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The introduction of smartphones as a tool for agricultural extension in rural Uganda: A three-phase study

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The introduction of smartphones as a tool for agricultural extension in rural Uganda: A three-phase study

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DEDICATION

For my parents, without whom none of this would be possible.

Thank you for believing in me.

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ABSTRACT

While Information and Communication Technologies (ICT) have long been an interest in development efforts, smartphones have only recently become prevalent. The impacts of standard mobile phones are represented in the literature, but smartphones are new enough that little research has been published regarding their use in development contexts. This study follows the introduction of smartphones to an agricultural extension organization in rural Uganda with the goal of understanding what expectations the staff members have for the devices, analyzing the effectiveness of the training provided, and discovering how the staff make use of the phones. In particular, this study pays close attention to the fact that these phones, rather than being adopted by individuals, were adopted by the organization and their use mandated. The study was conducted in three phases. In phase one, semi-structured interviews were used to collect information about how participants use their standard mobile phones to aid in their work duties and their perceptions about and expectations of smartphones. In phase two, participant observation was employed to gain insight into how participants were trained to use the smartphones and what they thought of the training, as well as how they learned to operate the smartphones over the course of the first few weeks of using them. In phase three, conducted six months after the introduction of the smartphones, a survey was used to collect information about how the participants were using the phones and how they felt about them.

The phase one interviews revealed that participants relied heavily on their mobile phones due to the challenges of their rural location; before mobile phones allowed them to communicate with client farmers remotely, they spent most of their time travelling long distances over bad roads to visit clients in person. They expressed excitement at the prospect of smartphones and were most interested in the idea of having a camera on their phone. A few participants expressed

concerns about the phones, including worries about short battery life or poor quality, but all participants overwhelmingly expressed that having smartphones would greatly benefit both the individuals using them and the organization as a whole.

Phase two revealed that the two-day training seminar used to introduce the smartphones was both overwhelming and insufficient. Because many participants had never used a smartphone or even a computer before, even the basics needed to be practiced and repeated many times before participants felt confident in their knowledge of them. As a result, only a few applications were introduced. In the weeks that followed many participants had trouble using their smartphones, and many even had trouble using the applications that had been covered during training. However, participants remained positive and inquisitive, and expressed their confidence that they would be able to master their new devices in time.

Phase three revealed that after six months participants were using the smartphones regularly. Participants frequently used the applications they had the most experience with, such as placing phone calls and checking the time or date, and the applications that they had expressed excitement about in phase one, such as taking pictures. Only a few individuals were using novel applications, such as GPS or email. Some participants reported problems with the phones and solar charging kits, but responses were still overwhelmingly positive. Participants reported many positive changes including being viewed as a better resource, experiencing increased communication, and being able to work more efficiently. It was found that a participant's status within the organization, gender, education, location, and functionality of their smartphone all played a role in how they used their phone. Age was not a significant factor.

CHAPTER 1

INTRODUCTION: THE CHALLENGES ASSOCIATED WITH INTRODUCING ICT IN DEVELOPING AREAS

Information and Communication Technologies (ICT) have the possibility to help farmers in developing areas achieve higher levels of food security. Yet, research into technological adoption finds that adoption is most successful when directed by user needs rather than external goals. Users in targeted development areas are unlikely to have high levels of education, may be illiterate, and generally have little experience operating electronics. These challenges can lead to underuse or abandonment of the technology if proper support is not provided to meet individuals' needs. If the long-term goal is autonomous use of these devices, thoughtful training and introduction strategies are required to promote continued adoption and use. This study follows the introduction of smartphones to agricultural extension workers in rural Uganda and contribute to the body of research by identifying successful strategies as well as pitfalls to be avoided when introducing new technologies to developing areas.

The idea of delivering agricultural assistance via mobile technologies has taken many forms. Top-down services deliver content dictated by the goals of an external organization. An example of such a service is SMS push notifications that provide subscribers with agricultural tips and seasonal reminders. These programs have the benefit of providing farmers with access to the most recent agricultural research and introducing novel topics, but lack the flexibility to address issues that are unique to each farmer's situation. Conversely, bottom-up services like call centers and agricultural databases empower farmers to seek answers to their questions. Yet, this approach comes with drawbacks as well: the information farmers receive can be limited by their

knowledge of what information would be valuable, their willingness to take the initiative, and having the knowledge of how to use the service.

