer (connected to a mobile communications-enabled device, i.e. a phone or a modem) to send individual or mass messages to all of their staff and beneficiaries. Their Medic Mobile application specifically targets health organizations, partnering with OpenMRS to enable text-based forms collection, and patient records. TextToChange (TTC) is another NGO in Uganda, specializing in text-message based quizzes intended to educate participants about HIV, malaria, child abuse and other topics (Danis et al., 2010). In addition to SMS-based quiz functionality, EpiSurveyor enables mobile phone-based data collection, allowing synchronization of the data manually, over mobile Internet, or by SMS (Selanikio, 2008). Other organizations use SMS to improve patient attendance (Downer, 2006; Mapham, 2008; Cocosila et al., 2009; Furber et al., 2011; Francis Sarmiento et al., 2011), enable communication with health practitioners during crises (Okolloh, 2009; Gomez, 2008; Shirali-Shahreza and Shirali-Shahreza, 2006), manage patient information (Francis Sarmiento et al., 2011; Manguni et al., 2010; Banks et al., 2011; Asiimwe et al., 2011), health education (Lim et al., 2008; Nyberg et al., 2011; Danis et al., 2010; Mapham, 2008) , data collection (Banks et al., 2011; Asiimwe et al., 2011; Patnaik et al., 2009; Lucas, 2008), drug prices (Nisperos and Urano, 2011), tele-consultation (Keyani et al., 2009; Luk et al., 2008; Mapham, 2008; Mitra et al., 2008; Furber et al., 2011), health diaries (Mapham, 2008), treatment adherence (Cocosila et al., 2009). While many applications use SMS directly, others send non-human readable information, using SMS as a transport layer instead of a person-to-person communication medium (Oliver, 2008; Asiimwe et al., 2011). These and other systems sometimes entail installing an additional application on a Java-capable or otherwise advanced phone (Shirali-Shahreza and Shirali-Shahreza, 2006; Asiimwe et al., 2011; Banks et al., 2011; Patnaik et al., 2009; Jeffrey Coker et al., 2010). Some projects explicitly acknowledge the general-purpose aspect of SMS by subsidizing text-messaging costs but not specifying the ways they should be used (Luk et al., 2009; Mapham, 2008; Furber et al., 2011); however, most apply the SMS medium to specific tasks. Results from these studies range from no improvement found, to improvements in patient adherence, attendance, or knowledge (Kaplan, 2006; Nyberg et al., 2011). SMS is often promoted for its accessibility with minimal training, and relatively low cost. However, there are concerns about the literacy of the target population, as well as security and privacy of the data

transmitted by SMS.

by an NGO to improve communications with their clients. The intention was to provide a new mechanism for sending payment confirmations, to help mediate medical consultations, and to send out announcements. However, as with (Luk et al., 2009; Mapham, 2008; Furber et al., 2011), the platform was introduced more generally, enabling other uses to also emerge as HSPs and the NGO staff familiarized themselves with the system. In this case, literacy was not an issue, since the NGO staff and the health practitioners (the doctors, midwives, and clinicians that ran the private health facilities) were highly skilled and literate by virtue of their position and education. Most SMS messages were written in English, however, it was not a problem for people to communicate using local languages, since the shared local languages (primarily Ruyankole and Luganda) are phonetic, using alphabetic characters. The users of the system addressed issues of security and privacy on a message-by-message basis - by leaving names out or choosing to make phone calls or visit in person for more sensitive information exchanges. This case study differs from prior work in that 1) the Bulk SMS system was deployed by the NGO directly, not by the researchers, 2) I address the character of communication by SMS between the NGO and health practitioners, and 3) I discuss technical issues arising from infrastructural limitations (e.g. network failures, lack of electricity).

4.2   Methods

In this section I present an overview of methods I used to develop these findings. Please refer to Chapter 2 for a detailed description and discussion of the overall approach to this work.

4.2.1   Participant Observation (May 2009 - April 2010)

Although the scope of observation for this population as a whole extends from June 2007 onwards, in this chapter I present findings primarily from observations occurring during May 2009-April 2010. During the period of January 2009 - April 2010 I was situated as an IT consultant working in the offices of the NGO, where it would be possible to observe the daily workings of the staff, how they used information technology, and how they interacted with participants in the health financing project. In addition, the staff of the NGO would call upon the researcher to evaluate technology project bids, to fix computers on occasion, and to advise on various other relevant technology matters, including the purchase, design, and deployment of a Bulk SMS system.

4.2.2   Baseline Survey (Aug 2009 - Oct 2009)

Just prior to the deployment of the Bulk SMS system, and after its commissioning, I surveyed the participating HSPs about information technology use, information management practices, and their relationship with the NGO. At the time that the baseline study was conducted (September - November 2009) there were 83 facilities participating in the Uganda RHVP project, 37 treating patients for STIs, and 52 overseeing mothers (6 facilities were

Code	Name	Description
17	SysAcceptedForDelivery	The message has been received by the network.
8	DeliveredToSmsc	The message has been received by the SMSC.
1	DeliveredToPhone	The message has been received by the recipient
16	NonDeliveredToSmsc	The SMSC did not receive the message.
2	NonDeliveredToPhone	The SMSC could not reach the recipient.
18	SysQueuedOnBearer	The message could not be delivered immediately

Table 4.1: The Bulk SMS system receives status messages from the network as the SMSes are delivered

participants in both reimbursement programs). Out of 83 HSPs, I acquired survey data from 59 facilities.

4.2.3 Analysis of SMS Data (Oct 2009 - June 2010)

As a feature requirement, the NGO specified that the third-party Bulk SMS system should support the ability to download a history of all the SMS messages sent and received by the system. During the period between system launch to June 30, 2010 (7.5 months), the record includes 4,167 messages, including the message, the recipient, and date of the message.

As part of the history, each message is accompanied by one or more status codes, indicating to the sender whether and when the Short Message Service Center (SMSC) and the recipient received the message (See Table 4.1). Based on these message codes and the accompanying timestamps, I derive the ultimate status of each message. Any message with status codes 16 (NonDeliveredToSmsc) or 2 (NonDeliveredToPhone) is considered dropped. Delays can be calculated using the sent time, indicated by 17 (SysAccepted-ForDelivery) or 18 (SysQueuedOnBearer) and the delivery time and the timestamps on status code 8 (DeliveredToSmsc), or 1 (DeliveredToPhone) if present. Using phone numbers, status codes, and message content, I analyze adoption and usage patterns over the course of the first eight months of the use of the Bulk SMS system.

4.2.4 Semi-Structured Interviews

To supplement observations and statistical analysis, I also conducted semi-structured interviews with users of the Bulk SMS system, including staff from the NGO, and facility owners and clinicians from selected HSPs. These interviews were conducted throughout the study period, gathering information about preferences and needs within the health system. In addition, a number of interviews focused on the advantages and disadvantages of the Bulk SMS system.

4.3 System Design

The Bulk SMS system is based on a third-party vendor's infrastructure, hosted on their servers and viewable through a customized web application. In this section I describe the
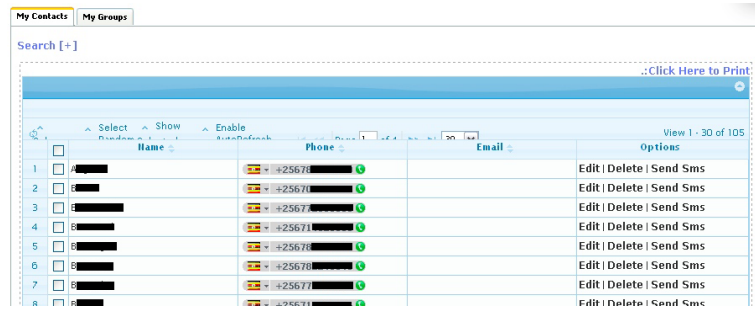
Figure 4.1: Screenshot of the contacts view in the Bulk SMS system.
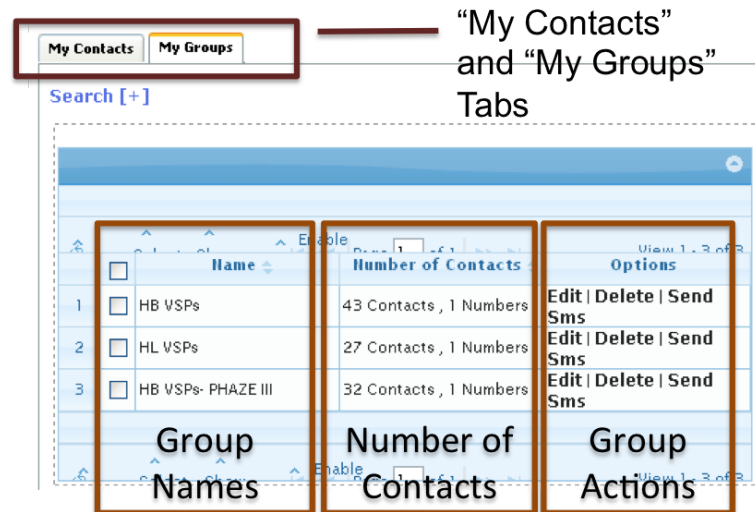
Figure 4.2: Screenshot of the groups view in the Bulk SMS system.

features and usage of the system.

4.3.1 Groups and Contacts

One key feature of the Bulk SMS system is the ability to manage mobile contacts and groups of contacts. The program served 83 HSPs at the time of system launch (October 2009), and added an additional 32 HSPs to the maternal delivery program in January 2010. While managing relationships and contacts for the original 12 HSPs (2006-2008), managing over a hundred contacts is much more difficult. In some cases, HSPs had multiple contact numbers, for different staff members, or additional phones owned by the HSP proprietors. This system provides an easily accessible central repository for this information. In addition, individual contacts can be added to groups (e.g. MCH HSPs vs STI HSPs)

Figure 4.1 shows the interface for managing contacts. Each phone number is specified including the international country code for Uganda (+256). The interface displays the Ugandan flag next to the number to indicate which country it corresponds to. Users can sort contacts by name, phone number or e-mail, if provided. In addition, individual contacts can be added to groups (e.g. Maternal Health HSPs and STI HSPs)

60
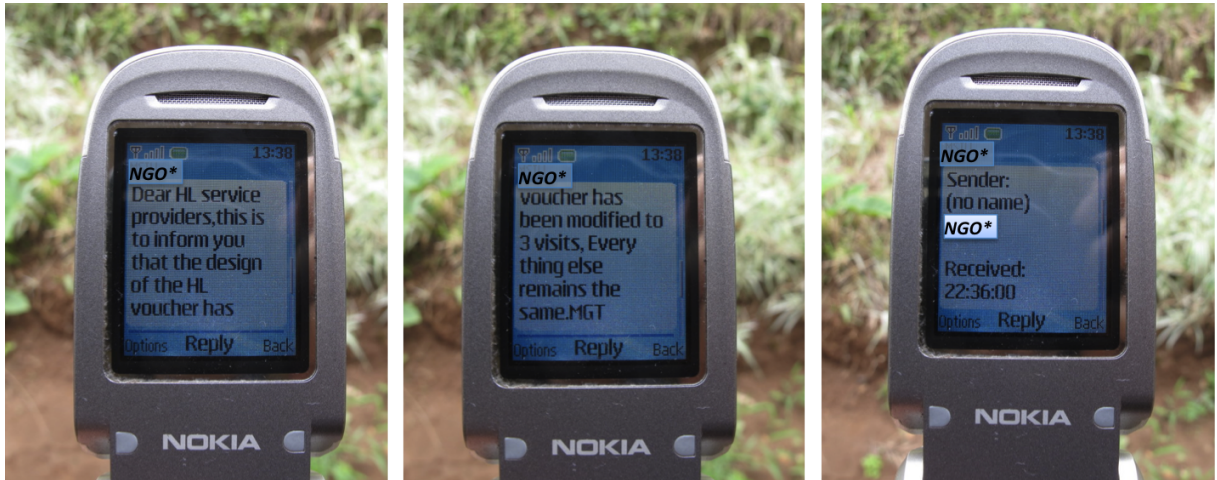
Figure 4.3: Bulk messages sent via the system are addressed with the NGO's name. This is an anonymized picture of a received bulk message.

A second tab allows the user to view groups (Figure 4.2). As with contacts, the groups can be sorted by name. From this page, they can click on "Send SMS" to start writing a bulk message to all of the contacts in the group. In addition, it is possible to add phone numbers that do not correspond to existing contacts to the group. In practice the NGO includes the project coordinator's (PC) mobile number in each group. As a result, the PC receives a copy of each group (i.e. bulk) message sent.

4.3.2   Message Types

The system supports four different types of messages. *Bulk messages* are identical messages sent to groups of numbers, typically an announcement or a request for information. *Template messages* are similar to bulk messages, where the same message is sent to a group of numbers, but each message is customized for each individual in the group. For example, a payment notification will be customized to include the name of the health facility and the amount paid. *Direct messages* consist of a single message sent to one number, often in response to a query, always initiated by a staff member at the NGO. HSPs can also contact the NGO by sending a *query* to the system phone number.

Bulk and Template Messages

Often the NGO wants to send out an announcement to some subset of their contacts. From the group interface (Figure 4.2), the user can click "Send Sms (sic)," to start composing a *bulk message* to every phone number in the group. In addition, there is a page for saving and modifying these messages for reuse. Each group member receives the same message, addressed with the NGO's name, regardless of whether the originating phone number has been added to the recipient's address book (See Figure reffig:bulksms:phone).

Template messages are a specific type of bulk message, which allow the NGO to personalize each message based on metadata about the contact (Figure 4.4). Square brackets ([])

61
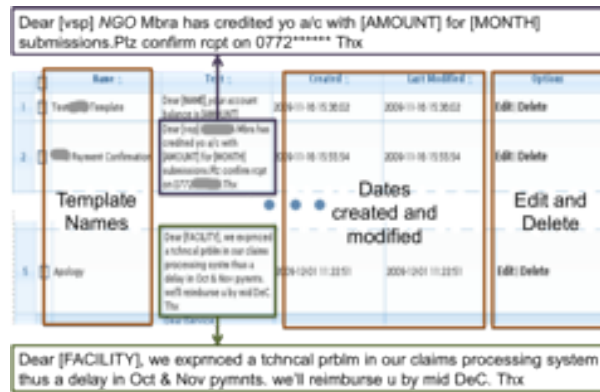
Figure 4.4: This screenshot shows the templates tab of the Bulk SMS system, which allows the user to view pre-defined templates.

indicate fields that will be replaced by other content. For example, the template message (copied from a message used December 12, 2009):

> Dear [vsp], u've been credited with[AMOUNT]sbmission of [MONTH].send us your queries and cnfrm rct to mgt on 078******* (sic)[1]

might expand to:

> Dear *Wellness Clinic*, u've been credited with1041050submission of November send us your queries and cnfrm rct to mgt on 078*******

for a given HSP. The metadata is specified along with phone numbers in a Microsoft Excel spreadsheet. The fields named in the brackets correspond to spreadsheet columns. Using the *advanced send* feature (Figure 4.5), the user uploads the spreadsheet and sends the message. The advanced sending feature also allows the user to schedule message for either a one-time message or repeated messages.

Direct Messages

The system can also be used to send messages to a single contact. NGO staff use this for two reasons: 1) direct messages are stored in the SMS database, allowing the NGO to retrieve them for later reference and 2) direct messages are charged to the NGO's account, instead of using the staff member's personal airtime.[2]

Queries

Queries are messages relayed via the system, typically questions sent by HSPs to the NGO about the program. Upon receipt, the system then sends the message to five phone numbers

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[1]The name of the NGO has been replaced by *NGO* in all example messages for the purposes of this chapter. Likewise, actual phone numbers and names will be replaced or redacted for privacy (indicated with *italics* or asterisks*). Messages are quoted here exactly as they appeared in the system.

[2]Most Ugandans use prepaid mobile phone plans. In order to make phone calls they purchase credits, usually in the form of a paper scratch card with a concealed number code. These credits are known as 'airtime', since they allow the purchaser to speak on the phone (i.e. the air) for a certain amount of time.

Figure 4.5: Screenshot of the advanced send feature in the Bulk SMS system.

of staff members at the NGO, who can then reply to the query by direct message, or by sending another query. *Query replies* will then be sent via the system to the original sender and also to the rest of the staff, much like a 'reply all' feature in an email application.

Figure 4.6 illustrates a scenario in which a project participant (e.g. a clinician at a HSP or a patient) uses the query feature of the BulkSMS system, sending a message to the NGO. First, (1) the **Query User** uses their mobile phone to a message to one of two numbers, either the shared shortcode (i.e. "8111 ngo my message"), or the standard long number (i.e. "078 555 5555 my message"). They are charged a standard text-messaging rate to send this message. The **System** then (2) relays the message to selected NGO staff, re-formatted as a query. Each NGO staff now receives a text message on their own mobile phones in the form: "NGO Query #55 from +25678555556: To reply to this query, send ngo reply 55 followed by your reply, to 8555[-]"

Any of the NGO staff may (3) reply to the message, either by sending a direct message, by bypassing the system, and sending a message to the query user from their personal mobile phones, or by replying to the query using the shortcode:

a To bypass the system, the **Query Recipient (QR)** must look at the phone number in the message, and create a new text message to that phone number. (3a) They are then charged for that text message. The **Query User** then receives the reply directly from the recipient, with their personal phone number appearing as the sender. (4a)

b To send a query reply, the **Query Recipient (QR)** sends a text message to the system

63
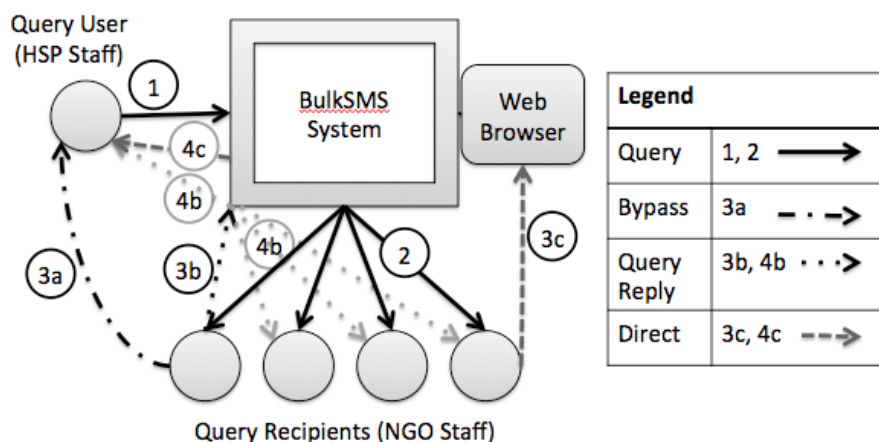
Figure 4.6: This diagram shows how messages might be relayed as part of a query and subsequent replies.

short code (in this anonymized example, 8111), with two keywords, the original keyword, 'ngo', and an instruction, 'reply 42', reply to message #42. Thus, the full message sent to the system is "8555 ngo reply 55 your reply". (3b) The **QR** is charged a standard rate for this message (although in some deployments could be charged a premium rate for the use of the shortcode). The System then process the message, re-formats it, and then sends a new query ("NGO Query #56 from +25678555556: your reply To reply to this query, send ngo reply 56 followed by your reply, to 8555[-]") out to the original query user, and all of the other query recipients. (4b) The cost of the relayed text messages is deducted from the NGO's pre-paid balance.

c The **QR** may also choose to send a direct message, by using the web interface of the BulkSMS system. In this case, they may log in with their user id, enter the phone number of the recipient and the message, the **System** sends the message, and the cost of the text message is deducted from the NGO's pre-paid balance. Depending on their network provider, the sender of the message will show up either as the long phone number or branded as the NGO name. If they choose to do so, they generally tell the other NGO staff that they have addressed the issue, usually in conversation, or by assumption due to the nature of the message.

4.3.3 Branded Addressing

Messages sent to and from the system are also branded by the NGO. As mentioned before, query users can send messages to the system either using the NGO's dedicated phone number, or using a shortcode. When using the shortcode, users must also start messages with the NGO's name (e.g. "8111 ngo my message"). In addition, messages received from the system show up automatically as having originated from "NGO" rather than an anonymous phone number (See Figure 4.3).

Update Balance

Name/Description: medical advisor
Username: ▮▮▮▮
Current Account balance: 512
*Add How Much? [   ]

[Submit]

* denotes required field

Figure 4.7: From this page, administrators can view and update credit balance for individual users.

4.3.4 Credit Balance Management

As part of the initial agreement, the NGO pre-purchased approximately a year's worth of SMS credits from the vendor. The web interface displays the balance of credits remaining, and the total number of credits used. This credit differs from airtime credit in that a single credit in this system will send one SMS message. Text messages typically cost anywhere from 50-250 UGX (2-12 cents US).

In addition, the administrator can allocate credit to individual users (Figure 4.7). Users can then use this credit to send direct messages or bulk messages through the system. Thus, the NGO can monitor and control use of the system by many users.

4.4 Expectations and Requirements

In the previous section, I gave an overview of the deployed system, which serves as a general-purpose gateway for sending out SMS messages. In this section I discuss the expectations for its use, and the mechanisms by which the NGO selected the software vendor that hosts this system.

4.4.1 Selecting the Bulk SMS Provider

In this NGO, software adoption often occurs through a bid process, in which many potential vendors are invited to submit a proposal and system description in response to a request for proposals. The evaluation process is closed to key staff, and formalized with a pre-defined grading rubric.

Four people participated in the evaluation of the bids: the project support manager (PSM), the project coordinator (PC), an outside IT consultant, and the researcher who was for the purposes of the meeting labeled as "Visiting Researcher attached to RHVP Project." The proposals included company descriptions, curriculum vitae of key personnel, examples of prior work, and a budget and description of their proposed approach. The three bids varied widely in detail, pricing and feature availability. All were graded on an

evaluation rubric, determined before the evaluation meeting. We discussed the bids together and scored the bids independently. Included in the rubric were:

- Ability of the candidate to deliver: evidence of prior related work, presence of skilled software developer on team

- Technical approach and methodology: appropriate software platforms used for system, security considerations, backup and recovery, documentation and reporting, remote access

- System Features: system-to-mobile, mobile-to-system, data storage and retrieval, grouping and other customization appropriate to project

- Finances: procurement, recurring costs, training

- Implementation Time Frame: realistic/reasonable framework, clear work plan

- Training and support provision

In reviewing the proposals, we[3] found that there was insufficient detail for us to provide a satisfactory analysis in many areas. While the companies approached had solid reputations in Uganda for providing bulk text messaging services, even with two information technology experts on the review panel, we were unable to make our own assessment as to their technical prowess based on the information they provided.

Two primary features emerged from the review process as key choices in the deployment of a Bulk SMS system. Firstly, the deploying agency must choose whether to pay for all of the text messages sent to and from the system, or to expect the users to pay for their own text messages when they reply[4] via the system. Secondly the deploying agency must choose between using a standard telephone number or a short code, a sequence of usually 4-6 numbers that are generally used for value-added text services, such as television voting and charity donations. In Uganda, short codes consist of three to four digits; these codes are significantly easier to read, memorize, and use than the ten-digit numbers used for standard communication. However, securing short codes, especially cross-network short-codes that would work with different mobile carriers, is expensive, potentially increasing the costs of the system by thousands of dollars. One bidder priced short code and non-short code versions of their system at a difference of 6,000 USD.