Recently, some organizations have sought to combine these approaches in a structured system that trains local citizens to become professionals, acting as liaisons to provide assistance and seek information on behalf of other farmers in their community. This way of using technology combines the best of both approaches; the self-guided nature allows the users to tailor information to the specific needs of each client and situation, but the organization and training of the users means that the knowledge they provide can include up-to-date research and curriculum to introduce farmers to new ideas. However, empowering these individuals to fill this role takes a great deal of support and training, especially if the end goal is to eventually withdraw external support and leave the local organization with the ability to direct itself.

Identifying best practices to be used for training programs and support systems would be beneficial to these organizations. Once established, these guidelines would prepare new users for their devices to promote continued use and adoption, even beyond the period of intervention by a supporting external organization. The ideal support system will allow for the organic development of practices while also providing enough structure to facilitate troubleshooting problems and learning new skills.

This thesis uses a combination of interviews, observation, and survey procedures to collect data about how extension agents in rural Uganda adopt smartphones as a new technology. The data was collected in multiple phases of the project to explore three main topics: (1) what do users expect and want from smartphones, (2) how can training best support and empower users, and (3) how do users actually use smartphones? Phase one investigates the initial ideas, perceptions, and desires of participants. Phase two analyses the training provided to identify

successful and unsuccessful strategies. Phase three revisits users after their initial learning period to see how participants are using the technologies without external guidance. This final phase answers sub questions posed in both previous phases: Did the phones meet their needs as stated in phase one? Were the training and support systems put in place during phase two sufficient to ensure competent and confident use after external support was withdrawn? Results from this project can be used to guide strategies for the introduction of smartphones or similar devices in other developing areas.

This thesis will take the format of three separate journal articles, each answering one of these questions. Chapter 2 will explore the first question of what users with no prior experience with smartphones expect and want from them. This article will be submitted to the International Journal of ICT Research and Development in Africa. Chapter 3 will detail the training procedures used and identify the successful and unsuccessful aspects of training, as well as suggesting future changes. Chapter 4 will detail how the users actually used their smartphones after the initial initialization period, with special attention to how these uses correlate with training topics and their initial ideas. These last two articles will also be submitted for publication after incorporating committee feedback.

CHAPTER 2

PHASE 1 STUDY: WHAT UGANDAN EXTENSION WORKERS REALLY WANT AND EXPECT FROM SMARTPHONES

Abstract

The introduction of smartphones to extension services in rural Africa has enabled communication with farmers, experts, and managers in ways that were impossible before. Those in charge of adopting the smartphones for the organization are often top-level managers whose visions for their use are quite different from field-level staff or supervisors who will actually use them. This study used semi-structured interviews with 18 staff members of a small agricultural extension organization in rural Uganda to obtain and compare the perceptions of two levels of staff – field agents and their immediate supervisors – concerning how they would use smartphones that they expected to receive in the next year. The theoretical framework utilized Rogers' organizational adoption theory and hierarchical organization theory to compare perceptions by staff at different levels. Results showed both field level staff and supervisors generated a rich variety of ideas about how the smartphones might be useful, especially for photo/video applications and monitoring/evaluation. Results also confirmed that even when discussing similar uses, supervisors and field agents do not always have the same ideas about how photos, videos or other uses might help the organization most. Finally, both field agents and supervisors tended to focus more on specific individual uses, and neglect the systematic changes in the organization that would be necessary to make them work.

Key Words

Organizational Adoption, Hierarchy, Smartphone, Uganda, Extension, Perceptions

What Ugandan Extension Workers Really Want and Expect from Smartphones

Introduction and Statement of the Problem

The adoption and use of smartphones to enhance extension communication activities and capabilities has been one of the most important developments of the past 10 years. Globally, initiatives such as the Google Earth Outreach Grameen Foundation Applab (Culbertson, 2012; Google Earth, 2014) has introduced smartphones into Uganda and other African countries that contain extensive agricultural databases, built-in questionnaires for gathering farmer and extension agent information, GPS abilities to map and locate farms, and a system for linking farmers to Community Knowledge Workers who help route their questions to experts for answering. This project alone has obtained data from 600,000 farmers in Uganda.