The NGO also had to choose whether to hire a third-party organization, to use an off-the-shelf open source application such as Frontline SMS, or to develop a solution in-house. The Frontline SMS application already offered most of the feature requirements, and was available as a free download (Banks et al., 2011). Minimally, it was missing remote access capabilities, and initial modem configuration. However, by choosing to hire a third-party organization, the NGO outsources support and customizations to people that specialize in bulk SMS software, possibly at the expense of more money (Weber, 2004).

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[3]I switch from 'I' to 'We' here because the proposals were reviewed by a committee including the NGO staff and me.

[4]Note that in Ugandan pricing plans mobile users only pay for text messages when they send a text message. Unlike most plans in the United States, they do not pay for text messages when they receive them.

At the conclusion of the bid process, the NGO balanced budgetary requirements with recommendations about usability. We chose to use a shared short code, piggy-backing on the pre-existing short code of our selected software vendor. Shared short codes pair well-known codes with keywords, such as "Text 1234 myNGO" vs. "Text 1234 to contact myNGO". While dedicated short code might be easier for the participating HSPs to remember, and less prone to error, the additional expense entailed by this feature exceeded the donor's budgetary restrictions. Thus a user-centered design decision might be in conflict with financial restrictions. Likewise, the NGO reduced their own risk by outsourcing to the third-party vendor with existing expertise in Bulk SMS systems. In addition to the design of the web interface, these infrastructural decisions factor into the user experiences of the NGO and the HSP staff.

4.5 Anticipated Uses

In preparation for the customization and development process, the software vendor circulated a questionnaire regarding the user groups and anticipated uses of the system. Table 4.2 has been extracted from the researcher's communication with the NGO regarding feedback to the software vendor. For each type of anticipated communication, I have listed the parties using the system (origin, recipient), an overall category (desc), example messages, frequency, a group size (i.e. count: estimate of the recipient group size), and the aggregate estimate of how many messages would be sent per month, calculated from the frequency and the group size.

The NGO expected to use this system to send out payment notifications (40x/month), make announcements (every other month to 80 HSPs), manage questions (1-2x/month for each HSP), and handle stock requests (50x/month). We expected that the NGO would get about 160 messages per month from the HSPs at a rate of 1-2x per month, and that the total usage would be about 660 messages per month.

4.6 Bulk SMS System Usage

I have described above the conception and anticipated uses of the system. In the next sections I examine in detail how the NGO and associated stakeholders actually used the system.

4.6.1 Overall Use

Using the reporting feature of the BulkSMS system, I acquired data from its initial launch to June 30, 2010, reflecting approximately 7.5 months of usage. During this period of time, the system sent 4,167 messages, comprising 250 unique messages. Figure 4.8 provides an illustration of when the messages were sent, divided by message type. This figure reflects numbers of unique messages rather than total numbers of messages sent. For example, when the HSP sends a bulk or template message to 80 recipients, there are 80 messages in the system, but only one unique message. However, when the same bulk message is sent

Origin	Recip.	Description	Message	Freq.	Count	Monthly
Finance Officers	HSPs	Notification of Payment	Your payment has been processed and XXXX UGX has been deposited in YYYY bank account No. ZZZZ	Every 15 days	40	80
Management	HSPs	Announce	Misc	Every 60 days	81	40
PC	HSPs	Queries	Responses to queries about payment, treatments, referrals, etc.	1-2x per month	81	160
Service Providers	PC	Queries	Queries about payment, treatment, referrals, etc.	1-2x per month	81	160
Sales Team	CBDs	Announce, Queries	Announcements about outreaches, publicity, availability of vouchers	1-2x per month	100	150
CBDs	Sales Team	Voucher Requests	Please send X vouchers	Every 60 Days	100	50
Medical Officers	HSPs	Feedback On Claims, Continuing medical Education	Claim XXX is missing a voucher, etc – not standardized. Maybe can be standardized around particular types of feedback, and error messages, but particularly egregious problems will entail phone calls, emails, and in person visits, not SMS messages	Every 30 days	10 SPs	10
Project	Patients	Queries	Answers to queries about the project, radio program, etc	3-4x per month	1	4
Management	Sales Team	Announce	Announcements about program changes or communications about news from head office.	1x per month	6	6
Estimated Monthly Total						660

Table 4.2: This table documents the anticipated uses and frequency of use for the Bulk SMS system.
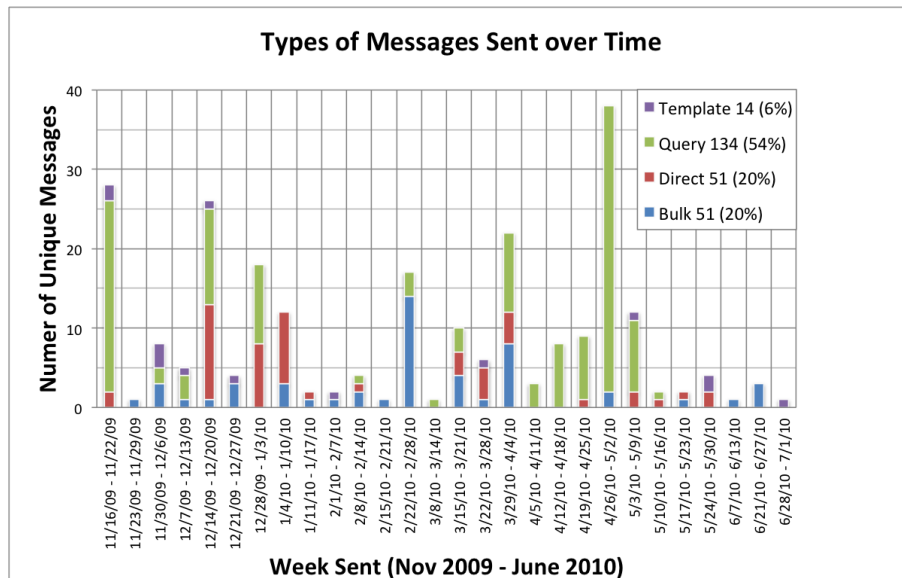
Figure 4.8: Timeline of Bulk SMS system usage, divided by weeks. The legend specifies the total number of messages of each type sent, followed by the percentage of the total. Each 'bulk' message has been counted as a single message.

out in multiple batches separated by several hours, each batch is counted as an individual message. Each query is duplicated as 4-5 messages in the logs, one for each staff member who receives a copy of the message and a confirmation message for the sender. Each query is counted as one unique message.

Since payment notifications should occur twice, template messages should appear about twice a month, which remains approximately true until mid-February, when payments were significantly delayed due to a claims processing backlog beginning in January. Increased usage of direct messages typically coincide with queries, but not all queries receive direct messages in response. One can also see that the bulk message feature is used consistently, except during April. During that month there is increased query usage, which will be discussed later in this section.

4.6.2 Payment Confirmations

The first intended and primary motivation for the BulkSMS implementation was for the notification and confirmation of payments. As can be seen from Table 4.2, I estimated that the NGO would send out approximately two notifications per month to about half of the HSPs each time. This was based on the contractual agreement with the HSPs in which the NGO would accept claims twice monthly (on the 15th and the 1st of the month) and make payments 15 days following.

I subcategorize communications regarding payments in Figure 4.9. Complaints dominate the HSP communications. Also, despite explicit asks for confirmation of deposit, (e.g. "cnfrm rcpt to mgt on 0785555555") very few HSPs send back acknowledgements, with only six acknowledgement messages in total. Indeed, after the first three payment confirmations, the NGO no longer includes a request for receipt/acknowledgement, perhaps

Subcategories of Payment Messages

NGO to HSPs   HSPs to NGO
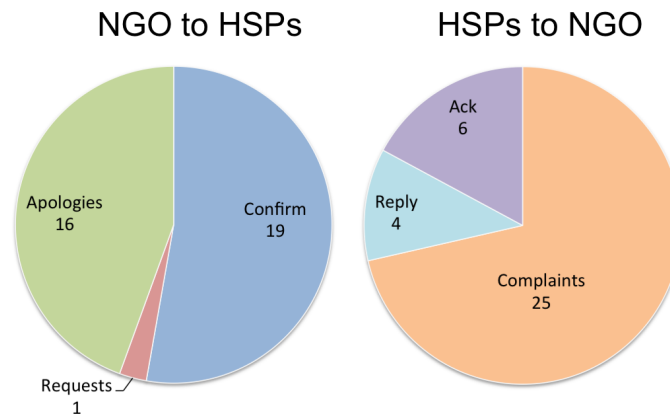
Figure 4.9: Distribution of payment-related messages, divided by direction of message.

realizing that they will get complaints until the money is deposited. 19 total confirmation messages were sent by the NGO to the HSPs, comprising the six total payments. This occurs because payment confirmations are often sent out in small batches, to a subset of the HSPs each time, based on when their payments and claims were actually processed. As a result, the NGO does not normally use the "HSP" groups for template messages. Instead, they rely on the *advanced send* feature, which allows the NGO to upload an Excel spreadsheet with phone numbers and template fields.

> "Dear *Wellness Clinic*, u've been credited with1041050sbmssion of [dateof-sub.].send us your queries and cnfrm rcpt to mgt on 0785555555[-]" (12/12/2009)

While payments were made on a timely basis for much of 2009, during early 2010 the NGO was deploying a new claims processing system. As a result, claims processing took longer, and payments were delayed, as can be seen from this template message, sent on December 1, 2009:

> "Dear [FACILITY], we exprncd a tchncal prblm wth our claims processing systm thus a delay in pymnts 4 Oct & Nov.We'll reimburse u by mid Dec.Thank you.[-]"

While unanticipated, in retrospect, it is almost unsurprising that the first response to the introductory SMS of Dec 17 was:

> "that's o.k but when are you paying me? ur delay has actually paralyzd my work. try 2 be fair."

In fact, out of the seven months of the study, only six out of the expected 14 payments were made (twice monthly). Table 4.3 shows the dates when the NGO sent payment notifications or other communications related to payments. Between February 1st, 2009 and May 6th, 2009, the backlog was so bad that they decided to make a partial payment, paying all of the HSPs 80% of the total value of their outstanding claims on March 31st, 2009. Three HSPs acknowledged this gesture:

Chronicle of Payment SMS Events and Responses

	Dec	Jan	Feb	March	April	May	June
15th	12/1 apology 12/15 paid	no sms	no sms	3/18 apology	no sms	no sms	no sms
30th	12/23 paid	2/1 paid	2/24 apology	*3/31 80% paid*	4/29 apology 5/6 paid	5/27 paid	6/25 apology 6/30 paid
HSP	5 Ack 5 ☹	?	?	3 Ack 11 ☹	1 Ack 7 ☹	?	?

Table 4.3: Chronicle of Payment SMS events and responses. For the HSPs, the top line indicates how many acknowledgments were sent in reply to payment notifications. The bottom line (with the frown (☹) symbol) indicates how many messages were sent complaining about late or absent payments.

> thanks for that good message. wishing u a happy easter.

> thanks to *ngo*. i have withdrawn my first claim at last.

> we received a msg early ths morning that mane had been deposited bt its nt reflected on the account (we received a message early this morning that money had been deposited, but it's not reflected on the [bank] account)

However, 24 HSPs over the next month sent query messages complaining about lack of payments, whereas, since only five HSPs had sent complaints by SMS in December, and there had been no queries regarding payments in January and March. However, based on observation and interviews at the time, complaints were also delivered by other channels (namely, in person, via the researcher, or through any channel possible).

Payment complaints take on a number of forms. Some are more neutral:

> what about our feb payment?we only received 50percent.for both jan.n feb. *facility* hciv

Others claim that non-payment affects the functioning of their facility, or fear from creditors:

> hello, i would lyk to enquire whn we shd expect payment coz its over a month now and we ar really counting on you 4 us to be able to clear salaries and procure sme drugs. i will be grateful if we ar considered. thank you

> hullo ngo project. thanks for ur good work. am requesting u to make advance payments for april claims/submissions. as the month is ending, salaries for workers and others facility expenses are on our necks. thanx am *bob / facility name*

kindly do us a favour and clear the outstanding bill coz due to the pressure frm our creditors we were forced to issue out a postdated cheque due to pressure on promise that you would clear ths week. thank you

Some just attempt to appeal to a sense of obligation:

facility name hospital unpaid medical claims fro ngo now total ugx 20,941,300. other vouchers ready for submission are ugx 6,197,800.p'se act urgently to enable us serve d poor mothers

Note: In 2009, $2100 UGX \approx 1 USD$, therefore values represented here are about 9,972 and 2,951 USD.

Rather than using the system for the intended, expected purpose, HSPs used the SMS channel for complaints. Likewise, the NGO realized that SMS was a useful channel for broadcasting apologies about delayed payments. Previously, when payments were delayed, HSPs felt ignored. They would text or visit the NGO offices to ask when their payments would come (See Chapter 3), also complaining:

I don't know. I don't know how we are performing. I don't know how we are faring. And of course my staffs are also complaining. They are overworked, they don't get any benefit from the project, and of course it takes a lot of time... They need to be motivated as individuals. All that will depend on – are we making any profits?

In response, the NGO staff would explain their limitations, giving various reasons for delayed payments. However, they were less able to be proactive about addressing the complaints that would invariably arise. While theoretically they could SMS, phone, or send a written letter to each HSP individually, such an endeavor would be time consuming. Calling each HSP or delivering letters would be costly. Furthermore, a personal phone call or an official letter would be too formal of a communication channel for an apology. In contrast, Bulk SMS, with its informal language and ease of use provides a casual channel for broadcasting notifications, including apologies.

4.6.3 Administrative Communications

The Bulk SMS system is also frequently used for program administration, in coordinating visits, requesting resupply of claim forms or vouchers, and even carrying out contractual agreements.

In one instance a newly recruited HSP received a contract and notified the NGO that they had signed it:

Query #70 from +256774*******: *facility name* h/center has signed the contract today 14th dec.o9.thanks. To reply to this query, send ngo reply 70 followed by your reply, to 8**8[-]

In response, the NGO sent a direct message:

Dear service provider, thank you for your compliance. Please begin providing voucher services. A team from NGO will come and pick the contract.[-]

Travel to health facilities, especially the newly recruited facilities often entailed overnight travel. As a result the NGO scheduled visits about once or twice a month to the areas near each health facility. When requested, they could arrange a visit and pick up paper documents, like contracts and claim forms. Since the NGO trusted the Bulk SMS system as a temporary proxy for the signed contract, the HSP was able to offer the NGO-covered services several weeks earlier than otherwise.

Later, when the NGO conducted the annual review of drug reimbursement prices, they decided that the Bulk SMS system would be an efficient and effective means of recording acceptance of the new prices. The NGO sent an email to the affected HSPs, followed up by a bulk SMS message:

NGO has sent you an email on revision of service delivery costs. Please retrieve email and confirm receipt. Thank you (March 16, 2010)

Hello service provider, please check your post office mail for your payment summary reports and review letter from NGO.Confirm receipt. Thx. MGT (March 23, 2010)

This message served two purposes. Firstly, it informed the NGOs that they needed to check their email or post office box for the new service delivery costs. Second, it provided a mechanism by which they could confirm receipt of the email and accept the new prices. Out of the 22 recipients of the message, 12 responded over the course of the next month with acceptance or conditional acceptance of the prices:

christian greetings. i acknowlfge that i received yo letter dated 9th march 2010 on 30th march 2010.txs 4 yo support n we a ready 2 continue working with you.4rm name,*facility h/c 111,village*. (March 31, 2010)

In addition, HSPs and voucher distributors used the system to request additional blank claim forms, vouchers, and other stationary:

good morning ,am adistributor of *facility name* mi[my] sti health life cards [vouchers] are out of stock.

However, there are only 5 instances of this type of message. While the system proved useful for some of the NGO's partners, the NGO faced an uphill battle encouraging widespread use of the system.

4.6.4 Medical/Protocol Consultations

HSPs often had questions about what medications to use, or how to diagnose certain presentations of symptoms. Since the NGO was strict about only reimbursing treatments that followed their protocols, HSPs wanted to verify their courses of action prior to spending money. For example, in one health facility I observed a clinician calling the NGO to see

if they would be reimbursed for transporting a mother and her newborn child to Mbarara. The baby was born with extensive neural complications (hydrocephalus and spina bifida) and required follow-up treatment. After the call, the clinician paid a driver to transport the mother and child to Mbarara. The clinician then filled out the appropriate claim form, and was reimbursed a few months later.

One of the expected uses for the Bulk SMS system was to provide an official channel through which HSPs could ask for advice about the treatment protocols. Each query message was automatically copied to the medical advisor, the project coordinator (PC), and other NGO staff. Based on the content of the message, the appropriate person would answer the query, either using the query reply function, sending a direct message, or using their personal mobile phone. The medical advisor was expected to answer messages about treatment, and the PC often responds to queries about protocol administration. For example[5]:

> if apregnant mother has +mps. what shd ido on rx (Dec. 30, 2009, 1:43 PM)
>
> thnx 4 ur msge.dependg on wat trimester she is, consider cortem from a govt facility. NGO doesnt pay 4 cortem coz funders are d same!1st trimstr Fansd (Dec. 30, 2009, 5:52 PM)
>
> Hello, in reference to the text you sent to *NGO*, if a pregnant mother has +mps, please give Fancida. Thank you (Jan. 6, 2010, 8:42 AM)

In this case, the initial query was sent in early afternoon. An initial reply was sent (via the web system) about 4 hours later, with a clarification sent a week later. A second response is then sent a week later, correcting the course of action suggested in the first message. This has several implications on message characteristics for the HSP: **1) unknown provenance:** based on the message alone, it is unclear which NGO staff member has responded and how reliable the answer is, **2) lack of immediacy:** the mother in question might need immediate treatment, but solutions are not presented until several hours or several days later, **3) brevity:** due to the length constraint on SMS messages, content is abbreviated, which may lead to confusion or insufficient information. In both messages, no information is given regarding appropriate dosages.

In general, the HSPs chose not to use the Bulk SMS system for medical queries, preferring to call or ask questions in person. Over the course of the seven months covered by the logs, only three messages are recorded involving medical queries. Instead HSPs dropped in or called, preferring more conversational mediums for sharing this type of knowledge. In addition to wanting to speak to the medical advisor directly, they expressed a need for describing conditions in detail. In many instances, they needed immediate answers for treating a patient with them at the time. These mechanisms are not afforded by length-limited SMS messages.

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[5]HSP: If a pregnant mother has been tested positive for malaria, what should I do on prescriptions? MA: Thanks for your message. Depending on what trimester she is, consider coartem from a government facility. The NGO doesn't pay for coartem because funders are the same! First trimester Fansidar [a malaria preventive given to pregnant mothers in Uganda].

Network	MTN	Zain	Warid	UTL	All Messages
Average Delay	0.77 h	0.59 h	0.39 h	46.7 h	4.60 h
Dropped	3.4%	1.2%	10.4%	0.0%	3.1%
Delay > 4h	9.9%	3.1%	4.9%	29.1%	10.5%
Reliable	26.9%	1.4%	95.1%	2.0%	24.5%
Unknown	6.8%	4.5%	2.5%	7.1%	6.4%
Messages	3181	487	163	354	4185

Table 4.4: Message delivery statistics.

4.6.5 Misdirected and Dropped Messages

In addition to non-use of the system by the HSPs, the NGO experienced instances in which their bulk SMS messages were dropped or misdirected. Messages sent to HSPs never arrived, others were left off the address list by omission, and still others received payment notifications addressed to other HSPs.

An individual payment notification includes the HSPs name and the amount for which they were reimbursed. As a result, a misdirected message results in a privacy violation for the HSP named in the message. Often this is a result of human error; either the data administrator or the finance officer may have included the wrong phone number when assembling the spreadsheet for the template message. Each spreadsheet includes information for 29-118 recipients, sometimes including multiple phone numbers for a single HSP. Despite careful assembly of the spreadsheets, mistakes occurred.

In addition, many HSPs never received messages from the system. One HSP reported that he had received messages in the beginning, but stopped shortly after. It turned out that he had changed phone numbers. Although he had been actively using the new phone number when calling the NGO, the data administer was never made aware of the change, and failed to update the system and his records. Others reported receiving messages intermittently. If their phones were turned off when the message was delivered, the underlying network would attempt to resend the message. However, many HSPs did not have electricity, resulting in phones that were without power for longer than the resend timeout[6]. In these instances, neither the NGO nor the HSP would know that a message had been dropped.

Table 4.4 lists the delivery statistics, as derived from the status codes. *Reliable* indicates what percentage of messages for which there was sufficient information to calculate the delay. *Unknown* indicates the percentage of messages for which there is no information about the delivery status and delay of the message. *Average delay* indicates the average amount of time it took to deliver messages on each network, with *Delay > 4h* indicating

---

[6]The resend timeout is the period of time in which the mobile network will automatically continue to contact the recipient phone number and deliver the SMS message. After this time, the message is considered 'undeliverable'. If configured to do so, the network and the original sender might be notified that the message was dropped.
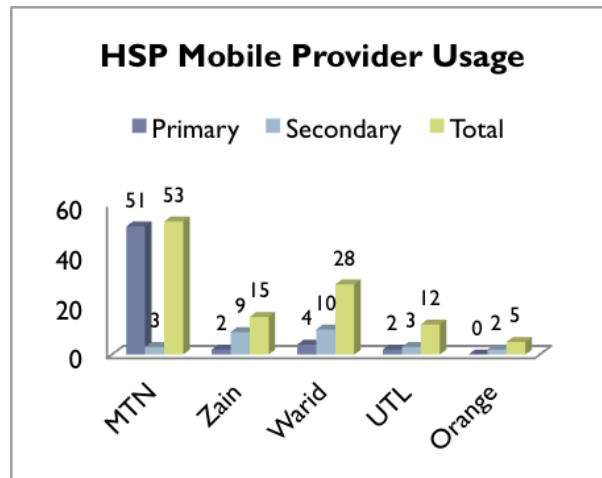
Figure 4.10: This graph depicts the mobile providers used by the HSPs who participated in the baseline survey. Primary SIMs are typically used for receiving incoming calls. Secondary SIMS may be used to enable the HSP to make cheaper phone calls. While some HSPs own more than one phone, the majority (59%) of those interviewed only own one phone. SIMs are 'swapped' in the available phone on demand.

what portion of the messages were delayed by more than four hours. For unreliable messages I calculated delay based on when they were delivered to the SMSC (status 8). As a result calculated results may be lower than the actual delay. *Dropped* indicates the percentage of messages which I can reliably verify were dropped. Any unreliable messages may have been dropped also. Thus out of all the messages anywhere between 3.1% (dropped) and 28.6% (100-reliable+dropped) of the messages were dropped.

The reliability of status delivery was carrier-dependent. While Warid's system responded with status codes for 95.1% of messages sent to phones on their network, far fewer messages sent to other networks included delivery-based status codes. Most of the messages (75.5%) were not accompanied by sufficient information to reliably verify whether and when they had been delivered (i.e. received statuses with codes 1:DeliveredToPhone, 2:NonDeliveredToPhone, or 16:NonDeliveredToSmsc). Table 4.4 shows that 0.0% of UTL messages were dropped. However 98% of these messages were not accompanied by status codes; it is unknown whether any of the remainder were dropped silently.

Based on the available data, messages were delayed by less than an hour on average for MTN, Zain, and Warid, but delayed by an average of two days for recipients on UTL. Likewise, more messages sent to Warid lines were dropped (10.4% vs 3.1% for all messages).

This speaks to a critical problem: in most instances neither the HSPs nor the NGO know whether a message has been dropped. Based on available data, between 3.1%-28.6% of the messages have been dropped. Since most of the Warid messages are 'reliable', it is reasonable to estimate that about 10% of messages sent to mobiles on other networks are also dropped, yet at most 3.1% of those messages are marked as dropped in the system. However, dropped messages may also due to specific carrier or inter-carrier issues, instead of technical issues on the network side. Furthermore, many HSPs use their Warid line as a secondary line, putting their SIM card into a phone only when they are expecting or

making a call (See Figure 4.10). As a result, Warid phone numbers might be more likely to be 'off' at any given time. Even though the Bulk SMS platform provides status codes to the NGO, the status codes do not provide sufficient information for the NGO to know whether their messages have been delivered or not. In the HSP case, they cannot know when they have missed a message, unless they see that neighboring HSPs have received a message. As a result dropped messages are ignored, and HSPs may unknowingly miss vital communications.

Problems with inter-carrier (inter-network) communications resulted in dropped and delayed SMS messages. In the early days of deployment, all messages sent to Warid lines were dropped. Although this was corrected eventually, this problem was also observed with other SMS solution providers. Based on available data, messages (from an MTN line) were delayted by less than an hour on average to MTN, Zain, and Warid numbers, but delayed by an average of two days for recipients on UTL. Likewise, more messages sent to Warid lines were dropped (10.4% vs. 3.1% for all messages). In addition, the 'branding' of the messages failed for Zain users, with the message arriving from an 'unknown sender' instead of the NGO (See Figure 4.3).

As a message delivery system, the Bulk SMS platform has significant flaws. First, it is subject to user error – it implicitly delivers messages where it is asked, which may not match the *intention* of the user. Second, it is subject to the limitations of the recipient networks (i.e. MTN, Warid, Zain, and UTL). If the service provider fails to provide sufficient status information, or has difficulty sending or receiving messages from another network, there is no way for the platform or the user to know whether messages have been delivered. Message delivery problems are silent failures.

4.6.6 Other Technical Difficulties

In addition to delivery problems, the NGO endured other technical difficulties. First, the system only retained data for a few months (approximately three) at a time, transferring old data to a backup server to save space. As a result, the NGO was required to pro-actively download the data every few months, or to work with the vendor to procure backlogs. While not insurmountable, this was inconvenient, especially given the NGO's desired ability to use the Bulk SMS system as a reliable repository. It was impossible to readily retrieve old SMS messages. Second, NGO staff could not send new messages unless they had an Internet connection. Often the project coordinator and the medical advisor were in the field visiting HSPs. If they received a message on their personal phones, they could normally use the Bulk SMS system to send a 'direct message' in response. However, if they were in the field, they were unable to shift the conversation to the system. Likewise, it was impossible to send bulk or template messages without an Internet connection.

4.7 Analysis

4.7.1 System Limitations vs. Design Flaws

The usability and the reliability of this Bulk SMS system is ultimately subject to limits imposed by the mode of use. SMS message delivery can be delayed and is not guaranteed because 1) the networks do not guarantee quality of service for SMS messages and 2) messages cannot be delivered when the recipient phone is out of network range or out of power. The system is unsuitable for messages requiring immediate attention; often the NGO will send a response hours and sometimes days later (immediacy). In these instances, the HSP might visit in person or make a voice-based call. As a short message service, messages are limited in length - as a result messages are abbreviated and contain less information that may be gained in a phone call (brevity). In addition, all messages sent by various NGO staff using the system are anonymized as coming from the NGO and not individuals, leading to potential misunderstandings regarding the reliability of responses to medical queries (provenance). User error could lead to incorrect information being sent, or misdirected messages, as with the case of one HSP receiving payment notifications intended for another HSP. This has privacy implications: bank and payment information should not be shared with other HSPs.

While these problems may be a function of the SMS channel or other limitations, many of issues could be addressed through changes in design. Longer messages could be sent by sending multiple messages, broken up with continuation markers (e.g. 'msg cont..'). The system could cross reference phone numbers and HSP facility names with its internal contact database prior to sending template messages, thus reducing the potential for misdirected messages. Messages sent through the Bulk SMS platform might be appended with the name of the user logged into the system, as appropriate. The system might send warnings or highlight messages that are known to be dropped or significantly delayed, enabling at least some means for the NGO to address known message delivery failures. In addition, the vendor might negotiate with the networks to enable more status information. The vendors might enable sending of messages via the system from the field by accepting the recipient number as a keyword from certain senders (e.g. "8111 ngo +2567** message").

At the same time, changes in design cannot address all of the limitations. A message split across multiple SMSs is still a relatively short message. As an asynchronous medium, it is natural for responses to be at least somewhat delayed. In theory, user error for payment confirmations could be reduced, but changes might entail compromising the inherent flexibility of the system, requiring the data administrator to create a contact for each payment confirmation recipient. It is important to understand the difference between limitations inherent to SMS-based systems and limitations that are imposed by design flaws.

4.7.2 Design Choices and Adoption and Usefulness

> "I hate sending messages they are time consuming I prefer making audible calls and then having audible communications." - an HSP

In addition to the NGO's issues with using the system, the HSPs were reluctant to send
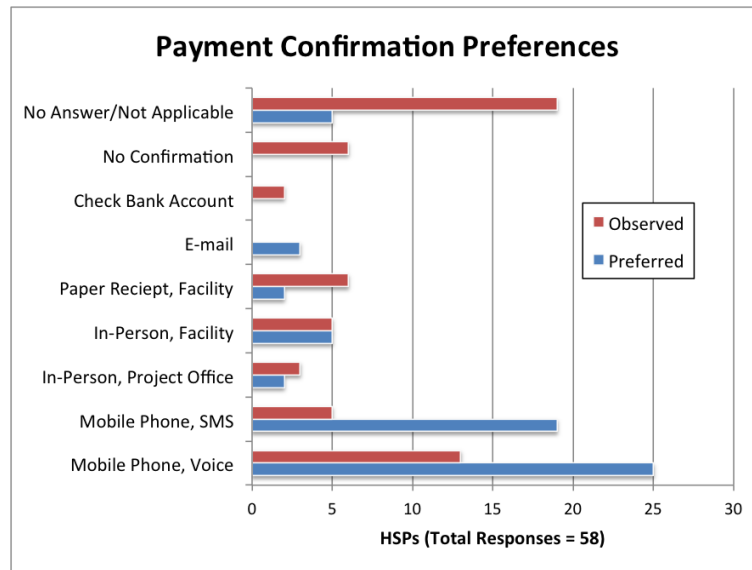
Figure 4.11: This graph documents how HSPs reported receiving payment confirmations, and their preferences.

SMS messages through the system. Table 4.11 show the results of a survey question asking how they preferred to receive payment confirmations prior to the system deployment. While many (19/53, 35.8%) are happy to receive these confirmations by SMS message, about half (25/53, 47.2%) of the HSPs prefer to receive payments confirmations over a phone call instead.

Despite this, the NGO went forward with SMS-based payment notifications. Preferences aside, the NGO deemed that it was better to ensure that each HSP received regular notifications. A few (6/58, 10.3%) HSPs reported not receiving notifications when they should have been. Many HSPs were not receiving notifications on a regular basis. Indeed, two reported that they just checked their bank accounts until the payment arrived. When taking preferences into account, the use of SMS did not preclude any other type of payment confirmation, except for paper receipts delivered to the facility, which were discontinued. The trade-off between HSP preferences and NGO convenience greatly favored the use of SMS.

However, HSPs were slow to take up their end of the Bulk SMS system, by sending acknowledgements or sending queries to the NGO. Figure 4.12 shows the cumulative adoption of the query feature, as compared to the total number of HSPs participating in the NGO program. At any given time, less than half of the HSPs have sent even one message. Indeed, by the end of this dataset, a large majority of HSPs had sent only one message, with only 25/63 (39.7%) users having sent more than one query (See Figure 4.13).

Peaks in Figure 4.12 correspond to events, such as a specific bulk messages requesting information to the Bulk SMS phone number (Nov. 18, 2009) or confirmation of contract revisions (March 23, 2010). Messages specifically asking for responses via the Bulk SMS system increase adoption, and awareness of the system. However, each on their own does not guarantee responses. Out of the 106 HSPs participating in the program, only 63 sent even one query. Ultimately, Bulk SMS does not stand alone as an effective medium for
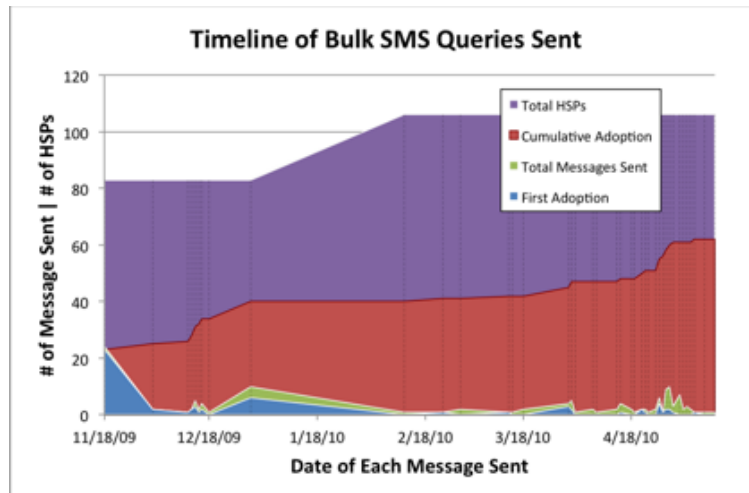
Figure 4.12: Cumulative adoption of queries.

communicating with *all* of the HSPs.

4.7.3 Braided Communications: Negotiating Tradeoffs Between Costs and Capabilities

> "I prefer calling. Say for a few days ago when we sent a message to them I had tried calling but it's like the place where they were there was not enough network so I had to send a message so that they can get or understand what I was talking about, . . . so for NGO, I normally call. I don't send messages." - an HSP

Each mode of communications has different capabilities - and also has different costs. Trucks are expensive but can carry physical documents. It is less convenient for HSPs to visit the NGO offices, but the reward is in-person communications. SMS might be a system of record, but the recorded messages are short, and asynchronous communication makes 'conversation' tedious and time consuming.

In these examples SMS augments the usability of email and postal messages. When the NGO sends documents to the HSPs, they can 'signal' to them that they should expect an email or letter. This signal also enables the HSP to notify the NGO if they do not find the expected letter:

> am stil wating ad up nw hv nt receivd any leter frm the yo ofice via ma box numbr address. bt i wish u use ma email addres email@yahoo.com its post ofice pple a not eficiet. bt i wl agree wth yo new terms (April 2, 2010)

Thus, the short message entailed by the Bulk SMS system (i.e. its capability) is useful for brief announcements and notifications, while the postal service and email is more effective for sharing larger amounts of information, or delivering more official communications like claim reports and contract revisions.
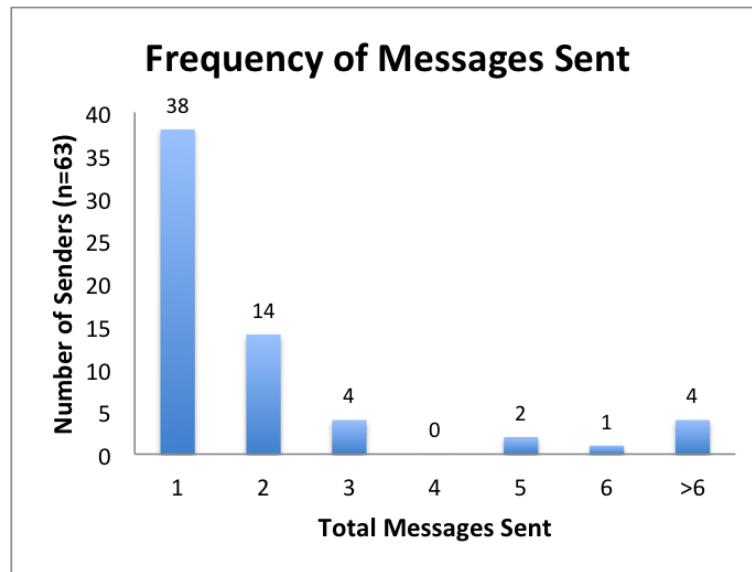
Figure 4.13: Most query users only used the feature once.

	Immediacy	Content	NGO Cost	HSP Cost
SMS	High	Short, Informal	Low	Low
Trucks	Medium travel time	Long, Formal	High travel cost	Low
Postal	Low	Long, Formal	Medium	Low
Phone Call	High	Long, Informal	Medium	Medium
Email	Medium infrequent access	Long, Informal	Low	Low

Table 4.5: Comparison of the immediacy, content style, and cost of different communications channels.

For each mode of communication, the NGO must weigh the cost of information delivery against the amount of content and immediacy of the information. SMS is low cost, and relatively immediate, but only enables short communications. For critical, formal or long communications, the NGO can have their drivers personally deliver messages. For less critical communications, email and postal service suffices. One-on-one conversations may occur at the health facility, in the NGO offices, or over the phone.

4.7.4   Unexpected Outcomes

Using the Bulk SMS system, HSPs were more empowered to communicate, frequently using the query feature to complain about late payments. In turn, the NGO used the system to maintain a casual communicative relationship, sending apologies when payments could not be sent. The Bulk SMS system was a low cost and convenient mechanism of communication between the HSP and the NGOs.

The choice of a relatively generic system enabled the NGO to find ways to use Bulk SMS outside of their initial set of expectations. Contract revision confirmations, apologies, and e-mail/postal communication notifications are all examples of uses that were not

initially identified. Indeed, out of the anticipated uses, payment confirmations remained useful, but medical queries and voucher requests were not used frequently. While SMS messages have a specific structure (i.e. 160 characters to be delivered to mobile phones), the Bulk SMS system does not incorporate specific uses (i.e. payment confirmations, voucher requests, medical queries). Instead it provides generic functionality that the user can adapt to fit specific needs. The structured generic-ness of the Bulk SMS channel permitted the NGO to innovate around its use, and to respond to changes in their own needs as necessary.

While the NGO went into the bid process with specific aims in mind, they benefited from the general-purpose nature of the system. I characterize this system as *flexible* because it was easily able to accommodate un-specified uses in addition to uses that were specified prior to implementation. Perhaps the uses were known, but could not be included in a written specification (e.g. apologies for late payments). Or, the potential use was not considered until after the system had been used for some time (e.g. contract revisions). Thus, **flexible systems** are compatible with 1) changing needs in the organization and 2) unspoken needs.

4.7.5 Perceived Benefit

Finally I observe that in spite of the idiosyncrasies of the Bulk SMS platform, both the NGO and the HSPs found this system to be beneficial. The HSPs expressed their appreciation through the system and in follow-up interviews. Likewise the NGO staff felt they had a new means of communicating with the HSPs.

4.8 Conclusions

In this chapter I have detailed the conception, design, and use of a Bulk SMS system in the context of a health financing organization in Uganda. We suggest that the *flexibility* of the system enabled it to better cope with 1) changing and 2) unspoken needs of the NGO. In addition, I found that the utility of SMS messages depended on NGO and HSP needs around the 1) immediacy, 2) brevity, and 3) provenance of the messages. While the HSPs did not use the system extensively, I suggest that addressing the above three features may increase usage. When appropriate, the NGO can encourage use and visibility of the system by sending specific requests for information, to be sent via the system. While Bulk SMS is not the most appropriate solution for every communications problem encountered by organizations in developing regions, we show that it can easily coexist with and supplement other communications mechanisms. *Braided communications* entails building a rich understanding of relative costs and capabilities of available communications mechanisms.

This Bulk SMS system exists in a rich ecosystem of interactions between the HSPs and the NGO. In addition, it co-exists with many other communications technologies. These technologies, independently and together help the NGO improve communications with the HSPs, and thus also improving the program management of the health-financing program. Although HSPs often used SMS to complain about delayed payments, providing a channel for the complaints helped them to feel more engaged with the program. Likewise, the NGO was able to communicate more frequently and casually with all of the HSPs. Finally we

observe that in spite of the idiosyncrasies of the Bulk SMS platform, both the NGO and the HSPs found this system to be beneficial. The HSPs expressed their appreciation through the system and in follow-up interviews, and both parties were able to communicate in new ways using the system.

BRAIDED COMMUNICATIONS

5.1 A Cord of Three Strands

Two are better than one, because they have a good return for their labor: If either of them falls down, one can help the other up. But pity anyone who falls and has no one to help them up.

—Ecclesiastes 4:9-10 (NIV)

In 2007, there was a billboard in Accra, Ghana advertising the then-new National Health Insurance Scheme (NHIS) (See Figure 5.1). It pictured a woman twisting a bundle of sticks in her hands: "Strength in Numbers". It is a common lesson from many cultures, not just Ghana. The Japanese proverb says, "A single arrow is easily broken, but not ten in a bundle." Aesop has a lesson for a farmer's quarrelsome sons, showing them that while each of them couldn't break a whole bundle of sticks, they could break the sticks individually. The moral: "UNION GIVES STRENGTH".

On the other hand, technical solutions for Africa's poverty seem to have an almost singular focus: mobile phones. Mobile phones as a platform provide a compromise between the specificity of our solutions and the need for a sense of commonality in what we do. They have a broad appeal to granting organizations (important!) as well as to media organizations. It is undeniable that mobile phone penetration in Latin America, Africa, and Asia has been extremely rapid. However the hype of mobile phones rings almost to the exclusion of all other communications technologies.

Radio, television, postal service, in-person communication, newspapers, and broadband Internet continue to play (or are beginning to play) roles in how people and organizations share information and build relationships with one another. While it is undeniable that the advent of the mobile phone is changing the roles of each of these modes of communication, the mobile phone is not replacing them wholesale, no more than the television replaced the radio.

In this chapter I examine the roles of communication technology in the Reproductive Health Voucher Project (RHVP). During the three-year span of this study, access to mobile phones and the Internet has changed for both the NGO and the independently-run health service providers (HSPs). Due to the wide geographic span of the HSPs, the NGO faces a number of structural limitations, including poor road infrastructure, intermittent power, and unreliable mobile network coverage. I describe how the stakeholders work together to

Figure 5.1: Billboard in Accra, Ghana, advertising the National Health Insurance Scheme. 'Strength in Numbers' reminds Ghanaians that health insurance works best if more people participate together.

develop and maintain effective relationships using a number of different communications channels in parallel - a combined channel I describe as **braided communications**.

I build upon Norman (Norman, 1988) and Gaver's (Gaver, 1991) notions of *affordances*, looking specifically at communication technologies, and examining the ways in which external factors can cause affordances change over time. Each communication channel offers a number of affordances. Often these channels fall short of the needs of tasks at hand. By using different technologies together, the NGO overcomes the limitations of individual channels, better coping with the conditions of their environment. The NGO draws on the strength of different channels to achieve desired tasks. Furthermore, over time, as individual uses of technologies change, the nature of the braided use evolves as well. Thus I establish three main features of braided communication channels: they are composed of co-existing, co-dependent and co-evolving uses. This chapter discusses communication *affordances* and the nature of braided communications, drawing from my observations of the RHVP program. I describe the different modes of communication adopted by the NGO and HSPs, how they evolved, and how the use of the individual technologies and the technologies together served to address the structural limitations imposed upon their environment.

5.2   Characteristics of Braided Communications

Communications are braided when one or more communicative channels are used to reinforce one another, through redundancy or complementary affordances, thereby creating a more appropriate, braided channel of communications. Communicative channels can encompass many different types of information exchange. In the earlier example, the Sri Lankan first talks to his neighbor in person, to get permission to use the phone. Then he uses a combination of bus travel and fax to communicate to his relative in Dubai. Finally, the villager receives the phone call at his neighbor's home. This situation illustrates some of the constraints and affordances of fax and phone communications. Faxes are only available in the nearby town, and entail road travel to support exchange of information. Perhaps the villager is illiterate and knows the fax operator well enough that he or she might be

able to write down the message for him. In this case a constraint of illiteracy is complemented by the strength of a helpful operator. Lack of finances to support an international call, alleviated by the ability of the Dubai relative to absorb these costs by initiating the call. However

In response to constant social and technological change, braided communications continually evolve over time, composing and re-composing as information technologies uses emerge and change. For example, today, this Sri Lankan villager might send and email instead of a fax. As Internet-enabled phones become more prevalent and technology skills allow, the villager might send this email from the phone of the neighbor. Or if the costs of SMS messaging change, and international communication is reliable, they might send a text message instead, perhaps reimbursing the neighbor for the cost.

5.2.1 Affordance Requirements

Braided communications are constituted and re-constituted in response to the *affordance requirements* of communications tasks. Functionally the original goal of payment notifications (See Section 4.6.2) was to notify HSPs when they had been paid and how much, and to secure confirmation from the HSPs that they had actually received their payments. Supporting this requires 1) timely notification 3) personalized information, and 3) legibility. However, the relative importance of each of the affordance requirements can change over time, based on the expressed and presumed needs of the stakeholders involved. Indeed, a shortfall in one affordance requirement can often lead to overcompensation in the process of correction. For example, the NGO switched to voice-based notification of payments, from paper-based notifications in response to a recognition that opportunistic delivery of paper notifications was too slow and cumbersome to meet the needs of the payment notification task. However, while these phone calls were easily personalizable, they were not legible. As a result, the NGO had no record of what had actually been communicated, and the HSP often forgot when payments had been made and how much to expect to be deposited in their bank accounts. My survey also revealed a previously *invisible* affordance requirement: half of the HSPs preferred to receive this information by SMS or other means instead of by phone (See Figure 4.11). Bulk SMS addressed all of the known affordance requirements, but was also subject to this last requirement: several HSPs greatly preferred to receive this information in phone calls. Since Bulk SMS alone was inadequate, both due to preference differences, and silently dropped messages, informal calling and email were also used to supplement completion of this task.

5.2.2 Analyzing Salient Affordances

For the NGO, the affordance requirements emerged through an ongoing dialogue between the related stakeholders, depending on both goals and objectives as laid forth by the European donors, and the perceived needs of the NGO staff and project participants. In addition, experience exposed *invisible* affordance requirements, causing the NGO to seek new means of alleviating these gaps.