The Google/Grameen initiative is the biggest in Africa, but it is only one of a number of initiatives designed to bring the benefits of smartphone use to non-governmental organizations and extension systems throughout Africa. Davis and Addom (2010) document the growing use of ICT devices including mobile phones and smartphones by extension and other agricultural organizations in Africa. Masuki et al. (2010) specifically address growing use of mobile phones in southwest Uganda for farmers and farm extension organizations. Applications of smartphones have been especially noteworthy in bringing health care assistance to rural Africans, in agricultural extension work, and in mobile banking through use of smartphone applications.

Although the adoption of smartphones by extension has occurred even more rapidly in the United States and other Western countries than in Africa, its adoption in Africa merits special importance and attention because extension systems there have been

characterized by too-few field agents and a lack of communication support infrastructure and budget. The arrival of mobile phones in Africa has truly been a game-changer in terms of their ability to link extension workers with farmers, experts and extension managers in ways that were impossible before.

The adoption of smartphones has led to some research, usually on their ability to carry out a particular task, such as provide access to market information, or display video that can help farmers learn (Cai, Abbott, & Bwambale, 2013). However, the current study examines a broader set of impacts that relate to the organizational context in which adoption and use takes place. Decisions about adoption of smartphones are usually made at the top level of an organization's hierarchy, often without consulting those at the lower levels. This is not unique to smartphones. When the decision was made in the 1980s to computerize extension in the United States, it was primarily made by those at the top who desired to save money by reducing the need to print large numbers of publications and pay postage to send publications and messages to extension offices. The impacts that this might have on local offices and staff were not carefully considered (Abbott and Gregg, 2000). Smartphones can have important impacts on organizational hierarchies. Thus, the expectations of those at each level of the hierarchy should be considered, and research is needed to examine how smartphones might be used at each level. What do field agents believe smartphones might be used for? How might those expectations be different than their managers? If the expectations of groups at each level are well understood when smartphones are introduced, more appropriate training can be provided, and conflicting expectations can be addressed.

The current study examines the adoption and use of smartphones by a small NGO extension organization working with farmers in rural Uganda. The organization, VEDCO, employs local citizens who are trained to teach improved agriculture techniques to farmer groups in the area. The study began with interviews held with field agents and managers a year before the smartphones arrived, and then included a second wave of interviews when the smartphones arrived and training occurred. The goal of the research was to better understand managers' and field agents' perceptions of how smartphones could be used in the NGO extension program. This information, collected before participants had been exposed to the smartphones, is intended to be used to design training and is hoped to impact initial use that takes place when the smartphones were delivered. Additional future studies will take place to investigate how the phones are used.

Theoretical Framework

As was the case with organizational introduction of computers, it is often assumed that smartphones and similar devices will have positive impacts. Kling (1996) referred to this as "technological utopianism." Because it is assumed that the devices will dramatically improve an organization's performance, in many cases systematic research and evaluation has not been conducted, or has been limited to one or two uses without consideration of what other effects might be taking place.

The introduction of smartphones into extension is what Rogers would call an "organizational innovation." In his influential book, *Diffusion of Innovations* (2003), Rogers took pains to distinguish innovations that occur in organizations from individual adoption patterns, pointing out that the processes are quite different. His book,

Communication Technology: The New Media in Society (Rogers, 1986), has a special section focusing on organizational adoption patterns. One of the key points is that organizations often have "champions" who advocate for the adoption of an innovation, such as a smartphone. These champions also often provide a vision of how the devices will serve the interests of the organization. For example, in the United States, visions of computers in schools showed clusters of excited students in classrooms conversing with counterparts in other countries. While these visions are often important in securing adoption, Kling (1996) and Rogers (1986) both found that the actual most important and common uses of computers were different than originally envisioned. Importantly, Rogers (2003) found that those who actually were going to receive and use the technologies often had little or no input into decisions about the type of device or the training necessary to use them effectively. Very often the champions were managers, IT specialists, or others who would not be the actual users.