Matching communications technologies to communications tasks requires an understanding of the capabilities and constraints of the technologies. For the NGO, this under-

standing arises from experience, as well as expert consultations. The use Bulk SMS, for example, emerged from prior NGO experience with SMS systems for health education, but required expert feedback to differentiate between and select an SMS gateway provider (See Section 4.4). The motivation for Bulk SMS arose out of increasing frustration with management of the communications on dispersed personal mobile phones, and feedback from my survey regarding HSP communications preferences. For the NGO, Bulk SMS *afforded* centralization of the records and more facile communication with the HSPs.

This process of learning and identifying salient affordances is an important part of program management. In 2009, the NGO attempted to shift certain communications to e-mail, but shortly thereafter realized that a majority of the HSPs could not access email regularly. As can be seen from this experience, it was not initially apparent to them that affordances can differ between their experiences and the experiences of the HSPs. However, when they attempted to shift to this communications channel, it quickly became clear that many of the HSPs would not be able to use email in the way that they expected. They learned also that the affordances of e-mail differed from HSP to HSP. Flexibility upon the part of the NGO required observation of HSP experiences, reflection on the workability of their approaches, and a willingness to change communications strategies as necessary.

In addition to being different relative to context, *affordances change over time*. New mobile providers lead to greater competition and changing mobile rates. New Internet infrastructures such as the SEACOM East Africa submarine cable that landed in Nairobi in Fall 2009 potentially changes rates, and practically changes the offered throughput and speed of available Internet. A Bulk SMS system can be deployed, when it was not even considered earlier. An HSP clinician might get computer training, purchase a computer and subscribe to mobile Internet - changing the convenience of checking email. Savings generated as a result of RHVP financing might be spent on new infrastructure and staff, leading to additional clients, or more frequent travel to Mbarara, or more disposable income for mobile airtime. The acquisition of a camera or a cameraphone changes how HSPs educate their clients and ask the NGO for medical advice.

5.2.3   Co-existing and Co-dependent

Communications technologies do not exist in isolation. In addition to deep relationships with the potential users of technology, and the socio-political context of their interactions, these technologies are used alongside one another. Table 5.1 lays out some of the different communication mediums and their features. The radio program and the NGO sales staff (traveling by truck) worked together to increase awareness and visibility of the program. Documents could either be actively dropped off at the HSP facilities, or picked up at the NGO project management office. Phone conversations could be documented with a follow-up SMS. In cases where *new technologies* or new uses of technology emerged, the ways in which these *emergent technologies* are able to integrate with and support existing and future structures, both relational and technical, ultimately influence their adoption.

The program administrators addressed many of their needs by employing creative, braided, uses of mobile communications, radio, couriers, and in-person visits. Participants in the program overcame communication barriers by leveraging the capabilities of different technologies together. For example, text (SMS) messages are relatively immediate, brief,
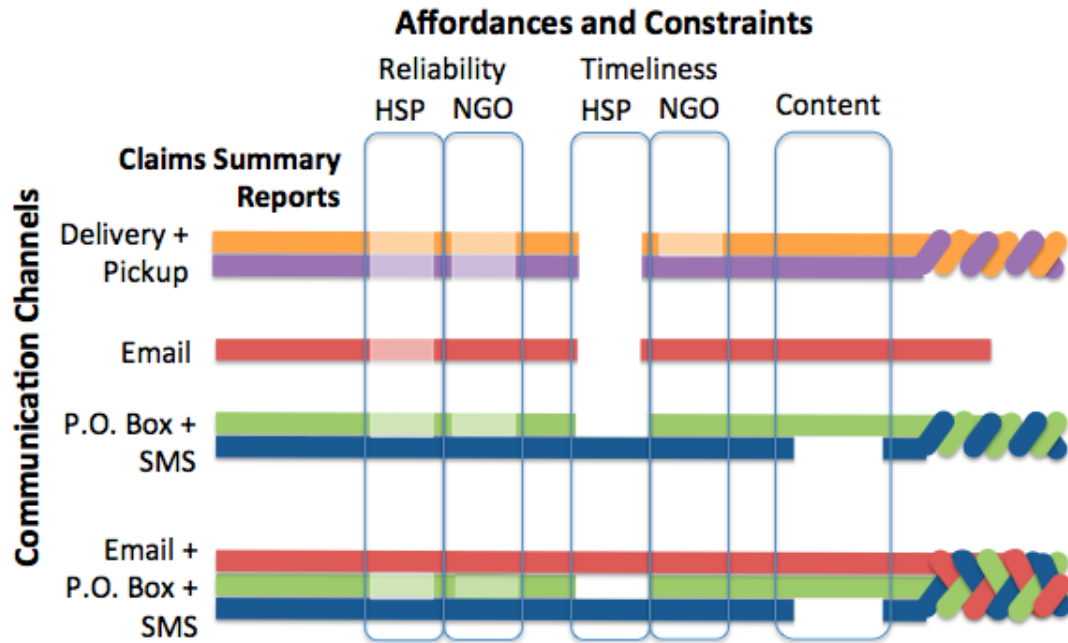
Figure 5.2: This diagram illustrates the affordances and constraints of different communication channels, and the comparative ways in which they combined.

and informal communications. On the other hand messages delivered by postal service in Uganda can be missed for long periods, since retrieval entails a special trip to the post office in nearby towns; however, this medium can accommodate longer, more formal messages. A braided communication using SMS to notify recipients whenever a postal message has been delivered enables the organization to get more utilization out of the postal service, and successfully deliver their documents. For formal communications, this new and braided channel leverages the immediacy of SMS to overcome the barrier entailed by the formerly 'invisible' arrival of documents by post.

Braided channels *reinforce* and *complement* one another. Similar channels can be used to build redundancy, such as when the NGO duplicates content over postal service and email, or when an HSP can check for a payment either by checking their bank account, calling the finance officer, or waiting for a notification. The ways in which channels support one another emerges from their different *affordances*. In Figure 5.2, I illustrate some of the different braided channels used to deliver Claim Summary Reports (CSRs). In the first example, the NGO allows CSRs to either be delivered or picked up opportunistically. From the prior discussion on paper-based communications, we can analyze the constraints and affordances of these two mechanisms. Infrequent visits to certain HSPs meant that the paper exchanges were often not timely. In general, both of these channels were subject to the fallibility of memory. However, using both together was better than using either one singly. Email was reliable and timely for the NGO, but ranged from being difficult to use to being completely inaccessible for over 60% of the HSPs. Availability of email was not reliable, and infrequent access made the information delivery untimely. At the same time, for HSPs that had regular access to email, especially in their own facilities, Email was both

reliable and timely. The affordances of email not only differed between the NGO and the HSPs, but they also differed for different HSPs. P.O Box and SMS succeeded because, while 160 character SMS messages couldn't deliver the reports, they could augment the timeliness and reliability of post by notifying the HSP when messages had been sent. Using email for HSPs that had regular access to email, made the triply combined channel even more effective.

Reliability and timeliness are not the only relevant affordances that influence how communications are braided together. Each task is associated with a desired set of affordances, and each communication channel has different affordances with respect to the users. For example, payment advices started out on paper because this medium made both the information and the confirmations (i.e. the signatures) *legible*. When the advices switched to phone use, some HSPs complained that they couldn't recall the amount paid or which claims submission had been reimbursed. Switching to Bulk SMS made the payment advices legible again - not only did the HSP have a record of the communication stored in their phones, but the NGO had a record of all payment confirmations sent stored in the Bulk SMS database. *Trust* also plays a factor, and is intertwined with the *formality* or 'officialness' of the communications. In-person communications generates the most trust, but in many cases is virtually infeasible (Nardi and Whittaker, 2002; Wilson et al., 2006). Using a formal channel, or a formal document like a contract or a memo on letterhead, can also engender more trust than SMS messages (Danielson, 1996). However, in the range of necessary communications, different levels of trust and formalism are required, allowing the use of less expensive communications like Bulk SMS. *Cost* is another affordance/constraint. Changing attitudes towards the cost of Internet (and a large grant) influenced the provision of faster, more expensive Internet connections. But unexpected costs entailed by a service that charges exorbitantly for exceeding a data limit resulted in the scale-back of Internet in the same office. Cost and *convenience* together influence the uptake of Internet in the HSPs, with wealthier health facilities near towns with Internet tending to have more frequency of Internet use. HSPs run by NGOs or the church sometimes had donor-sponsored computers and Internet connections that enabled doctors to check email every day. Using braided communications allows the NGO to cater to the differing affordances of the HSPs, and to leverage affordances against one another.

5.2.4   Evolving Communications

This is most practically illustrated in Figures 5.8 and 5.11. In both scenarios, the strategies for delivering feedback and payment notifications changes from year to year. Several things change. From 2008 to 2009, the NGO responds to the shortfalls of opportunistic delivery and pickup of paper forms by using phone calls and e-mail. Phone calls addressed lack of consistency in payment advice delivery, but revealed the previously un-prioritized affordance of legibility, and entailed sitting down with a phone for several hours to call the HSPs, calling them back until they answered[1]. Emails were attempted but ultimately failed

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[1]To make this cost effective, the PD briefly considered directing all the HSPs to acquire a Warid phone number (i.e. 24 hours of calls for UGX 1500), but ultimately decided that this was impractical. While half of the HSPs owned Warid lines already, these were often secondary numbers, with SIM chips only inserted into active phones when a call was pre-arranged or when they were making phone calls. A good idea, but more

Medium	Features	2007	2008	2009	2010
NGO Trucks	• Visibility • Speakerphone • A/V equipment • In-person visits • Courier service	2 trucks	2 trucks	3 trucks Regular visit schedule implemented	3 trucks
Office Phone	• Cost borne by NGO • Shared use	Available	Available	Available	Available
Radio Program	• Interactive call-in • Broad coverage • Single Language • Weekly	Broadcast focused on STI program	Broadcast focused on STI program	Broadcast focused on maternal program	Broadcast focused on maternal program
Mobile Phones, Voice	• Cost borne by individuals • Rec'd calls are free • Can make queries outside of formal communications	Phone numbers not formally shared	Increased calls to key program staff Pakalast introduced	Dedicated 'NGO' line Increased shared usage	
Mobile Phones, SMS	• Short messages		Increased use	Formal conf of voice conversations	Used in addition to Bulk SMS
Paper Claim Forms	• In triplicate • Use as both claim form and medical record • Physical exchange		Forms picked up from distant HSPs on a monthly basis Revised to quadruplicate	More forms introduced for maternity	
Paper Payment Confirmations	• Written signature • Explicit confirmation • Hand delivered	Many forms signed 6 months late		No longer in active use	Confs sent by SMS
Bulk SMS	• Centralized record • Group management	Not available	Not available	Introduced in November	In active use
In-person, NGO Offices	• In conjunction with claims submission • Clearer communication • Opportunistic	All HSPs visited regularly	HSPs from distant areas added, less freq visits	More HSPs added in distant districts	
Claim Reports	• Summaries for claims submitted and paid • Written record for all stakeholders	Paper forms picked up by or delivered to HSPs Shared between program offices by email	Project Coordinator delivers to head office in Kampala by hand	Delivered by email to HSPs	Delivered by post to HSPs

Table 5.1: Different communications channels/mediums, some of their features, and the ways their availability and use changed over time.

to address lack of consistency due to the wide difference between affordance of email for the HSPs and the NGO. The 'new' technology of email did not spread to all of the program participants equally. However the 'new' approach entailed with phones happened once the NGO realized that all of the HSPs had access to a mobile phone.

Over time, usage of Internet and mobile phones will continue to increase - further changing affordances relating to both technologies. Finally, the *emergent technology* of Bulk SMS addressed newly prioritized needs for documentation at relatively low cost, but was also only feasible due to changed priorities regarding payment acknowledgements. Physical signatures were not feasible for SMS-based acknowledgements, but also no longer deemed necessary. Instead the NGO prioritized communication of payments. Communications strategies changed over time, both as emergent technologies became available, and in response to changing affordances and exposed constraints of prior approaches. Not only do information technologies change over time, but the socio-economic structures that support their use and define their affordances change as well.

5.2.5 Communicative Ecologies

I want to discuss briefly the relationship between *communicative ecologies* and *braided communication*. Communicative ecologies arises out of a methodology called "Ethnographic Action Research (EAR)". As such, it represents an attitude towards information and communications technologies (ICTs): "instead of focusing on individual ICTs and their 'impacts', an ethnographic action research approach will look at the whole structure of communication and information in a people's way of life." (Tacchi et al., 2003) In this case, the EAR approach tells me that interventions like Claim Mobile (Chapter 3) and Bulk SMS (Chapter 4) do not stand independently of other communications technologies, stakeholder objectives, and other ecological influences. Indeed, this is demonstrated by the interaction between the *design* of Claim Mobile and stakeholders relationships in the RHVP program (See Chapter 3). Furthermore, the use of the Bulk SMS system is deeply embedded in a range of technical and social needs, as well as the complex relational needs in maintaining the engagement of HSPs in the face of delayed payments.

However, as an approach to ICTs, communicative ecologies does not explain how and why different communication technologies are employed at different times and for different tasks, it merely indicates that this multitude of approaches exists. By what mechanism do people combine, select, and ultimately adopt different modalities of communication? In a UNESCO book on Ethnographic Action Research, Tacchi et al. pose a scenario: "in order to contact a relative in Dubai, a Sri Lankan villager may talk to a neighbour to ask to use their phone; then travel to town to send a fax to Dubai arranging a time to receive a phone call at their neighbour's house." Communicative ecologies explains that one should recognize that different modes of communication may be used together to accomplish a task, in this case, contacting a relative abroad. Braided communications explains why this happens: why individual mechanisms have been selected, what this combined channel offers that individual modes lack, and how new communications strategies are constituted.

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complicated in execution than initially intended.

5.3 Affordances and Constraints in Communications Technology

In the previous chapters, I described several scenarios in which Bulk SMS combined with other communications mechanisms to form a more complete and coherent 'braided' communications channel. While a courier might be the appropriate mechanism for sharing official documents, geographic distribution makes this time consuming and costly. The use of more immediate communications enabled the HSPs to begin services before they would have otherwise. In this section I analyze the differing affordances and features of individual communication channels.

While the word 'affordance' is used widely in the context of ICTD literature, it actually originates in perceptual psychology, and was formally developed for 'everyday artifacts' by Donald Norman (Norman, 1988). He famously analyzes doors, and the variety of configurations used to indicate how a door might be opened. *Affordance*, he states, "refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used." (p. 9). Gaver expands on this concept, suggesting further that "affordances exist whether or not they are perceived." (Gaver, 1991) As I discuss in Chapter 1, *hidden affordances* are especially troublesome in ICTD implementations. Not only do differences in cultural constraints affect the perceived affordances, but many technologies have 'invisible' affordances. Mobile phone calls only work within the range of far-away cell towers, and may be terminated unexpectedly in response to lack of credit, lack of coverage, or an overloaded network. SMS messages sent may never be received, or are received hours or even days later. Trial and error (i.e. experience) teach people the affordances of these technologies more than visual perception or technical understanding.

Likewise, communication constraints are common to all walks of life. Causes include everything from cultural and language differences to the more fundamental barriers entailed by geographic distance and technological capabilities. Indeed, it is possible to argue any particular communications medium entails its own set of barriers. For example tele-conferencing enables a group of people to engage in conversation, even when not geographically co-located. However, lack of visual cues changes the nature of the conversation (Olson and Olson, 2000; Kreijns et al., 2003; Hinds and Bailey, 2003). A phone call may be less ideal for a negotiation (Nardi and Whittaker, 2002), or video-conferencing might enable more effective team-building and learning than a mediated tool (Tang, 2007). Lack of visual cues is a *barrier* entailed by phone conversation. Presence of certain types of cues is an *affordance* of in-person and video-conference communications. It is these constraints and affordances that help us to select appropriate communications mediums for our daily tasks.

Constraints are particularly apparent in developing regions, where available infrastructure is often weak, and available communications technologies can be unreliable or even non-existent. Poor road infrastructure, the cost of communications, and even education levels all contribute to make coordination, information sharing, and other communications tasks much more difficult. In developing regions 1) existing constraints are exaggerated, 2) minor inconveniences become constraints, and 3) communication technology is subject to

intermittent failures.

This is consistent with my observations of the RHVP program. Based on my findings in 2007, HSPs felt isolated and disengaged from the program (See Chapter 3) in spite of considerable effort on the part of the program administrators to deliver regular reports and monitor treatment standards. At the time, HSPs traveled several hours to deliver paper claims in person, pick up reports, and ask about payments. Depending on distance and other circumstances, most could only afford to visit the program offices once a month. At the same time, the program staff also needed to visit the health facilities, inspecting the quality of the services, and providing 'continuing medical education' (See Figure 3.7) to address differences between treatment given and treatment protocol eligible for reimbursement. However, in-person visits were expensive and time-consuming; only a few facilities could be visited in a given day, and only a few days could be allocated each month for visits. Furthermore, availability of the phone for scheduling visits or relaying information was limited. There was only one office line available for making phone calls, which often stopped working when its prepaid allotment of airtime was spent. Poor road infrastructure, time constraints, and budget constraints all combined to make it difficult for the HSPs and the NGO to communicate effectively.

5.3.1   Broadcast Media

The use of radio for wireless communication dates back to Marconi's efforts in the 1890s. Strictly speaking, even mobile phone and satellite-based communications fall under the category of 'radio'; however, in its common conception, broadcast radio (and television) is widely used for entertainment, news, and advertising. In addition, many attempts have been made to use radio and tv for distance-education, with varied degrees of success. For the RHVP program, radio provided a means of educating the public about STIs and maternal health, while also advertising the availability of services. This medium was advantageous for the NGO, since it resulted in a broad reach of the messaging (i.e. anyone with a radio in Uganda's Ankole region) with the minimum of effort for the HSP staff.

At the same time, there were several limitations inherent to radio shows. The RHVP program was able to augment the one-way nature of radio programs by allowing people to call in, asking about health center locations, treatments provided, and STI symptoms. In addition, the weekly format brought perspectives from different HSPs and testimonies from clients. However, all of these efforts would be in vain if people chose to listen to other radio stations or not to listen at all. Behavior change campaigns and advertisement flyers distributed to the HSPs and the community-based voucher distributors were used to increase awareness. And, while radio is useful for education, addressing misperceptions, and dispelling myths, it is less useful for more personal logistical conversations around payment and claims processing. The use of other media increased the efficacy of the radio program, but the media needed to be used appropriately.

5.3.2   In-person Conversation

Why do people converse in-person? Having this type of conversation entails a physical meeting, and often implies single-tasking, as the two people focus on their conversa-

tion. The onus of a 'physical' meeting is especially high for the geographically-distributed RHVP project. In 2007, the average travel time for an HSP to reach the PMO was 3.5 hours. As the program expanded to further and further districts, many HSPs *never* visited the PMO. The furthest HSPs was located over 430km away, a distance that would take all day to travel by public transport. For the NGO, in-person visits to the HSP facilities was a necessary component of program administration. The sales teams would visit each facility once or twice a month to deliver communications or pick up forms. The medical advisor and PC would visit facilities less frequently to conduct surprise inspections. As a result, in-person communications at the facilities was possible, but infrequent. Indeed, this frequency was further aggravated by the irregular schedules of the HSP clinicians. Since these visits were often made without forewarning (hence the 'surprise'), the NGO staff might arrive to an empty facility, and end up waiting for the clinician to come from home, or being required to bypass the facility altogether. Even within the NGO, a physical visit entailed 4-6 hours of travel between Kampala and Mbarara and arrangement for overnight accommodation. Despite the constraint of physical co-location, in-person conversation remained an important means of communication between all stakeholders in the program.

In-person conversations are important because of the richness of the information that can be exchanged. Even video-conferencing falls short of in-person exchanges, with research in telepresence often attempting to restore this or that aspect of being in the same location (Buxton, 1992; Nguyen and Canny, 2005). In-person conversations encourage shared attention – in which an HSP might direct the HSP staff to immediately address an issue important to them (e.g. payments, medical queries). In addition, non-verbal cues might lead conversationalists to trust or not trust one another (Kraut, 1978; Wilson et al., 2006). For some of the same reasons, voice-based phone conversations can be more productive than written and asynchronous communications. Immediacy, shared attention, and trust all make in-person conversations useful when they can be reasonably arranged.

5.3.3 Paper-based Communications

The exchange of paper forms within the RHVP program support the primary 'formal' mechanisms by which the program is run. Sticker bar-code vouchers provided physical validation of a patient or client's involvement. Claim forms, usually submitted in batches of 20, accompanied by a claims summary sheet mediate adherence to the RHVP treatment protocol and payments for services rendered. Claims Summary Reports provide feedback to the HSPs, documentation for the NGO, and enable payments across multiple NGO offices. Payment Advices provide additional documentation of the completion of payment, and help overcome human and bank errors. The program contracts are on paper, consisting of a bound booklet signed by the HSP, a witness, and the program director. In addition, the NGO occasionally sends paper letters to each of the HSPs, such as the letter requesting e-mail addresses.

Paper has a number of key strengths. Compared to SMS or voice communications, paper can convey formality. Letters and official forms carry the letterhead of the NGO, and often incorporate signatures and organization stamps to augment validity. While each of these is not strictly required, they add to the professionalism of the stakeholders. 'Official' paper communications on NGO letterhead also command more attention than informal

Claim Forms

Payment Advices

Facility Name: _____
Bank Account: _____
Amount Paid: UGX _____
Date Paid: _____

Project Coordinator Signature

Amount Rec'd: UGX _____
Date Received: _____

Health Provider Signature

Claims Summary Reports

Figure 5.3: Paper forms used by RHVP

communications like conversations and SMS, due to the rarity and the obvious overhead entailed in delivering the communications, as well as the authentication entailed by the letterhead and NGO staff signature. In addition, paper forms can serve as an official record. Paper forms are not merely persistent, but they are accessible regardless of availability of electricity. For the NGO, claim forms double as medical records and payment requests. Claims summaries and payment advices double as receipts. While a digital document might serve the same purpose - they are not accessible without access to electricity and some sort of device to read the documents. Indeed, use of digital documents generally requires training beyond that normally available to the HSPs.

Paper documents serve as low energy data storage and viewing artifacts. Furthermore, the NGO is able to front-load paper costs. That is, the NGO pays for the paper, printing, and delivery costs, much of which might entail a burdensome expense for the HSPs. Finally, paper documents offer a density of information that would be difficult to convey in conversation or in the 160 character limits of SMS. Claim forms included free-form medical history, as well as lab results, drugs given, and patient details. Claims summary reports encoded and summarized feedback for each of the hundreds of claims submitted and processed each month. For all of these reasons, paper forms retain relevance within the context of the RHVP program.

At the same time, interpretation and documentation of information on paper can be cumbersome and prone to error. While the claim form existed as a structured document, often HSPs would enter additional data in the margins, noting that a patient might be pregnant, or allergic to particular medication. They also left out critical data, including the time of visit and the diagnosis (aka syndrome, as described in Chapter 3)). Claim summary reports were less prone to error, but prone to misunderstanding - the complex document
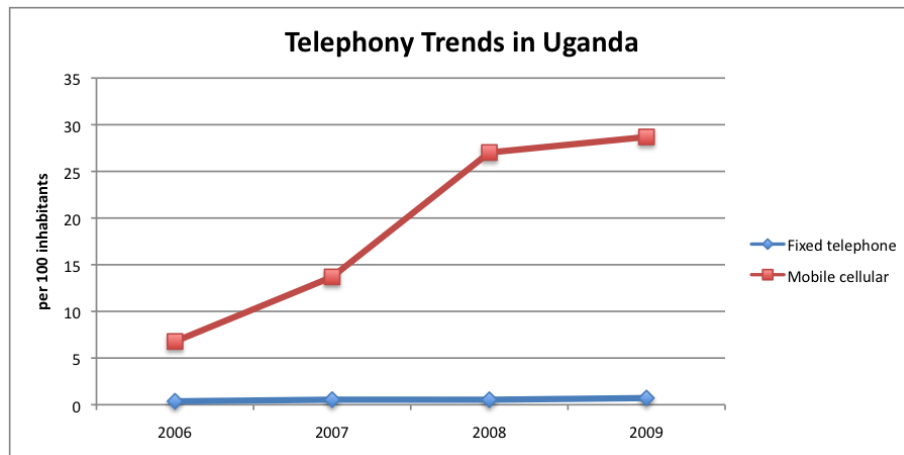
Figure 5.4: Trends in telephony in Uganda show steadily increasing mobile phone owner-ship from 2006-2009. (ITU, 2012)

fared better with in-person explanation of its contents (See Chapter 3 for a discussion of difficulties associated with HSP interpretation of CSRs) . Furthermore, documents could be misplaced, or filed away and forgotten. The presence of the information did not imply its availability. Finally, exchange of these documents was subject to the irregular timings of physical meetings.

While the NGO overcame some of these vagaries by instituting rounds of regular visits to each of the health centers, this monthly interval was not sufficient for the purposes of payment notification and certain types of announcements. Furthermore, these visits often 'borrowed' expensive resources (about USD 100/day per truck) from advertising and ed-ucation campaigns. In instances like contract delivery or price changes, this was deemed necessary, but for others, the overhead was too high. As a result, some of these 'paper' communications began to shift to 'digital' communications, and new types of communi-cations emerged as a result of the low overhead of Bulk SMS. Payment advices and short announcements, containing relatively little information, were transmitted by SMS. Still others, like the claim summary reports, began to be transferred via the postal system.

Each paper document 'purpose' highlights a different strength of this medium. Further-more, paper is versatile; it can be transferred opportunistically during office or facility vis-its, regular deliveries, or even the postal service. On paper, people can share large amounts of (often numeric) information. At the same time, paper is a convenient information storage and access medium, even in places with unreliable access to electricity.

5.3.4   Mobile Communications and Bulk SMS

The ways in which telephony is leveraged in the project changed over time. At the be-ginning, the PMO had two 'fixed mobile' phone lines in the office, one dedicated for the PC's use, and the other used by the rest of the staff for managing program logistics. Un-

HSP Mobile Provider Usage
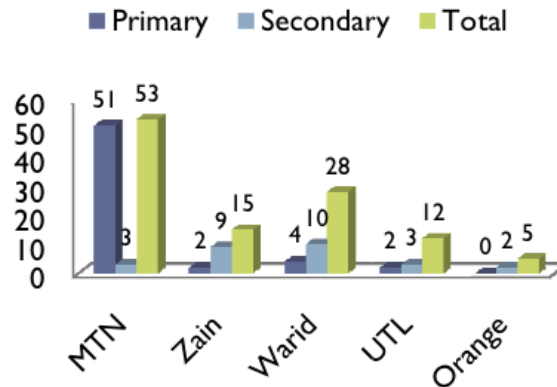
Figure 5.5: While most HSPs used the dominant network provider, MTN, as their primary provider, almost 50% also owned Warid lines by Sept/Oct 2009, just a 1.5 years after Warid's launch.

surprisingly, some HSPs opted to bypass phone charges[2] by sending a 'missed call' (a.k.a beeping) (Donner, 2007). By 2008, the NGO staff opted for a mix of use of the shared fixed mobile line, and using their own mobile phones for communication. Several staff owned a phone dedicated for 'project use'; they could distinguish the source and purpose of incoming calls and text messages based on which phone was ringing, and prioritize their responses accordingly. However in early 2009, the leadership within the NGO (the PC, PD, and PM) identified a gap in documentation. Decisions made over the phone could be questioned or forgotten. In response, the PC encouraged the staff and the HSPs to follow-up on phone calls with a summary text message, eventually launching a Bulk SMS system to serve as a central repository for these messages in October 2009.

What led to these changes in phone use over time? As mobile phone ownership (Figure 5.4) and competition increased, mobile airtime prices decreased. In particular Warid encouraged uptake by offering the Pakalast plan, enabling unlimited calling to other Warid users for just UGX 1000 per day. In contrast, the same amount would allow for only 3-5 minutes of talk time on any other network. As a result, almost half of the HSPs I talked to had Warid lines in addition to their other numbers (Figure 5.5). Even so - prices are not perpetually decreasing or even steady. In January 2010, the cost of Pakalast went up to UGX 1500 per day, and prices on all the networks fluctuated greatly throughout the study. However, even with all of these changes, mobile phone use went from being prohibitively expensive to *affordable* for the NGO staff and many of the HSPs between 2007-2009.

Other factors also influenced uptake of new technologies. The Bulk SMS system emerged out of an increased prevalence of similar systems in Uganda. TextToChange launched its campaign in 2008 (Danis et al., 2010), and the Ugandan version of Ameri-

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[2]At the same time, not all HSPs opted this way. Some people declared 'beeping' to be rude, and surveyed HSPs estimated spending an average of 11000 UGX on airtime calling the NGO.

can Idol encouraged public voting through SMS[3]. In particular, this NGO helped provide health information to support another organizations SMS-based health education program, giving them direct interaction with this mode of communication. Indeed, we received bids from four different SMS gateway companies interested in implementing the RHVP Bulk SMS service. Popularity of the medium and availability of in-country, affordable expertise lent to the ability of the NGO to innovate by integrating a customized SMS gateway into their program.

> NGO has sent you an email on revision of service delivery costs. Please retrieve email and confirm receipt. Thank you (March 16, 2010)

> Hello service provider, please check your post office mail for your payment summary reports and review letter from NGO.Confirm receipt. Thx. MGT (March 23, 2010)

> am stil wating ad up nw hv nt receivd any leter frm the yo ofice via ma box numbr address. bt i wish u use ma email addres *email@yahoo.com* its post ofice pple a not eficiet. bt i wl agree wth yo new terms (April 2, 2010)

> *Am still waiting, and up [till] now have not received any letter from your office via my p.o. box number address. But I wish you used my email address ***. Post office people are not efficient. But I will agree with your new terms.*

For all of its advantages (e.g. convenience and accessibility), Bulk SMS did not fulfill all the needs of the RHVP program. The short format of messages limited the amount of and types of content, making it less suitable for claim summary reports and medical consultations. At the same time, Bulk SMS could be used to augment the accessibility of other modes of communication, notifying the HSPs of program-relevant emails and postal communications. The NGO drew upon the Bulk SMS system when appropriate, but also used other mechanisms in parallel to communicate, according to the differing preferences and constraints of the HSPs.

5.3.5 Email

The ways in which people used the Internet also changed over time. The number of Internet users in Uganda steadily increased throughout the period of this study (See Figure 5.6) (ITU, 2012). Even within the NGO offices, the number of computers and provisioning of Internet increased, in relation to the number of staff that needed to use the Internet and according to cost of the service. Table 5.2 shows the provisioning of Internet in the two offices over the course of the project. The PMO switched between three different Internet Service Providers (ISP), each offering different services at different prices. As the number of staff increased, and Internet-based communications increased in importance, so did the willingness of the NGO to pay for additional bandwidth. However increased advertised connection speed did not always correlate with increased experienced throughput. Each ISP (WiMax A, WiMax B, and DSL C) had its own characteristics with respect to technology used, reliability, and pricing plans. As a result, the links responded differently

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[3]I personally voted for an associate by SMS in the Congolese televised singing competition.
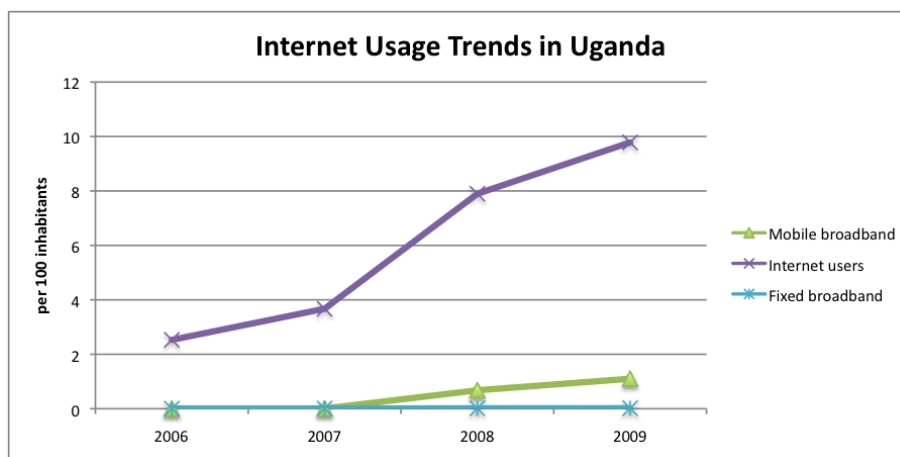
Figure 5.6: Trends in Internet, mobile, and fixed broadband users in Uganda 2006-2009 (ITU, 2012).

to over-provision, becoming unusable at certain times of day or even charging additional fees for overuse. NGO staff learned to cope, while the management weighed Internet utility against budget restrictions.

While the NGO used email throughout, other Internet uses also emerged. After the addition of several HSPs 2009, there was increased use of email for medical queries, document exchange, and other monitoring tasks, especially with HSPs who accessed the Internet once a week or more. While the claims databased and data entry tasks stayed largely local (i.e. the data entry clerks were generally co-located with the database server), improved Internet service provision also enabled increasing dependence on web-based applications, like their bank's web interface for submitting EFT requests, and the web interface for Bulk SMS. Internet chat enabled low-cost conversations and status requests across the NGO's multiple offices (Nardi et al., 2000).

However, despite NGO uptake of Internet-based activities, Internet access within the HSPs was not universal. Figure 5.7 shows that, as of late 2009, 43% of Maternal Delivery HSPs and 30% of STI HSPs had never used email. Out of the surveyed HSPs, 43% had no computer training, 38% could turn on a computer—only 19% of HSPs felt confident using computers and about 20% had ever used mobile Internet. An attempt to encourage adoption with a paper edict fell flat, and the NGO switched to use of the postal system to deliver Claim Summary Reports.

E-mail, while useful for sharing documents and for communicating over long distances, also bears a number of inconveniences. I have already discussed the changing Internet situation at the PMO. Network outages and under-allocation of bandwidth characterized *unreliability* of email for day-to-day use, and eventually led to purchase of more bandwidth. However, for most of the HSPs, purchase of local Internet was not an option. Instead, they travelled to nearby towns, where they could access Internet cafés, and people that could help them check their email and open documents. At best case, they could analyze their records generate reports, printing relevant documents. Others required Internet shopkeepers to open the Yahoo! Mail website, and enter usernames and passwords on their behalf. Still others might arrive to find out that the power was out, or that the Internet connection

	HQ Internet		PMO Internet		PMO Staff
	Service down/up	Cost (USD/month)	Service down/up	Cost (USD/month)	
2007	WiMax B 128/64	650	DSL C 115	50-100	6
2008	WiMax B 256/128	1500-2000	WiMax A 2048/32 DSL C 115	10-50 50-100	6-9
2009	WiMax B 256/128	1500-2000	WiMax B 64/64	USD 300	10-12
2010	WiMax B 256/128	1500-2000	WiMax B 128/64	USD 650	12-15

Table 5.2: The NGO changed Internet service providers and bandwidth selection throughout the project. This table shows the changing ISPs and upload/download speeds for the HQ in Kampala and the PMO in Mbarara.

was temporarily down. Furthermore, was not clear to whom these HSP clinicians would be sending e-mails, besides the NGO staff, and perhaps me. The onus of travel, service fees, unclear benefits, and lack of confidence with computer skills combined to discourage the use of Internet.

> *Early on, Andy attempted to use email, but 'dumped it' because he could only check it by traveling to Mbarara, 2-3 hours away by public transport. It was too difficult to know when he had received mail and to read all of his messages on a regular basis. He abandoned that account and has since opened a new account, which he checks with the help of his lab assistant. However his lab assistant has taken on a new position in Mbarara and is no longer available on a regular basis. As a result, Andy primarily communicates using his mobile phones.*

Another interviewee noted that she only checks her email when her supporting NGO calls, telling her that they have sent an email that they want her to see. Out of the HSPs who check their email at least once a month, they travel an average of 15.8 km and pay an average of 3000 UGX (~USD1.50) per hour to use Internet in the nearest major town center. For many NGOs, e-mail was unreliable, time-consuming, and costly.

The survey indicated more frequent Internet usage amongst the STI voucher HSPs than the delivery voucher HSPs (Figure 5.7), which can be explained by differences in geographical distribution. The delivery voucher HSPs are spread out over a much larger number of districts, including many rural areas without access to power, while the STI HSPs were generally located in much more developed districts. Ultimately, the NGO would deliver all official communications by Bulk SMS, postal service, and courier (i.e. via staff visiting health facilities), duplicating information by email for the HSPs that maintained communications by and expressed a preference for email.

Baseline Survey: Self-Reported Frequency of Internet Usage
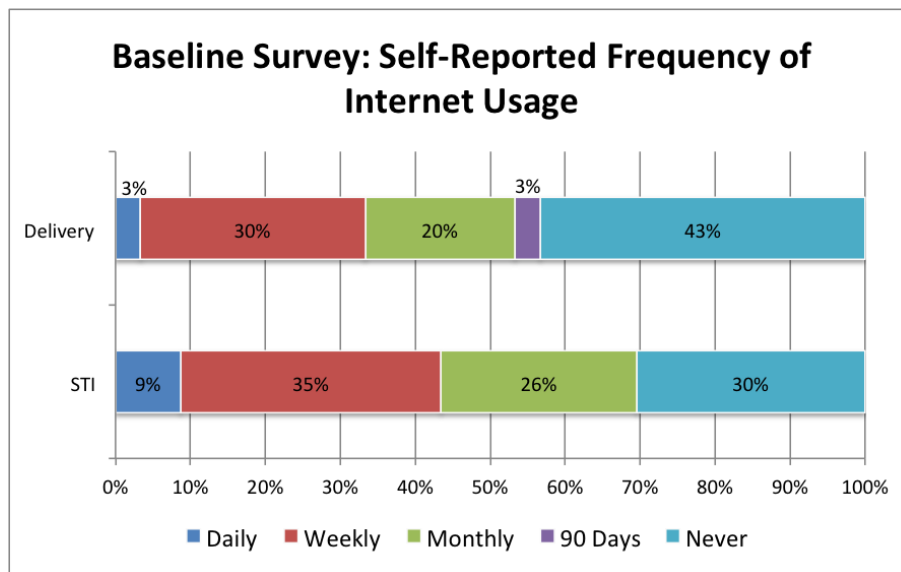
Figure 5.7: This graph shows the distribution of Internet usage frequency amongst the STI and the Maternal Delivery HSPs. Less than half of the HSPs participating in Fall 2009 used the Internet regularly, with over a third *never* using the Internet.

5.4 Communication Scenarios

As detailed in Chapter 3, communication is a critical component of the RHVP program. Without communication, the health service providers (HSPs) may feel isolated and disengaged from the program. Effective communication enables the NGO to create and maintain working relationships, in spite of the obstacles that occur especially often in developing regions. In this section I present several scenarios from my observations, and describe the ways in which they demonstrate the characteristics of braided communications.

5.4.1 Continuing Medical Education

As part of the program, the NGO offered training workshops to participating and interested HSPs in 2006, 2008, and 2009. In these multi-day workshops, the NGO trains the HSP staff on medical procedures, the claims process, and what will and will not be reimbursed by the program. The sessions also served as an opportunity for the HSPs to share experiences with one another, and for HSPs that had been in the program to talk up the RHVP program to the new participants.

However, even with a comprehensive training program, there were conflicts between the HSPs and the NGO over appropriate treatment protocol and, subsequently, claims reimbursements. The HSPs were being asked to treat patients based on lab investigations instead of symptoms. In an environment where patients and the HSPs wanted to minimize costs, it seemed like conducting lab tests constituted an unnecessary expense. Furthermore, treating patients with weaker (albeit less expensive) drugs, and asking them to come back seemed pointless when a stronger (more expensive) drug would be more effective. Patients often wanted the stronger drug - so they would not have to come back. This was especially

problematic when HSPs experienced staff turnover. New staff were not familiar with the RHVP treatment protocols, and often submitted invalid claims as a result. This new model in which lab tests were required, particular drugs were indicated for treatment, and patients were required to return for follow-up visits to confirm whether or not they had been cured was counter-cultural.

To deal with this gap between HSP practice and accepted protocol, the NGO worked to detect problems as they appeared in the claims forms, contacting the HSPs over the phone or with in-person visits to explain proper protocols:

> Immediately you see it on the form while vetting. There is usually a standby telephone, so you call the provider and discuss why you have to do that, so they tell you why. You make a decision. So usually I get in touch with them over the phone, when they come here at office, and we discuss their vetted forms. So they go and are satisfied with what we have vetted, what we have calculated for them, what we have deducted.

> At least for every rejected form, if he's making a common mistake over forms, over several forms, there is an urge to call them, while vetting. You can't wait until they realize that some set of money was reduced from them. You call them immediately so they are aware when they find a deduction. So you call them and discuss with them why they had to do some particular changes, why they had to do - you know? Prefer certain treatments to others, certain laboratory test that are not recommended. So they explain to you - and they usually have very funny excuses ... and you say this is not allowed then.

> *Interview with Medical Advisor, November 2007*

The medical advisor has one main task: 'vetting', in effect, verifying the claim forms for validity. This entails going over 3000 forms per month, checking for math errors, missing information, and inconsistent treatments - for example, treatment given for an STI despite a negative test result, or a second-line drug being given without adequate reason:

> If you do not have a reason for giving a second line, and it is not indicated anywhere on the form, don't expect any money. If that mother is pregnant, if someone is hypersensitive to penicillin then give that. Someone cannot tolerate benzathine, give us a reason why... Because there is a erythromyicin dose is around 12,000. So if you cut around 20, then you will not repeat the same thing, because you cannot stand losing money on that.

> *Interview with Medical Advisor, November 2007*

In the process of vetting, the medical advisor must balance a number of factors. Primarily the goal is to catch attempts at fraud - HSPs submitting forms for patients who are not there or submitting false results. In addition, the advisor enforces adherence to the treatment protocol, designed to reduce costs while ensuring adequate treatment. This is especially problematic for HSPs just starting with the program - they are required to produce additional documentation and provide different treatments than they would normally

prescribe. However - once enough payments have been 'cut' they begin to conform to the protocol, or resign from the program, and all the potential income associated with it. At the same time, the RHVP needs to keep all their providers, in order to meet voucher targets. Alienating them by refusing to pay for services and treatments already given would result in fewer treatments given and vouchers sold. As a result, the medical advisor, together with the project coordinator work at a second task: maintaining HSP relationships by negotiating claims payments. This entails 'continuing medical education' and 'surprise inspections' through phone calls, visits to the health centers, and conversations at the NGO offices.

Continuing medical education has a number of affordance requirements. The goals are to improve adherence to treatment protocol, to enable timely notification of errors that might affect reimbursements, and to assess the health facilities to determine whether they are maintaining the required standard of care. In some cases, *immediacy* is required - to prevent additional errors from occurring. In general, *specificity* and *trust* are important. Education and behavior change require sharing of relevant information. In addition, *responsiveness* enables clarification of concepts, and verification of understanding.

Both phone calls and in-person visits afford responsiveness. As one HSP remarked, phone calls are *direct*, and one can immediately know whether actual communications have been established. At the same time, it is clear that in-person visits afford *more* of specificity and trust than phone calls. At the same time, phone calls are *immediate* (assuming that the person is reachable) while in-person visits required scheduling of a vehicle and travel to the health facilities. As an additional constraint, the desire to overlap these continuing medical education visits with surprise inspections meant that, for the HSPs the visits were unscheduled. As a result, sometimes the HSP staff were not available when the NGO staff arrived.

For calling the HSPs, the medical advisor used a 'standby telephone', that is, a fixed mobile line[4] sitting in the receptionist's office and shared by all the staff in the program office (the project coordinator has a dedicated line). Next to it was a register with the names, phone numbers, and sometimes mailing addresses for all of the people that had attended the training sessions. Every few months, the phone would become unavailable until the finance officer had an opportunity and funds to pay money into the account. More often, use of the phone was merely inconvenient and intrusive, entailing working in someone else's office, and breaking up the momentum of reviewing forms. While the standby telephone was generally an immediate means of reaching the HSPs, the constraints of location and finances sometimes made it unavailable or inconvenient. However, for the purposes of the project, use of the phone was free to the staff. From observation of the use of the standby phone, it is apparent that continuing medical education also has an affordance constraint of affordability on the part of HSP staff, availability of the phone, and convenience.

When I returned in 2009, I noticed that while their objectives remained the same, the ways in which they achieved these objectives were slightly different. Phone calls were still used to follow up on inconsistent claims, but the new medical advisors were using personal mobile phones in addition to the standby phone. The project coordinator and the

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[4]Fixed mobile lines are desktop handsets that require external power adapters, and use the mobile network instead of landlines. They are often connected to an external antenna as well.

Figure 5.8: The Evolution of Claim Summary Reports

primary medical advisor began to use SMS messages, both in response to HSP queries about allowable claims, and to confirm agreements made over the phone or in in-person conversations. A few key changes led to these developments. First, the culture around keeping personal information private changed. Staff in highly communicative roles (i.e. coordination, medical advice, payments) began to maintain an extra phone dedicated for use by the HSPs and RHVP-related calls. They could more easily account for money spent for project airtime, and had the option of prioritizing incoming messages or phone calls based on which phone was ringing. Secondly, calling rates changed significantly with the establishment of a new mobile service provider, Warid Telecom. When an issue arose, they would ask around the room - "Who has pakalast?", and someone would volunteer their phone. 'Pakalast' referred to a promotion offered by a new mobile provider: Warid Telecom. Mobile phone owners who had a Warid line[5] could pay UGX 1000 (USD 0.50) for unlimited calls to other Warid phones for the entire day. Suddenly, instead of reserving the mobile phone for short calls, people would share the cost of pakalast, and be able to have conversations. The NGO staff leveraged Pakalast so they could use their own phones without worrying about paying for airtime associated with the phone calls. Lower-cost phone plans addressed some of the affordance requirements around phone availability and cost to HSPs.