The literature on adoption of smartphones by extension and NGO extension-type organizations in Africa indicates that smartphone adoption is spreading rapidly among these organizations (Davis and Addom, 2010). The main driver in many of the studies has been donor organizations or extension management that sees smartphones as providing a dramatically better way to monitor and evaluate performance on the ground. In most cases, such evaluation often depended on written reports that must work their way gradually through unreliable administrative channels over extended periods of time. Little attention was paid to what actual users of the smartphones might consider them good for, or how using smartphones might affect the overall organization.

Organizational hierarchical theory points out there are important differences in communication behavior and performance among field agents, middle managers, or top administrators (Blau and Scott, 1962). Expectations regarding appropriate uses of smartphones at each level might be quite different. For example, when the Internet and email were launched for extension in Iowa, field level staff perceived that it would give them instant communication with extension specialists and staff whenever needed. On the other hand, the specialists themselves envisioned that websites they would develop providing information to field staff would free them from the task of personally communicating with field staff. Studies (Mazmanian et al., 2013) have referred to an "autonomy paradox," in which the organization benefits from having instant access to all staff, but staff themselves lose autonomy because they must always be available. Early research on email found that lower level employees were able to use email to jump levels of the organization and communicate with top administrators directly, bypassing their managers. Because smartphones can provide even more communication options, careful attention is needed to understanding how those at each level of the organization expect to use the devices, and how such uses might affect the entire organization. Several recent studies of smartphone introduction in health care organizations (Park and Chen, 2007; Evidence Centre, 2011) document the importance of hierarchical organizational factors. Tapia, Tchouakeu, Maldonado and Maitland (2013) found that in humanitarian action organizations, greater hierarchies actually helped adoption and use of smartphones because the higher levels were able to help resolve problems at lower levels. However, few studies have examined hierarchical organizational factors for smartphone adoption by agricultural extension organizations in Africa.

Another important reason for careful field evaluation of smartphones in Africa is that conditions there are much different than those in most developed countries. Although the same device may be used, in a Ugandan context this may be much different than an organization in a developed country. For example, electric power is often not available in many rural areas, or is available only sporadically (Masuki et al., 2009). When that is the case, users tend to minimize the time the devices are on. This has important implications for how often users turn on their phones or how they might make decisions about when and how to use their devices. Connectivity is often absent or spotty in wide regions of Africa (Masuki et al., 2009). Building networks and cloud-based information systems assumes connectivity at a minimum and often high-speed access. It also assumes affordable cost for connectivity. In Africa, high-speed connectivity is often unavailable or very expensive (Masuki et al., 2009).

Michael Dertouzos (1997) in his book *What Will Be* about the impacts of computers on society, argues that organizational innovation proceeds like "electronic bulldozers," gradually working their way through organizations. Eventually, the promise and potential of the technology is reached, but this may take decades. IBM's study of the introduction of smartphones into its own organization found that it was best to start with only a few uses or apps, and then gradually expand over time (Ahmad and Orton, 2010). Users were not capable of envisioning or mastering all the complexities of the devices in the beginning. Thus, identifying what the priority uses are, and providing training about them, should be a high priority or organizational innovation. Martin and Abbott (2011) found that farmers adopting mobile phones tended to start out with a few uses, and then

expand the number of uses over time as they mastered the devices and learned what they can do from others.

Purpose and Objectives

This study focused on three main research questions relating to perceptions about smartphone uses by extension agents and their supervisors:

RQ1: Prior to receiving smartphones, what perceptions do field level extension staff and their supervisors have about how these devices might be useful to them?

RQ2: Based on their current knowledge of mobile phones and their perceptions of smartphones, what concerns do field level extension staff and their supervisors have about using these devices in the field?

RQ3: What are differences in expectations between field agents and their supervisors, and how might those differences affect training needs and future organizational functioning?