Mobile voice and SMS communications did not entirely replace prior practice. Conversations with HSP staff still occurred when they visited the program office. In addition periodic visits and use of the standby phone still continued. The standby phone was a stable option that did not depend on an available and paid-for Warid line. Visits gave the medical advisor opportunity to physically inspect facilities, in addition to discussing problematic claims. The increased number of options, as enabled by new uses and pricing models, greatly facilitated the NGO's task of providing continuing education for the HSPs.

5.4.2 Claim Summary Reports

As part of the claims review process, the data team (i.e. medical advisors, data entry clerks) produce a summary report for each batch of claims submitted by the HSPs (See Section 3.4.4 and Figure 3.6). This claim summary has taken a number of formats, and traversed many different routes, over the course of the project.

Initially, the claims summary report (CSR) was produced as an Excel spreadsheet, with information on each claim submitted, the requested amount, the approved amount, and any reasons for rejection or adjustments to the requested amount. The need to produce an excel spreadsheet in addition to doing data entry in the voucher/claims database was a point of contention between the NGO and the technical agency managing claims processing. Eventually the database was modified to produce an equivalent report automatically. Unfortunately, the database ceased working periodically, sometimes due to technical problems (license expiration), but also due to relationship problems between the two organizations, requiring periodic use of the Excel spreadsheets instead. In 2008, the technical agency (referred to as the CMA in Chapter 3) and the NGO broke off their partnership, and the NGO sought a replacement database. However, even though the NGO hired a new software developer in late 2008, the new database would not be operational until early 2010. In the meantime, the NGO reverted to Excel spreadsheets for both claims processing and producing CSRs.

The purpose of CSRs was to provide feedback to the HSPs, explaining any differences between requested amounts and actual amounts paid. Each CSR listed all of the claims submitted for that month and associated payment information, concluding with total amounts paid. Based on this information HSPs could either changes their practices to make fewer mistakes, or even dispute adjusted charges. Given the importance of the document for program operations, it was necessary that any means used to share this information between the NGO and HSPs needed to be *timely*, *reliable*, and able to contain a dense amount of content. In addition, HSP proprietors needed *sharability*, to be able to easily share and review this information with their staff, to prevent mistakes from occurring again.

Initially, they printed the reports. Whenever someone went out to visit a health facility, they were expected to check for any documents that needed to be delivered, including the CSRs. Or, whenever someone from an HSP stopped by the program office to drop off forms, the NGO would give them the CSR as well. After a while, the NGO began to realize that this ad hoc message delivery was not working. If the HSP was not experiencing any major problems, months would pass by before they received a single visit. This communications strategy was not timely. Even then, the NGO representative often forgot to check for, and bring these forms. HSP staff dropped off forms quickly – they either did not know to check for the forms, or simply forgot in the midst of the many errands they ran when visiting Mbarara. The opportunistic nature of sharing these documents ultimately made this channel unreliable. Finally, once the paper forms made it to the health facility, they were piled in a corner and forgotten. Often other people working in the same facility never saw it. Very rarely, a clinician would assemble his or her staff and review the document and associated claims. This casual mode of delivery spread to a casual perception of the

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[5]The phrase 'Warid line' refers to mobile phone numbers provided by the Warid network through the sale of SIM cards.

importance of the document.

My plan to address this issue was Claim Mobile. I proposed that HSP staff could enter forms on a mobile phone, submit them, and see the results of each form on the phone. However, this required 1) a smartphone for each clinic, 2) additional training, 3) claims processing either in parallel or integrated with the paper process. It also required that the location of the HSP have mobile Internet coverage, and the willingness of the HSPs to add credit for electronic claims submission as necessary. This solution introduced additional constraints and prohibitive costs. Ultimately, Claim Mobile was not the right solution for the changing context of the project.

With the new maternal health program, and expansion of geographic coverage area to more remote districts (See Figure 1.2), the NGO began to try new strategies for sending and receiving documents. First, they hired three full time drivers, and purchased new trucks for them. These drivers, together with sales staff, divided up the health centers into six two-week routes. Over the course of a month, they would visit all of the health facilities, picking up claim forms and dropping off any messages from the project. Unfortunately, many health facilities were only open on market days, and closed intermittently depending on the schedules of the clinicians, who split their time between government hospitals and their private clinics. It was almost impossible for the sales teams to specific an accurate day and time of arrival. Road conditions and schedules were unpredictable. It often took longer than expected to reach outlying areas, and even longer to find the voucher distributors. On these trips, visiting health facilities was a secondary priority; the purpose of the sales team was to advertise the program and to sell vouchers to the distributors. As a result the NGO continued to have difficulties delivering the CSRs to the health facilities in a timely and reliable fashion.

In August 2009, the NGO issued a letter to all of the delivery voucher HSPs, requiring that they provide an email address to the NGO. If they did not have one, they were expected to open an account, and to begin to checking it monthly, at a minimum. Their intent was to use e-mail to send CSRs to all of the HSPs.

Even two months following the edict, many of the HSPs claimed intention of getting an email address, but had not yet had a chance. . In my survey, I found that 33% did not have email and 30% only checked monthly. Only 8 facilities (13%) checked email daily. In this, the frequency of visiting towns with Internet cafes was a big factor. For those that had already opened an email account, their incentive to check it was minimal. They already had frequent communications with the NGO via other means. Checking email entailed travel, and additional expense of renting Internet café time. They rarely had time to review and understand all of the information in the CSRs while in an Internet café, and did not want to spend money to print them out. While e-mail was a very functional and convenient means of sending the documents, it was much less convenient for the HSPs, and failed to afford review of the document with HSP staff.

The NGO faced a classic email problem. While sending out CSRs as attachments via email entailed minimal cost for the NGO, due to network effects, the retrieval of the same reports was prohibitively expensive for the recipients, for the same reason. Many, if not most, of these HSPs had very small (i.e. size one) networks. While their participation in the program provided sufficient motivation to attempt to make a monthly pilgrimage to retrieve e-mails from the NGO, in the end, the costs often outweighed this obligation. It was
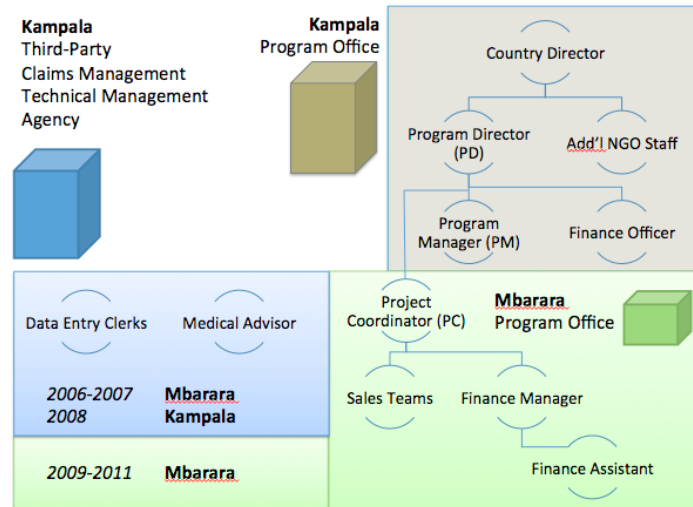
Figure 5.9: RHVP Organization Chart, 2006-2008

functionally impossible to require all of the HSPs to use email as a reliable communications medium.

The NGO ultimately decided to send printed copies of these reports to the HSPs' PO Boxes, which many HSPs also opened as a requirement of being a part of the NGO program. The PO Boxes were a superior solution because they continued to work during power outages, anyone else could easily send documents to the PO Box address, and the reports were already printed upon receipt. To notify the HSPs that they should expect communications in their PO Box, the NGO sends out a short text-based SMS message to each of the HSPs each time they send out a mailing. P.O Box and SMS together succeeded because, while SMS's 160 char messages could not deliver the reports, they could augment the timeliness and reliability of post by notifying the HSP when messages had been sent. If they also added email, for HSPs that had access to email, the triply combined channel would be even more effective.

5.4.3 Payment Processing across Multiple Offices

In addition to its role in client education, the CSRs are a critical component of claims processing. Once the claims summary reports are prepared, the program office also sends the documents to the head office in Kampala (See Financial Management Agency in Section 3.4). In the head office, the finance officer is in charge of disbursing the payments to the HSPs. In this section I will talk about the various means that the PMO and the CMA used to share the CSR with the head office in Kampala, using the concept of affordances to explain the evolution of this communications task.

The NGO head office is the base for all of their operations in Uganda, of which the RHVP program is just one component. Due to its location in Kampala, as well as the need for infrastructural stability in its day-to-day operations, this office has a faster Internet connection than the program office, as well as more reliable power and general communi-
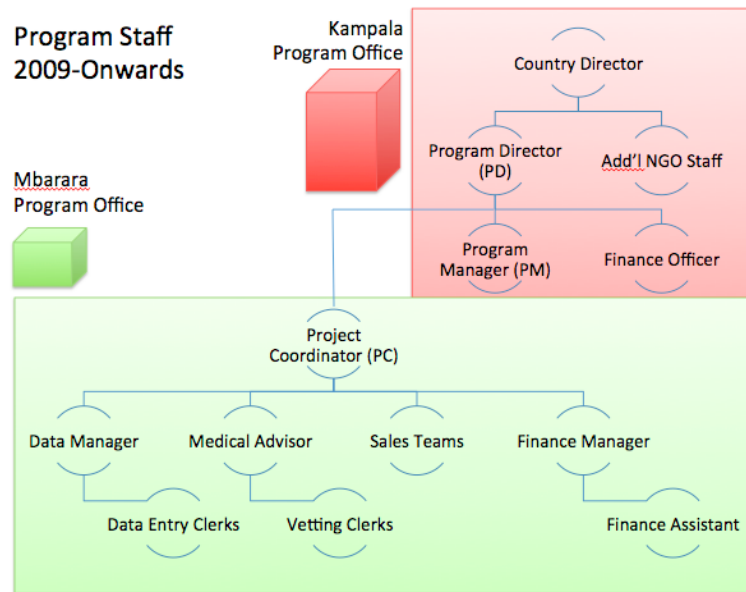
Figure 5.10: Consolidated RHVP Organization Chart, 2009-2011

cations. However, its location and status does not make them immune to Internet outages. The Internet would go down periodically, sometimes due to power outages, but more frequently due to problems with the Internet Service Provider (ISP). Overall, however, it was better off than the program office, where the Internet connection was under-provisioned for the number of staff in the office[6].

Despite this imbalance in quality of Internet services, email and eventually chat were a strong component of communications between the two NGO offices and the third-party claims management agency (See Figure 5.9 for a diagram depicting location and staff relationships). The data managers would email the CSRs to all the key staff in both NGO offices, as well as their superiors in the CMA office in Kampala. The program director could send a quick message to ask for status reports from the Mbarara office. Even within an office, staff would send messages to one another to quickly check on minutiae. Given that Internet infrastructure was already budgeted, emails and chat messages were preferred over phone calls - which were allocated a much more limited budget. In terms of affordances, Internet communications were both convenient and low cost.

And yet, even though all of these mechanisms were useful, they did not obviate the need for in-person visits. The program director (PD) and project manager (PM)[7] would visit Mbarara for a few days every month. The PC, while based in Mbarara, travelled to Kampala each weekend to be with his family, who lived in Kampala. He took advantage of his trips home to drop by and check in with the PD at the NGO HQ.

It transpired that e-mail, while convenient and immediate, led to miscommunication

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[6]This under-provisioning was due in part to differences in how the two offices were budgeted. The need to minimize RHVP operational costs led to slow provisioning of Internet, and a reluctance to purchase additional bandwidth to accommodate the growing number of staff in the office.

[7]The PD and PM were based in the head office in Kampala. The project coordinator (PC) was based in Mbarara.
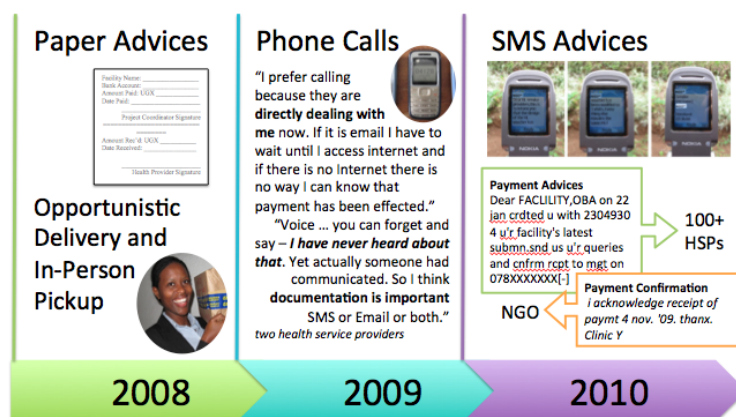
Figure 5.11: The Evolution of Payment Notifications

and, sometimes, 'lost' CSRs. Every few days, the Data Manager would send these completed reports by email. Sometimes, these emails were missed, or one of the many attachments was not downloaded by the PM or the Finance Officer in Kampala. As a result, HSPs would not get paid, and voucher sales might be under-reported. Initially these errors would be resolved by discussion and additional exchanges of documents. However this management overhead proved to be cumbersome. Once the NGO took control of the claims processing (See Figure 5.10), putting data management under responsibility of the PC, the PC (Mbarara) began to print all of the CSRs, physically bringing them to the HQ in Kampala every Monday morning. These 'official' copies would then be duplicated for relevant staff, and filed away. Renegotiation of this process occurred as the *invisible constraint* of *organizability* of the claims data. By physical processing the CSRs, the NGO took advantage of the already existing physical transportation channel (i.e. regular PC visits to Kampala), and enabled physical organization of the files in a more convenient way than that afforded by email communications. Interestingly, while normally physical transport of the claims would be significantly more costly than using email, the fact that the PC was already traveling to Kampala on a regular basis essentially made this channel free.

The NGO staff constantly adapted their strategies staying in communication across multiple offices, leveraging phone calls, email, Internet chat, and even in-person visits to exchange information and acquire status reports. While initially use of the phone dominated exchanges, the provisioning of and increasing familiarity with Internet applications enabled the NGO to shift more day-to-day tasks to this differently-budgeted (although not less expensive overall) medium. However, the lack of structure entailed in e-mail, combined with the change in structure of the RHVP program, led to use of in-person sharing of paper documents to support the multi-office administration of claims payments. Throughout, the NGO staff, and the program director in particular, responded to needs of the program by integrating new and old approaches into their processes.

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5.4.4 Payment Advices

Once the payment had been calculated and paid, the NGO sent payment advices (a.k.a. payment notifications) to each of the HSPs, indicating the amount of payment and the date of payment. With this information the HSPs could check their bank accounts to verify that the payment had successfully gone through. If not, the two parties would verify the bank account number and location, making corrections and repayments as necessary.

Payment advices served as receipts for both the NGO and the HSPs. Since claims processing took 15 days at minimum, and several weeks in many cases, this document theoretically let the HSPs know that their claims had been processed - and that money would be available in their bank accounts once the electronic funds transfer (EFT) had been completed. For the NGO, the signed notification also served as documentation from the HSP that the payment had been received. Without it, the HSP might be able to complain that they had never been paid, even if they had been. As noted earlier, these payment notifications needed to be timely, legible, and reliable. In addition, the HSPs needed to be able to acknowledge the advices conveniently and reliably.

At the start of the program, payment notifications took the form of half-sheets of paper, which were delivered, signed, and returned opportunistically. Once the payments had been made, the project coordinator (PC) would print a form, handwriting payment-specific information. The PC would give these forms to the HSP staff if they visited the PMO. Or, the PC would take advantage of facility visits, and deliver the forms then. Often, these visits might not align well with payments, so several weeks would pass by before the HSP received the payment notification. This was especially problematic for 'compliant' HSPs, who were visited less frequently, and often never realized that a payment confirmation was available for pickup at the PMO. To compound this, HSPs often could not sign the advices immediately. They needed to cross-reference the information with their bank accounts. Since many did not receive printed bank statements, these HSPs often needed to travel to their bank branches to confirm that the payment had been processed successfully, before they could sign the advices. This task added another several weeks to the extended ad hoc exchange. Indeed, a review of payment advices shows that many were signed as much as six months after the fact. Examining this strategy, it is apparent that ad hoc delivery of payment advices was neither timely nor reliable. In addition, sharing of payment acknowledgements was similar - exhibiting the same problems as were apparent in the sharing of the payment advices.

By 2009, the NGO had adopted a different approach. For each payment made, the NGO would call the HSPs to tell them that their payments had been processed. This mechanism was mostly functional. However, for HSPs that had frequent power outages, or no power at all, the NGO needed to call them many times until they were able to reach the HSP. Because a phone call is inherently duplex, confirmation of receipt of the information was built into the mechanism:

> I prefer calling because they are directly dealing with me now.

At the same time, these phone calls were not perfect. In addition to the overhead of repeated calls to the HSPs, the voice-based calls fell short with respect to documentation needs of the NGO and the HSPs:

Voice - you can - forget and say 'I have never heard about that'. Yet actually someone had communicated. So I think documentation is important: SMS or Email or both.

The NGO chose to abandon legibility in favor of timeliness, making the payment advices less useful for the HSPs, and introducing *uncertainty* about the information. In the HSP survey conducted September-October 2009, I learned almost one-third of the HSPs preferred to received these payment advices by SMS (See Table 4.11). Yet, while this channel would increase legibility for those HSPs, it was not convenient for the NGO to manually enter all of the notifications into personal forms. In addition, this was a worse solution for those that preferred voice-based notifications. At time, about half (25/53, 47.2%) of the HSPs expressed a preference for voice-based payment confirmations. In spite of this feedback, the NGO shifted to an entirely SMS-based notification.

In November 2009, the NGO began using an SMS gateway to send the payment notifications. To submit payment requests to the NGO's bank, the finance officer in Kampala would prepare a spreadsheet listing the HSPs, their bank account number, and the amount to be paid. This spreadsheet would then be uploaded via the bank website, sending payments by electronic funds transfer to all the parties involved. From there, the data manager in Mbarara would cross-reference each payment with the phone numbers of the HSPs, duplicating information if the HSP had multiple listed numbers. This cross-referenced spreadsheet could then be uploaded to the Bulk SMS system, and used to fill in the template for mass notification of the paid HSPs. (See Chapter 4 for details.)

In response, the HSP might send back a confirmation that the payment had been received. However, in practice this did not happen - in 6 months, the HSPs only 6 payment acknowledgements to 589 bulk sms-based payment notifications. Confirmation of payment receipt was an integral part of the paper-based process; however, over time, it was recognized as being less necessary than the notification. Daily practice and ongoing engagement with the HSPs led the NGO to realize that payment acknowledgements were not universally necessary. As a result, the affordance requirements for payment notifications changed, and Bulk SMS was still considered adequate, despite the sparse number of payment acknowledgements sent using the system. Instead HSPs followed up when 1) payments were late or 2) they were notified of a payment, but had not received it, such as:

> thx 4 de payment of 4,829,600 whc was received on 6-12-2009. however, accordg 2 us, u still have a debt of shs 11,412,100. being submissions of oct and nov.09. mgt is thinkg of haltg yo services till clear de debt (December 30, 2009, 1:43 PM)

> *Thanks for the payment of USD 2,300, which was received on Dec. 6, 2009. However, according to us, you still have a debt of USD 5,434 – being submissions of October and November 2009. Management is thinking of haltng your services till [you] clear the debt.*

> we received a msg early ths morning that mane had been deposited bt its nt reflected on the account (April 1, 2010, 4:15 PM)

> *We received a message early this morning, that money had been deposited, but it's not reflected on the [bank] account*
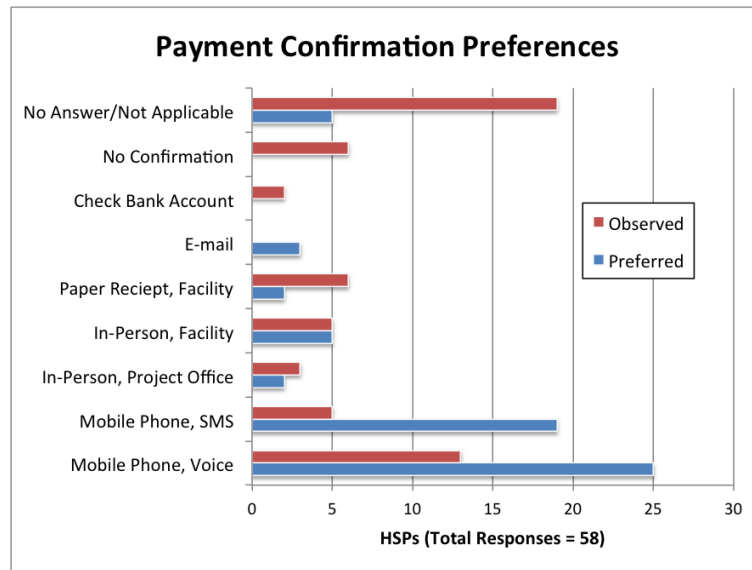
Figure 5.12: Payment Confirmation Preferences

Actual 'missing' payments might occur when the HSPs first joined the program, if they provided incorrect bank information. This was usually caught within the first round of payments, and corrected. In some cases, this recurred when HSPs changed banks.

Often, these 'missing' payments had actually been processed correctly. Processing of the EFT payments usually took at least 2-3 business days. However, for certain banks, especially smaller or more rural banks, the payments would be received a week or two later. The payment notifications were especially necessary for the HSPs to differentiate between late payments, delayed bank processing, or actually missing payments.

As a result of missing payments in various forms, the payment confirmation process is actually an extension of the payment process. While electronic funds transfer is generally reliable, the NGO uses payment confirmations to address the instances in which it is not. A notification by paper, phone call, or SMS starts an exchange in which HSPs can verify whether a processed payment has actually been received, and resolve any problems if it has not. This mechanism also addresses the unreliability of the payments themselves. Referring back to Chapter 4, while payments were expected within 15 days, they often occurred months later (See Figure 4.3). Lack of notification largely indicates that the payments are late, often prompting *complaints* from the HSPs, during in-person visits, over phone calls, and by SMS. Sometimes, to pre-empt complaints, the NGO would use the Bulk SMS system to broadcast notifications that the claims were still under consideration, but not yet processed. These regular 'encouragements', in the form of *apologies* from the NGO, and *complaints* from the HSPs, reassure the HSPs that a payment will be made eventually - that the entity responsible for payment still exists and considers themselves liable for payment. Using the variety of available communications mechanisms, the NGO and the HSPs ensure the successful (if belated) reimbursement of claims.

Even though, with respect to payment inquiries, each channel is used for the same purpose, they all have different affordances for the HSPs. In-person visits are viable only for facilities relatively close to Mbarara, and, for them, part of the regular mechanism of claims

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submission. Phone calls can be made by any of the HSPs (all of whom had confirmed mobile ownership), but were often subject to the vagaries of power and coverage availability. For HSPs in areas without grid power, their phones were often off if not in use, to conserve battery. Likewise, when the NGO staff were in the field, typically several days at a time, they were often out of battery, out of coverage area or both. This remained a problem for use of the Bulk SMS system. SMS worked as a 'delay tolerant' or asynchronous communications mechanism—an improvement over voice, which required an 'active' connection between the caller and callee. However, messages sent to phones that were off for several days were dropped silently, and the project coordinator and medical advisor felt that they could not respond to received messages unless they were in the office, with access to a computer with a web browser. Three surveyed HSPs preferred to receive payment notifications by email (See Figure 5.12). Two were facilities with multiple computers, and access to Internet in the hospital, and one was a facility owner who checked email twice a week in Mbarara, about one hour away from his clinic. For the majority, receipt of this information by email was significantly more inconvenient, with one proprietor stating:

> I prefer calling because they are directly dealing with me now. If it is email I have to wait until I access internet and if there is no Internet there is no way I can know that payment has been effected.

Each mode of communication does not exclude others - but use of multiple mechanisms results in added convenience and accessibility for the participants involved.

5.5 Conclusions

In this chapter I have used the changing context of the RHVP project to illustrate the characteristics of *braided communications*, in which many channels of communication combine to achieve more effective communications. This concept emerges out of a methodological approach: understanding information technologies as being embedded in communicative ecologies, and a technical understanding: reliable communications requires redundancy and reinforcement (See information theory (Shannon, 2001; Gleick, 2011)). Information systems literature analyzes organizational change (Keen, 1981; Markus and Robey, 1988) and technological change (Gleick, 2011), some suggesting that static approaches do not adequately handle change, and that a *process approach* enables flexibility and improvisation (Richard Heeks, 2002). The RHVP project admirably demonstrates both, and braided communications explains why each information technology improvisation was approached and adopted in turn. Hannan and Freeman document the relationship between structural inertia and successful organizational change, situating it in and ecological-evolutionary process, but their work focuses more on the adaptability/evolution of the organization, and less on the evolution of the information technology itself as a requirement for adaptability (Hannan and Freeman, 1984). Similarly, management literature often suggests that *better management* will lead to successful change (Burns and Stalker, 2009). Yet, better management is often limited by the ability to understand the technical processes being managed.

Ultimately, it is the 'how' of technology adoption and adaptation that is relevant to the technical community. How do new technologies integrate into existing systems? How do processes change or stay the same in response to new technologies? How do we build information technologies that will ultimately work - that is, that will be adopted successfully and actually address issues of poverty and development? Braided communications recognizes that new technologies do not just replace old processes, but they are integrated, and re-integrated (or not) in response to changing needs, changing context, and changing technological availability. The mechanisms of mutually reinforcing technologies explain how different communications channels are integrated, as well as motivations for continued change in technology use. While management and flexibility are important, braided communications attempts to offer a motivation for flexibility and a direction for management.

Braided approaches are especially important for developing regions. In areas where the context of financial viability, prior training, and infrastructure can widely differ, redundancy enables this NGO to reach a wide variety of HSPs. Reinforcement enables sometimes intermittent channels such as email and postal service to be come more usable. And finally, technology solutions are not static; their affordances and constraints change with context and over time, and new technologies are always emerging. Solutions and processes should plan for both present context and future change.

THE FAILURE OF CLAIM MOBILE

It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change.

—Charles Darwin

Information, communications, technologies for development (ICTD) projects endeavor to use information technologies (ITs) to disrupt the pace of development. We use the term "leapfrog" to propose that some countries might be able to skip over the tedious and expensive (and already outdated) process of introducing landlines, and directly move to cellular/mobile communication (Keniston, 2003). As information, communications technology and development (ICTD) and human computer interaction for development (HCI4D) researchers, we emphasize the importance of context and 'understanding the user needs' when designing our interventions, suggesting that effective application of participatory and user-centered design methodologies will lead to technologies that will work in challenged contexts (Muller and Kuhn, 1993; Vredenburg, 2002). Years of research shows that the introduction of new technologies is anything but simple; however, we still hope that the introduction of technology will speed up human development in a way that more traditional aid-based development programs have not been able to achieve (Brewer et al., 2006b; Ho et al., 2009).

It is with this understanding that I began my research collaboration with the Uganda Reproductive Health Voucher Project (RHVP), partnering with a non-governmental organization (NGO) to use mobile phone technology to improve form processing, to address communications gaps, and to better understand social dynamics around the introduction of new technologies. While the needs assessment and initial pilot deployment of my proposed technology generated positive results (See Chapter 3) it became apparent over the course of subsequent fieldwork that integration and scale-up of the pilot would be problematic. Furthermore, the NGO had addressed key inefficiencies in communication I had hoped to address with a mobile phone application, by changing their program management practices in the meantime.

In the remainder of this chapter, I will discuss the circumstances around the development, deployment, and ultimately my choice to 'fail' Claim Mobile. I suggest that 1) the suitability of interventions for a particular context may change over time and 2) simpler technologies and program management techniques are often more suitable than the complicated new technologies intended to replace them. The RHVP was able to address

inefficiencies in their program with their own solutions more effectively than with Claim Mobile. Furthermore, I propose that appropriate user-centered design should go beyond design of technology, and consider wider contextual issues, allowing for the option of failure for the proposed technology when relevant.

6.1 Motivating Claim Mobile

6.1.1 The Reproductive Health Voucher Project

While the RHVP program held a lot of potential on its own, Claim Mobile's purpose was to address a few issues inherent to the program design. This primarily paper-based process entails a lot of paperwork, and is subject to significant user error, with financial penalties entailed. With frequent power outages and varying mobile phone network coverage one of the primary ongoing issues in the project is communication between the MA and the HSPs. The MA often resorts to in-person visits to follow-up on or verify information communicated over the phone. However, the program involves people from a widely dispersed geographic area, including the head office of the MA in Kampala, the capital of Uganda, 270km northeast of Mbarara, the trading town around which most of the project is based, and where the project offices are located. In-person visits to health facilities are costly and time-consuming.

6.1.2 Claim Mobile

Claim Mobile had two components, a web server and mobile application. The web server served as the repository for all of the claims, and the main interface for the management agency and their partnering stakeholders. Depending on computer and Internet availability, HSPs could use either the mobile phone application or the website to enter and access their own claims. (See Chapter 3 for more details.)

Features

One of the primary features of Claim Mobile was claims submission, the ability for HSPs to enter and send claims to the MA, and for the MA to then review and make payments on the claims. Our initial needs assessment (2007) revealed that problematic paper claims usually entailed incomplete or inconsistent claims. Prescription drugs given did not match lab diagnosis results. Vouchers, date of treatment, and even patient demographic info was missing. Fees were recorded and calculated incorrectly. I addressed this by using pre-filled checkboxes to reduce text entry, limiting answers to valid options, and pre-calculating reimbursement amounts (MacKenzie and Soukoreff, 2002). This also aided HSPs by educating them on proper treatment protocols.

I also found that HSPs felt disengaged from the RHVP program because they often did not know whether their claims had been approved in a timely manner, or which claims had problems (See Section 3.4.5). I attempted to close the feedback loop by enabling status updates on each claim. As various people in the MA reviewed the claim, the status would

be updated. Should it not be approved, the HSP and the MA could use the feedback feature to discuss the status of the claim, retaining an audit trail of all queries in the database.

In addition to queries about particular claims, HSPs often needed to ask general questions usually regarding payments, availability of forms, or the outreach programs. In addition, the MA frequently needed to communicate with the HSPs either calling them individually, or delivering letters to them physically using their trucks. These interactions were time consuming and expensive. To address these needs, Claim Mobile also integrated the ability to send messages and announcements between the MA and the HSPs. The web interface included details and contact information for the HSPs, enabling the MA to send messages to the HSPs individually or as a group or subgroups.

Integration

At the outset of this collaboration, the RHVP had an existing claims process, including an Oracle-based database, in which all of the paper claims were entered. To simplify the user experience for the HSPs, the paper-based claim form, the mobile claim form, and the web-based claim forms are all largely the same, retaining the same titles, structure, and information. Likewise, I modeled the underlying structure to facilitate integration with their existing database, as well as to any other standard database. Most importantly, I had established strong ties with the third party company that provided the claims processing service and software on behalf of the MA, which gave me confidence that I would be able to integrate our software into theirs.

Design Constraints

Claim Mobile's primary requirement was network connectivity. I chose to depend on the availability of GPRS (general packet radio service, Internet over mobile GSM), having done a site survey of all of the then-participating HSPs (12), and verified availability of Internet in each of them. While data connectivity over SMS was also a technical option, I deemed it more expensive (2 bytes/ugx vs. 1 KB/ugx), and unnecessary at the time.

Given the small screen size, and the tedium of entering data into a phone, it was apparent that the single A4 page that comprised the claim form was approaching the limits of the length of form that a phone should accommodate. We addressed this issue by breaking it up into components, reducing typing as much as possible, and introducing branchpoints into the form logic where sensible. However, it was my assessment that the users would not have patience or time to deal with lengthier forms on this mobile phone; longer claims would require devices with larger screens and a different mode of data entry.

Logistical Constraints

As a researcher, I also had another limitation. Balancing fieldwork with class schedules, funding and the needs of the collaborating institution entailed negotiation with advisors, granting institutions and the NGO. While a grant for the needs assessment funded the first two visits, additional funding and academic requirements precluded another visit until the following year. In the meantime, the NGO project continued to run, and even terminated

briefly. Finally, in an effort to manage a research budget and to work with the NGO needs, I decided to conduct an extended field study, flying once to Uganda and staying for a year instead of making several short trips. By the time I was ready to do a wider deployment, the NGO was working with 52 HSPs, significantly more than the original 12 that I had planned for a deployment. With a budget and a time limit, I was unable to scale the Claim Mobile research to provide mobile phones for each HSP. Furthermore, with the additional HSPs, the NGO was swamped with many more claims than before, and did not have time for integration of the system.

6.1.3 An Evolving Research Scope

In 2007, I was initially invited, along with several collaborators, by the RHVP's management agency to examine the possibility of using smartphone-enabled digital forms to reduce some of the delays around receiving and processing claims. After a needs assessment in July and November 2007, I conducted a five-week deployment of a mobile phone system for processing claims in two health facilities (August 2008). In this pre-pilot, I simulated the proposed process, and the HSPs submitted claims on the phone in parallel with paper claims (Ho et al., 2009). Each visit entailed semi-structured interviews with staff at various levels of the RHVP, as well as direct observation of the claims form entry and processing. In addition to studying the functionality and usability of the system, I endeavored to understand how the use and introduction of ICTs within the HSPs improved the program management within the project. While the pre-pilot was largely successful, it became apparent over the course of subsequent fieldwork that integration and scale-up of the pilot would be problematic, due to reasons I will detail later in this chapter. As with many development projects, the RHVP was constantly evolving; it was necessary also for my research to evolve in response.

In early 2009, integration of the mobile claims processing software for just 8-12 of the (at the time) 83 HSPs into the claims process of the NGO would be disruptive to their own programs, due to changes in circumstances. At the same time – there was interest in and demand for a better mechanism to manage SMS (text) message communications between the HSPs and the NGO staff. While this was initially a feature in Claim Mobile – the time frame, scale of the deployment and platform did not match the needs of the NGO, and they decided to outsource an independent bulk SMS platform to a third party vendor in Uganda. Thus this research also incorporates the study of the development and deployment of a third party bulk SMS platform, designed based on recommendations and requirements co-crafted by the researcher and the collaborating NGO.

6.2 Changing Circumstances

After having carefully evaluated a number of potential partners, and also having conducted a survey of the needs of the user base, I felt confident collaborating with this NGO on this project, and hopeful that our invited technical solution would be of benefit. However, between 2007 and 2010, the RHVP program experienced a number of dramatic programmatic

and structural shifts, all of which had significant impact on the potential viability of Claim Mobile.

6.2.1 Stakeholder Structure

When the RHVP program began, the NGO outsourced claims processing to a third party agency, since they had no expertise in computer systems. This third-party organization, the claims management agency (CMA), developed a database system, including a mechanism to read the barcodes printed on the vouchers. Barring some minor hiccups, this was an extremely functional relationship throughout 2006-2007. (See Chapter 3.)

When my research started, I was collaborating with two organizations: a health NGO program with many communications bottlenecks, and a highly technical CMA with an interest in using communications technologies to improve their own insurance business. The NGO presented a clear development context, and the CMA presented a mechanism for smooth integration and technology transfer.

However, in the latter half of 2008, this relationship began to break down. One of the key disputes the NGO had with the original CMA was over ownership of the claims management database system. The CMA insisted that the software was available on license to the NGO, while the NGO insisted that any software developed with money from the Ministry of Health (MoH, i.e. the Ugandan government) legally belonged to the government in perpetuity. Then payments from the funding agency to the NGO were delayed, preventing them from paying the CMA for their work.

By November, the NGO and the CMA had severed ties, and the NGO was processing claims by entering partial review information into Excel spreadsheets. This method was prone to error, and more susceptible to potential fraud. Furthermore, donors and external reviewers felt this was inadequate for evaluation purposes. To address this, the NGO requested proposals for a new claims processing software vendor. I flew out in November 2008 to participate in the bid evaluation, and to meet my potential new collaborators. When establishing a relationship with the new vendor, the NGO made it clear that any software they developed would belong to the RHVP and the MoH. They also hired a Ugandan IT consultant to act as a liaison between the NGO and the new claims management software vendor (CMSV). Eventually, despite the tight three-month deadline we set in the initial proposal, this software would not be launched until late December 2009.

The replacement of the software vendor also changed my own role in the RHVP program. I had significant support from the NGO's donors for the mobile platform, and the NGO wanted to be the place where it was tested successfully. However, the claims ultimately needed to be put into a database. With the original CMA, I had already worked out plans to integrate with their claims management software. However, since the new software vendor was providing only the software, and not claims management services, they had no incentive to test out innovations, especially given that their software release was already late.

	June '07	Aug '08	Jan '09	Sept '09	Jan '10
STIs	12	12	0	37	25
Delivery	-	-	52	52	81
Total	12	12	52	83*	106*

Table 6.1: Health Service Providers contracted by the RHVP program from project inception to January 2010. *Note: Some HSPs participated in both the STI and the Delivery voucher programs. The 2006-2008 STI voucher program was called a pilot of the voucher program, and yet, implementing delivery vouchers was so different that it was almost like starting again.*

6.2.2 New Programs, Shifting Priorities

When I first began working with the RHVP program, it had a different name, and was only financing treatment of STIs in 12 health facilities. As with many donor-funded projects, the initial grant came up for review after it was spent. Since the 'pilot' voucher project was judged to be successful, the donor chose to expand the program, adding maternal delivery services, and asking the NGO to expand geographical coverage from four districts to 22 districts encompassing all of Southwest Uganda. To finance this, the donor collaborated with the NGO, applying for a grant from a multinational granting organization, eventually getting USD 4.3 million to finance the maternal delivery program. The first donor supplemented this grant with USD 2.1 million, funding the continuation of the STI program, for a total of USD 6.4M (5.96 for the delivery program). Based on their cost expectations at the time, this second granting organization expected the NGO to finance 50,000 deliveries, and 30,000 STI vouchers over the next three years.

The new maternal delivery (MD) voucher program was quite different from the STI voucher program. First of all, the Ministry of Health was strict about treatment and tracking requirements around births, requiring significantly more documentation than was required for the STI treatments. MD vouchers entailed four antenatal visits, a delivery, a postnatal visit, potential transport, and referrals over the course of ten months. While the STI claim form consisted of a single 8.3" × 11.7" A4 sheet, the MD claim forms consisted of five different forms, most of them using 16" × 11.7" A3 sheets. In addition, while treatment of STIs might be a high volume service, with hundreds of treatments per month per facility, deliveries constituted a low volume service, with tens of deliveries per facility per month on average. In exchange, the average STI voucher paid USD 7-15, while the average delivery paid USD 58. Most of the STI HSPs, even the new ones, were located within a few hours drive of Mbarara. However, in order to find sufficient qualified HSPs to provide maternal delivery services, the RHVP expanded delivery voucher services much further, contracting three times as many HSPs in the delivery program as in the STI program (See Table 6.1).

With the launch of the MD program in September 2008, the NGO abruptly shifted its focus, putting all its efforts into making sure the new program worked well. At this point, the STI voucher program was put on hold. The NGO stopped distributing vouchers, not resuming the program again until September 2009. Donor consciousness seemed to support this move initially – a significant proportion of the money was allocated towards the MD program. Target expectations around the STI program were also low, just 50%

	Aug '08		Dec '09 15 mo	Sept '10 24 mo	Target 36 mo
STIs targeted	19,000		17,000	50,000 (10,000)	30,000 (20,000)
Delivery targeted	-		4,700	30,000 (15,000)	50,000 (30,000)

Table 6.2: Vouchers sold.

more than their previous pilot, even though they had twice as many participating HSPs The MD program came with a new logo and a more fundable new agenda ("saving mothers and babies" is much more appealing than "treating sexually transmitted infections"). In the short term, the NGO was also far behind donor expectations, with only 4,700 mothers delivered out of the targeted 10-15,000 by December 2009. (See Table 6.2).

The hiatus of the STI voucher program had the most immediate impact on Claim Mobile's deployment. It was impossible to survey users or deploy a system for a client base that did not exist. I considered also shifting the focus of Claim Mobile to include delivery vouchers in its scope. However, the MD forms were simply too long and complicated for the mobile phone – it would be too tedious for the user to enter that much data, given the small screen size and keyboard on the phone. Furthermore, the NGO staff was focused on scaling up their program, while I only wanted to work with a few HSPs, to get a more detailed understanding of their interactions with the technology. Our objectives would be at odds, at an extremely critical point for the NGO. It was my choice to prioritize the NGO's actual technology needs over the traditional research agenda entailed in Claim Mobile's implementation.

6.2.3   Infrastructure Availability

The increase in the number of HSPs was motivated by the need to generate more voucher usage, and also entailed broader geographic coverage, and new geographies. Visiting newly added health facilities now entailed overnight travel for the NGO staff, and many did not have electricity, or good mobile network coverage.

The network communications infrastructure in the country was also changing. Warid Telecom launched in Uganda in January 2008, and Orange Telecom launched in March 2009. More competition resulted in new services and reduced prices.

At the local level, new funds enabled the re-launch of the voucher project, and also came with funds for new infrastructure. The NGO purchased new trucks for visiting HSPs, invested in new software, and upgraded the Internet, all in the name of improving RHVP program management. In this section, I discuss the changing infrastructure availability and its effects on claims management.

Mobile Internet

When this project began, Palm Centros and Palm Treos qualified as 'smartphones', on the basis of their ability to browse the internet and run advanced applications. Palm's long

history of use by medical practitioners also meant that the phones had medical applications available (El Emam and Garritty, El Emam and Garritty). While I had deliberately chosen Java 2 Mobile Edition (J2ME) as a platform for Claim Mobile's phone interface for its portability to other phones, when Android and iPhones came out I decided not to switch to the new devices. I decided that the PalmOS-based phones were more affordable, and less costly with respect to Internet use. While newer smartphones generally require unlimited monthly subscriptions to the Internet, the Palm phones only downloaded data when the user requested it, and its programs used protocols that conserved bandwidth and bytes. Since I expected eventually for the HSPs to pay for their own Internet use and airtime, I wanted to be cognizant of both the infrastructure availability then available in Uganda and the costs associated with mobile Internet use.

Even in retrospect, this was a wise decision. While Centros and Treos need to be charged once every three days, most Android-based and even newer WebOS-based Palm Pres need to be charged daily. In my baseline survey HSPs expected phones to have a minimum of three days of battery life. In practice, I found this useful, merely to ride out unexpected power outages. Even beyond the issue of electricity were the combined issues of mobile Internet availability, technical training, and affordability. In January 2009, when I returned to Uganda, a monthly subscription to mobile Internet cost 85,000-90,000 UGX (≈45USD). My baseline surveys showed that HSPs spent an average of only 20,000 UGX on phone services. To ask them to spend an additional 85,000 UGX seemed unreasonable. However, in March 2009, a new mobile provider, Orange, launched its services in Uganda. A few months later, Orange had 3G mobile Internet services available in all of the major Ugandan cities, and GPRS in many places in between. Their tiered plan started at 49,000 UGX/month (≈25USD). Eventually my research subjects would all purchase modems and subscribe to this plan, using the service to connect their computers, but not their phones to the Internet. I found that, while it was possible to get voice phones with data plans (indeed, Orange began offering the iPhone in Uganda in December 2009), most of the data SIMs have been encoded specifically to only work for data, and do not also allow voice communication. Enabling phones with voice and data generally requires a bit of tech savvy and willingness to negotiate with customer service representatives for SIM cards with appropriate configurations.

Now that the Palm phones have waned in popularity, these issues have implications for the design of future mobile phone technology. At present, phones are either low cost or fully featured. Until manufacturers of iPhone and Android phones address initial cost, maintenance, battery life, and mobile Internet availability, the suitability of advanced mobile health applications for users in regions with poor electricity infrastructure will be limited.

Using Existing Technologies Effectively

Over the course of my extended fieldwork, the NGO staff became more and more acclimated to the use of the Internet and mobile phones. They started using and sharing phones to call the HSPs regarding problematic claims. They also called one another, either between the Kampala and Mbarara offices, or when someone was in the field. SMS (text) messaging also came into popular use, with HSPs contacting the project coordinator to ask

for more claims forms, or to ask about recent payments. In the Kampala office, they started using GPRS modems to connect their computers to the Internet when their VSAT (satellite) connections went down. Skype and Yahoo! Chat started to come into use, and the program director (PD, the head of the RHVP program) mandated the use of Skype in both offices, as a cost-cutting measure. While the Internet connection in the Mbarara office was not fast enough during the day to support a reliable voice call, Internet chat was less expensive and disruptive than mobile phone calls.

Many of the other technologies were already available in 2007. The staff of the NGO merely became more familiar with the ways they could be used, both in general, and in the context of the project. They started primarily with paper-based and in-person communications, supplementing short phone calls with surprise visit inspections. In addition, they used broadcast radio to educate potential clients about the program, advertising the HSPs and the voucher distributors (usually local pharmacies). As they expanded their services, they began relying more on their drivers and their trucks. Where before, the trucks were used primarily to conduct village outreaches (movies advertising the RHVP project), they also started asking the trucks to visit nearby health facilities to pick up and drop off claims forms and communications, rather than waiting for ICs to visit the Mbarara office to pick them up. Informally, the HSPs started to learn the personal mobile numbers of the project coordinator (PC) and the finance officer (FO) that handled their payments. Anyone that felt disengaged or neglected just called the appropriate person and asked, "Where are my payments?" Many of the newer HSPs were supported by other NGOs, and had 24-7 Internet available in their facilities. The PD and PC began conversing with key staff at these HSPs by email, in addition to paper, SMS, voice, and in-person communications. Over time they learned that each communication channel had different affordances. Paper letters were the most formal, generally occurring on the NGO letterhead, and requiring signatures. Voice and in-person communications were convenient, allowing exchange of information. However, the PC found that, without documentation of the information exchanged, various parties could retract statements easily. He began asking HSPs to send SMS messages, write emails, and write letters reiterating what they had said on the phone, and asked the other NGO staff to do the same. It became a mantra in the office: "Get it in writing!" While this was less critical with regards to requests for new claim books, it was absolutely critical with regards to handling of complicated claims, often involving reimbursements of 50-150 USD. All of these measures, perhaps in response to the feedback from my 2007 site survey, combined to greatly improve relations between the HSPs and the NGO.

The failure of e-mail

In September 2009, the NGO had their drivers deliver a letter to each of the HSPs participating in the delivery program, asking them to contact the PC with their e-mail address, mandating that they create an e-mail account and check with at a minimum monthly if they did not yet have one. The NGO staff suggested that e-mail would be a more convenient and cost-effective means of delivering claims reports to the HSPs than having their drivers transport them personally by truck. The delivery route, using three trucks, generally took one month, but a minimum of two weeks to cover all 83 HSPs. During that time, the NGO paid for fuel, and living expenses ($\approx$25 USD/person/day) for two staff per truck on top

of their normal salaries. E-mails would be virtually free. Furthermore, they suggested, they could write more casual communications than those entailed by letters. A few months passed, and it transpired that it was not feasible for the more rural HSPs to check email on a regular basis. The effort of regularly checking the accounts was too much. Checking email required travel to a nearby town to visit an Internet café, asking the manager to help open the account, and paying for both the service and the travel. As often as not, the café would be closed due to power outages or network outages. It was too much work given the possibility of only 1-2 emails per month from the NGO that they could more conveniently reach by phone. Indeed, for some, by the time they had arrived in town, they could also visit the NGO offices in person.

Eventually, the NGO hit upon a working solution: the Ugandan postal service. First, they noted that many of the HSPs already had P.O. Boxes, usually in a nearby town, where the HSP staff already went on a regular basis to pick up medical supplies. Picking up mail at a P.O. Box involved lower overhead than checking email, both in terms of finances and time. In addition, the NGO made a practice of sending an SMS announcement to all of the HSPs each time they mailed out any notices. The HSPs knew when to look for mail, and appreciated that their documents came pre-printed and not just on a computer they could only access in an Internet café. While the information interaction remained the same, the final channel for the claims reports ultimately took on a non-digital form.

6.3 The Rise of BulkSMS

In May 2009, I was approached by one of the NGO staff. "What do you think of a system that will allow us to use our computers send text messages to all of our health service providers at once?" Shortly thereafter, the NGO put out an official request for proposals, and by late July 2009 we were evaluating three bids from four organizations, to be paid for by the separate funding agency that financed the overall project. The motivation for the Bulk SMS project stemmed from existing practices. Partly as a result of the 'Get it in writing' policy, the NGO was communicating by SMS with many of the HSPs. SMS messaging served as written and persistent communication channel for securing payment confirmations, requesting claim forms, and to communicating about issues regarding claims payments. However, all of these messages were scattered across personal phones belonging to the project coordinator (PC), medical advisor (MA), finance officer (FO), and other staff. The program director (PD) needed this information documented for the donors. Manually collecting them from individual phones, and sorting out personal messages from work messages just was not feasible. As an added benefit, a Bulk SMS system would enable the NGO to send broadcast short announcements to all of the HSPs at once, with much less overhead than writing letters, stuffing envelopes, and sending them, at the time, by their drivers.

The selected bidder, a Ugandan company, deployed the software in October 2009, bringing the PC and the project's database manager (DBA) up to Kampala for a training session. Over the next 7.5 months, from its initial launch to June 30, 2010, the system sent 4,167 messages, comprising 250 unique messages. The NGO sent 65 announcements, either using a template or identical messages. In addition, another 134 messages were sent

**Messages Sent by BulkSMS System,
11/16/09 - 6/30/10 (250 Total)**

Bulk 51 20%
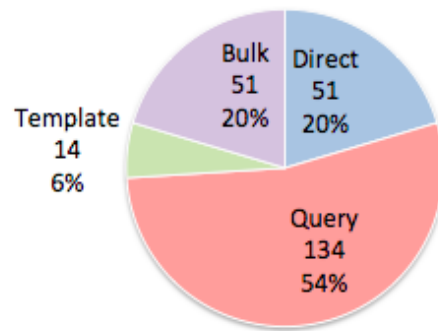Direct 51 20%
Template 14 6%
Query 134 54%

Figure 6.1: Breakdown of individual messages sent by the BulkSMS System

using the Bulk SMS system's query feature, which allowed HSPs to send a message to the system, which would then be relayed to all of the RHVP key staff, including the PC, PD, MA, DBA, and the FO. The appropriate person would then respond to the HSP, either directly, or using the system (Figure 6.1).

Messages sent dealt primarily with payments (22%), with a significant number of apologies for late payments and queries about payment timing. However, the NGO also used the system to make program announcements (17%), and to confirm acceptance of contractual changes (7%). In one instance, they mailed a new list of prices to the HSPs' P.O. Boxes, including a written letter asking them to send an SMS to the Bulk SMS system number to confirm acceptance of the prices, in lieu of a signature on a revised contract. The prior September, contract signing for new clinics occurred over a period of three weeks, as three copies of the contract booklet traveled from each HSP back and forth to the NGO offices for additional signatures and corrections. The introduction of persistence and centralization into the informal mechanism of SMS messaging enabled these users to use this media as a formal information repository, enabling a more efficient means of administration over a large geography.

6.4 Analysis

The bamboo that bends is stronger than the oak that resists. Japanese Proverb

6.4.1 Time Changes Everything

By now, the ICTD community has developed a number of strategies that contribute to the success of ICTD projects. Understanding local context and user needs may not guarantee success but are necessary components of success. Many groups use change agents and opinion leaders as local advocates for their technologies, understanding that these community members can be a bridge between outsiders and the local community. However, with the added element of long timespans, these measures may prove insufficient.

A primary change within this project was the addition and subtraction of key stakeholders. The loss of the CMA entailed the loss of a key change agent, and collaborative partner, endangering the potential sustainability of Claim Mobile within the context of the RHVP. The addition of a new granting institution, along with its millions of dollars in funding for the MD program shifted program priorities away from the NGO's original objectives around STI treatment. In late 2009, the RHVP was over 10,000 clients behind targeted expectations for the donors (See Table 3). Between the replacement of the CMA with a temporary stopgap of Excel spreadsheets, then a delayed release of the CMSV's database, all of the staff of the NGO were constantly working through early 2010 to catch up on a backlog of claims to be entered. This situation, combined with the observation that many of the bottlenecks in payments processing that were present in 2007 had been removed, motivated my decision to 'fail' Claim Mobile, despite backing from both my donors and theirs. It was clear to me that the NGO staff simply did not have the spare capacity to use a web interface to process claims for a subset of the HSPs in addition to their other responsibilities.

6.4.2 Appropriate is Beautiful

One of the strengths of the NGO was their core team, which carried over from the initial RHVP pilot throughout the program. This team was adaptable to changes in technology and stakeholder contexts, learning what worked as they went. Likewise, while mobile phones are generally flexible, mobile phone applications are generally rigid. One of the weaknesses of Claim Mobile was that it was designed specifically for the STI voucher. Since it was specific to that particular context, it failed to transfer well to the context of the delivery voucher.

While I have emphasized that mobile phones and text messaging, combined with basic project management decisions (Write it down!), are often better than a more complicated technology, simple is not always better. Small is Beautiful suggests that developing countries will more effectively adopt intermediate or appropriate technologies, specifying that such technologies should match available resources and context constraints (Schumacher, 1973). However, with ICTs, it is not always clear what constitutes 'appropriate' technology. Schumacher suggests that *intermediate*, or Appropriate Technologies (AT) should be sourced using local materials and labor. And yet, mobile phones and their supporting infrastructure do not fall into this category, despite their clear success in developing regions. At the same time, creative uses of the mobile phone are often the result of local innovation, supported by local labor. However, even this conception of AT does not capture the range of successful innovation. Both local and non-local web applications and websites succeed and fail in different developing regions contexts.

Recognizing user needs requires finding a happy medium between costs, infrastructure limitations, and manageability. For the RHVP program simple email technology failed, but even more basic postal service succeeded. BulkSMS as a technology was simpler than Claim Mobile, but more complicated than the SMS usage model that it replaced. At the same time, it simplified life of PC's personal SMS inbox, and consolidated the RHVP's SMS messages in a single location.

6.4.3 Braided Communications

Building on the concept of *braided communications*, as defined in Chapter 5, this chapter considers a wide range of communications strategies. Information technology encompasses radio, satellite, television, etc., in addition to computers and the Internet (Keniston, 2002). However, non-microprocessor-based communication mediums, such as postal service, and in-person communications also play a role in the communications strategies of the NGO. These various media support the evolving and heavily logistical relationships with the many (from 12 in 2007 to 106 in 2010) HSPs it finances. Due to the wide geographic span of the HSPs, the NGO faces a number of structural limitations, including poor road infrastructure, intermittent power, and unreliable mobile network coverage. These stakeholders work together to develop and maintain effective relationships using a number of different communications channels (e.g. delivery trucks, mobile phone, SMS, in-person, etc.) in parallel.
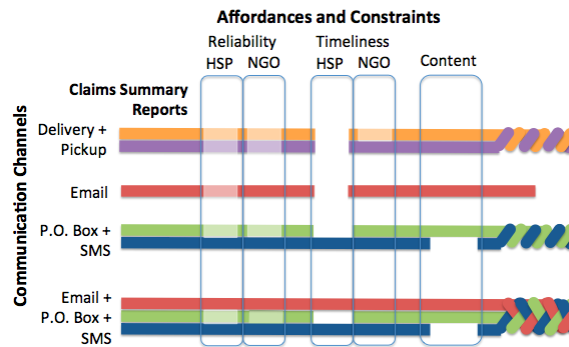

Figure 6.2: This diagram illustrates the different strategies used by the NGO to deliver Claim Summary Reports to the HSPs.

These different communications channels each exhibit a different set of affordances and constraints, subject to the actual mechanism entailed by the channel and the social, economic, and infrastructural contexts of the channel users. For example, e-mail was very inexpensive, convenient and reliable for the NGO, but in practice did not work well for the HSPs. At the same time, e-mail was convenient and reliable for the 13% of HSPs with access to e-mail in their facilities. Personal delivery of CSRs to the HSPs or pick-up of the documents at the NGO offices was convenient for the HSPs, taking advantage of pre-existing channels (i.e. claims submission) but often unreliable, since both the NGO and HSP forgot to exchange the document. For the NGO, however delivery of claims summary reports and other paper communications was costly and time consuming, entailing expenses and fuel for several trucks over the course of a month. In addition, infrequent visits meant that these mechanisms could often take several months for an exchange to actually happen. Postal delivery was more expensive than email, but also more convenient than personal delivery. And unlike e-mail, checking a P.O. box was relatively convenient. The use of Bulk SMS augmented postal delivery's unreliability, providing a signal to the HSPs that a document should be expected, so they could notify the NGO if it failed to arrive. Over time, use of communications technologies for document sharing evolved in response to

constraints and affordances of the technologies, yielding a *braided communication* in which the affordances of Bulk SMS reinforced the constraints of postal communications.

Just as each mode of communication has particular *affordances* and *constraints*, Claim Mobile also had its own set of affordances and constraints. In its design, Claim Mobile replaced common functions of claims delivery and provision of status updates with mobile Internet-based communications. However, the usability of the application was limited by its small screen size. When the project shifted its focus, and started using additional, longer forms, Claim Mobile was no longer a match for the project needs. In addition, Claim Mobile was subject to power constraints often seen by mobile phones - the system only worked if the phone was charged. While feasible in most clinics, still others had no access to electricity. Not only would it have been risky to leave the phone in phone charging booths, but the claims feature would not be available when the phone was charging. In larger health facilities, often two or more clinicians would provide consultations at the same time. With paper forms, each clinician would be able use their own set of claim forms - paper interfaces are easily shared. However with Claim Mobile, accommodating multiple clinicians required multiple phones, posing additional capital costs. Finally, Claim Mobile also possessed the constraint of a dependency on a collaboration with the CMA. Once that possibility dissolved, so did the viability of Claim Mobile's wider deployment. While this constraint became obvious over the course of the research, this dependency constituted an *invisible constraint* during the first stages of fieldwork. Similarly - the ways in which I specifically designed Claim Mobile to be appropriate for the original configuration of the RHVP project, actually created the constraints that made it impracticable for the changed context.

Ostensibly, other communications technologies might be used to augment the weaknesses of Claim Mobile. Perhaps paper forms could be used for health facilities without mobile coverage or reliable power, and Claim Mobile reserved for facilities with supporting infrastructure. Tablets or laptops might replace the phone-based form factor to allow Claim Mobile to accommodate longer forms - however this new configuration is further constrained by additional costs. At the same time, merely adding communications technology would not surmount the administrative obstacles of shifted priorities and changing CMA partnerships. In addition, the intention of Claim Mobile to replace claims forms and claims summary reports meant that Claim Mobile was not intended to be used in parallel with other means of communication. Ultimately Claim Mobile failed to braid well into the evolving requirements of the RHVP project.

6.4.4 Finding What Works

In retrospect, perhaps I could have anticipated that the context would change, and designed Claim Mobile to adapt to potential changes. In that respect, I used iterative methods to design the system, playing close attention to contextual issues (See Chapter 2 and 3). Indeed, even at that early stage I was able to the identify tensions between the stakeholders that ultimately led to the break between the CMA and the NGO. While, at the time, I did not anticipate the extent to which upcoming changes would affect the viability of Claim Mobile, it is actually this attention that enabled me to see that the system was no longer appropriate for the RHVP. While donors supported the concepts behind the technology, the

expanded program was no longer appropriate for its study.

As researchers, we are called to look at future technology, technologies that do not work in the field currently, and may not be expected to work for 2-5 years in the future, possibly more. Yet, as ICTD/HCI4D researchers, we examine our future technologies in right-now environments. These environments are often prone to break our interventions, or our technologies are prone to break in these environments. Either way, we scope our research pilots to represent a microcosm of what we expect the near future to look like. I chose two health facilities, deploying Claim Mobile with them. In this environment, I could ask, what would private health practitioners in Uganda do if they possessed Internet connectivity and advanced mobile phones? What might it look like if mobile Internet and devices started to be ubiquitous?

I do not necessarily expect all research pilots to achieve scale. In this case, we saw that when the number of HSPs increased, mobile Internet coverage was no longer ubiquitous, due to differences in geography. Given this tendency, industry or practitioner implementations may be more appropriate and reliable for NGO success. They can produce products within set time frames, and provide ongoing support. At the same time, researchers working with the Warana Wired Village Project improved access to information for sugarcane farmers by replacing a PC-based system with an SMS mechanism (Veeraraghavan et al., 2007). In this case, the researchers documented the failure of the kiosks, and adopted a new, more affordable approach. ICTD research interventions must carefully balance expected benefits from our work against the real needs of our collaborating partners. As researchers, we can build an understanding of how new technology approaches will work in these contexts.

I approached my research with the goal of understanding how the introduction of new information technologies changed relationships within the RHVP program. By being willing to step back from Claim Mobile, I learned how broader needs affect particular deployments. Scale, program priorities, and available technologies changed, revealing previously invisible deployment constraints, and making that particular angle of research less suitable for the context. Instead, my broader agenda enabled me to identify other creative approaches that the NGO took to address the needs I had previously identified as the basis for Claim Mobile.

6.5   Conclusions

If you want to truly understand something, try to change it. – Kurt Lewin

In order to successfully forward development, we need to look beyond the immediate success of our specific technologies, and build a better understanding of their long-term workability with respect to their contexts. I suggest that genuine discourse around ethnography in HCI and user-centered design requires room for failure. We cannot take it as given that IT is the correct solution for every problem (Toyama, 2010), or that a 'successful' solution will work in every context. Rather than centering research only on making a system appropriate for the users, we can endeavor to understand our users better, making the system second to their interests.

Researchers can support development organizations. However we must remain cognizant of the changing needs and context, both within the organization, and externally, as available infrastructures change. Appropriate interventions might entail simple or complicated tools. As demonstrated here, some interventions, such as Claim Mobile, may be initially suitable, but fail as the context changes over time. Other communications mechanisms, such as postal service, mobile communications, and Bulk SMS integrated more effectively into the formal and informal social processes of the program. In the case of claim summary reports, informal exchange of the documents was formalized by the introduction of e-mail, and then the introduction of postal communications when e-mail failed. Each new strategy revealed the constraints and affordances that influenced the adoption of the next communications strategy.

By giving myself room to fail Claim Mobile, I had the opportunity to observe in situ informal uses of mobile phones and texting, and a formal implementation of a Bulk SMS system. Through an extended period of observation, I learned how this organization used and adapted available technologies to their particular context—that the affordances of technologies affected and depended upon stakeholder needs and relationships.

Failure is not new, and has been much discussed in development and ICTD literature (Heeks et al., 1999; Kleine and Unwin, 2009). However, we continue to need to learn from one another's failures, and build on each other successes (Best, 2010). While it may be tempting to dismiss failures as foreseeable results of faulty approaches, the future is not always foreseeable, and failure can occur in the best of circumstances. Indeed by choosing to work in developing regions, we are subject to daunting challenges (Toyama, 2010; Anokwa et al., 2009; Brewer et al., 2006a). It is by sharing our experiences and building a better understanding of these challenges that we will succeed at finding effective ways to use information technologies for development.

CONCLUSION

> *Our world, with its rules of causality, has trained us to be miserly with forgiveness.*
> *By forgiving them too readily, we can be badly hurt. But if we've learned from a*
> *mistake and became better for it, shouldn't we be rewarded for the learning, rather*
> *than punished for the mistake?*

> *—Braid, the video game, designed by Jonathan Blow*

In the introduction, I asked "How do people renegotiate formal and informal processes around the introduction of new information technologies?". To answer this question I partnered with the Reproductive Health Voucher program from 2007-2010, observing the ways in which stakeholders interacted with one another, especially focusing on the ways in which they used new and old information technologies to support their interactions. I attempted to build an understanding of *existing communications processes*, both formal and informal, and in the process also observed how these communications processes evolved over time. In addition, *relationships* between the stakeholders and stakeholder experience with technologies also changed over time. Importantly, this work examines a research intervention and its intended context over a three-year period, thus considering the longevity of information technologies against the changing conditions of the program.

In Chapter 3, I described many of the pain points experienced by the NGO and the HSPs, situating their experiences in the paper-based claims process. Filling out claims (HSPs) and reviewing them (NGO) were both time-consuming and often error-prone tasks. Contention over the amount of claims reimbursements and delayed payments caused HSPs to feel disempowered, disengaged, and discouraged. Indeed, within the first year of the project four out of the 16 HSPs resigned from the program over disagreements about payment and treatment protocols. I found that there was a need to address this communications gap, proposing Claim Mobile as a means of reducing claims processing time, closing the feedback loop, and managing announcements. However, during the testing phase of Claim Mobile, I also found concerns about information poverty. In early 2008, the CMA moved their data entry clerks from the Mbarara office to the CMA offices in Kampala. With control of claims processing and the processed claims data sitting in the CMA, the PMO found that they were lacking critical information for running the project. Where the PMO originally had access to copies of the paper claims, the original design of Claim Mobile exacerbated this problem. In response I developed a web-based application to serve as an equally accessible interface for all of the stakeholders. This case shows how a particular *design* of

a system may influence the renegotiation of processes negatively. As a result, designers should consider ways to address the (often conflicting) needs of all of the stakeholders, not just the primary users.

Chapter 4 provides a second case of a technology being introduced to the RHVP program. In July 2009, I participated in the bid evaluation and design activities for the Bulk SMS system, which was used by the NGO to communicate with the HSPs. Intended to replace the formal system of paper and phone payment advices, the Bulk SMS system was a low cost means of communicating with all of the HSPs at once. The system served as a centralized storage for SMS communications, more effectively than the multitude of staff phones. At the same time, SMS as a mass messaging medium had specific constraints: messages had to be brief, were often delayed, and sometimes dropped. While some problems with SMS could be addressed with better design, others were inherent to the medium itself, a function of infrastructural issues. In addition, the system was also subject to existing preferences - half of the HSPs preferred to communicate by phone over SMS. Thus, new ICTs do not just replace old processes, they are subject to existing preferences and the availability of existing alternative technologies. Based on my observations, I suggest that Bulk SMS is better in a braid. Alone, it would be subject to silent drops and non-interest by half of the HSPs. However, the phone and email can augment the reliability and usability of Bulk SMS, enabling more effective and reliable communications overall.

I expand on this idea in Chapter 5, in which I define *braided communications*: *communications are braided when one or more channels are used to reinforce one another, through redundancy or complementary affordances, thereby creating a more appropriate, braided channel of communications*. Using several examples from my observations of the RHVP program I show that not only do affordances and constraints differ between the NGO and different HSPs, but that they also change over time. As a result, the ways in which communications technologies are used, both separately and together, evolve over time. As new technologies become available, or old technologies change characteristics, the NGO and HSPs adapt their processes, responding to the new or changed affordances, based on the needs of the associated tasks. For contexts in which all communications channels are unreliable, the reinforcement and redundancy of braided communications enables more effective and reliable communications.

Finally, I discuss the ultimate outcome of the Claim Mobile deployment in Chapter 6, situating it in relation to events within the NGO, and other strategies for addressing the communications needs of the RHVP program. In 2008, I thought Claim Mobile was an appropriate solution. Through the course of surveys, interviews and observation, I came to realize that my design choices were based on several previously invisible constraints. As the program progressed, the context changed. The STI program used a short relatively simple form, and I had established a collaborative partnership with the third party CMA, anticipating deployment to 12 facilities. These foundation blocks dissolved one by one, as the program itself recieved expanded funding and changed priorities. Furthermore, over time, the NGO found creative ways of addressing these communications needs, obviating the relevance of Claim Mobile I also observed that the program staff enabled more reliable and effective communications by combining the use of many available technologies. While I was able to modify Claim Mobile to address revealed affordances during my work in August 2008, ultimately the nature of context changes between September 2008-September

2009 caused me to 'fail' Claim Mobile. Where Bulk SMS was flexible and could be used alongside many other communications channels, Claim Mobile ultimately failed to braid effectively into the RHVP project.

The ways in which research interventions and emergent technologies integrate with in situ technologies is important for ICTD research: designs that take them into consideration will be more functional and effective for longer-term deployments. Using the concept of braided communications, this dissertation explains how this NGO adapts their processes, both formal and informal, in response to changing affordances of available communications mechanisms. Furthermore, the NGO braids communications technologies together, enabling a more reliable communications channel than would otherwise be possible with individual channels. New technologies also have affordances and constraints. These sometimes invisible qualities influence the uptake and replacement of communications strategies. Ultimately effective new communications technologies will braid with existing and future technologies.

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