Methods

The study was carried out within a small non-governmental organization (NGO) named VEDCO (Volunteer Efforts for Development Concerns) that has provided extension services to groups of farmers in the Kamuli region of eastern Uganda for the past 25 years. The organization receives funding and partners with the Center for Sustainable Rural Livelihoods (CSRL) at Iowa State University. VEDCO operates by recruiting local people, already well known and trusted in their communities, to serve as extension agents. Field-level agents are known as Community Based Trainers (CBTs). They provide extension services to local families in two ways: they hold regular training sessions where large groups of people come to learn new techniques and strategies and

they also make visits to individual households to assess progress and troubleshoot problems. Each of the three regions served by VEDCO in this area has 4 CBTs assigned to it. CBTs are supervised by Project Extension Officers (PEOs). Each PEO is responsible for overseeing 2-4 CBTs and meets regularly with them to assign work and consult on problems. Each PEO also oversees a specific facet of VEDCO's programming, such as microfinance loans or human nutrition, and are viewed as an expert in that program that other staff members can consult.

In this study, a total of 12 CBTs and 6 PEOs participated in in-depth interviews focusing on their perceptions about how smartphones might be useful to them in their extension work. At the time of the interviews in June 2013, smartphones were just beginning to appear in the Kamuli region. More basic mobile phones had been in use for approximately five years, and most of the field level CBTs and PEOs had some familiarity with them, although not all had their own mobile phone. Improvements in bandwidth in the area had made smartphone use practical, although in many rural locations service was still poor or totally unavailable. Those interviewed had participated in a workshop the previous year in which the idea of using smartphones and other ICT devices for extension work had been introduced. However, many had never seen or used a smartphone.

Because this was formative research asking both CBTs and PEOs to provide their perceptions about how smartphones might be useful, a qualitative approach was used. Guiding questions covering various possible categories of use (phone calls, photos, video, email, Internet, etc.) were included, as well as general questions about how the phones

might be most useful in extension work. Each field level extension agent is responsible for about 100 farmers, who are organized into groups that are visited frequently.

Each of the CBTs and PEOs, 18 in total, was interviewed separately over a three-week period. Three main topics were explored: (1) A description of the participant's current job and duties; (2) How the participant uses his or her mobile phone for both job-related and personal tasks; and (3) The participant's perceptions of what a smartphone is useful for and how they would like to use one for both job-related and personal tasks. No judgments were made about unrealistic expectations, and none of those interviewed were told what others had said during their interviews. The goal was to better understand how they perceived smartphones prior to receiving them. Information provided could be directly useful to preparing training for both CBTs and PEOs when smartphones arrived. However, the differing perceptions the field extension agents and their projects extension officers would also be very important in better understanding how smartphones are perceived at different levels of an organization. As has been the case in many smartphone initiatives in Africa, the initial idea for providing staff with smartphones came from the top – from Iowa State University's CSRL Director, in concert with the NGO's executive director, and an important motivation was to improve the quality and efficiency of monitoring and evaluation activities. However, those interviewed did not know this was an important reason when they were interviewed initially. They did know it was possible they might receive smartphones to facilitate their extension work.

Interviews were carried out by the principal investigator along with a trained interviewer conversant with the local language and culture. In some cases, the interviewees spoke English, but most of the interviews were conducted in the local

languages (Luganda and Lusoga) and translated to and from as the interview progressed. Interviews were recorded and transcribed. When analyzing results, the principal investigator searched for patterns of responses concerning perceptions of how smartphones might be used, problems participants encountered while using their mobile phones, and concerns about the new technology. Special attention was given to grouping patterns of responses by field level agents and supervisory staff.

The technique for data analysis was the constant comparative technique as outlined by Wimmer and Dominick (2011). First the transcripts were read and preliminary codes were assigned to participants' statements about their perceptions or concerns. This was done by summarizing lengthy quotes into concise statements that highlighted the main idea the participant was presenting, and then assigning a one- or two-word code that distills the main theme of the statement. For example, this statement was given by a CBT: "He says it will also help to motivate farmers to come. Because they feel nice or ok when you take a picture when you are training them. Next time they will also come in large numbers because they also know that they will be taking pictures". This statement was summarized as "Use pictures as incentive to motivate farmers," and assigned the code "Motivation." These codes were also compared to the context of the statement to ensure that the main point of the statement was accurately represented. If a statement had more than one main point, it was broken apart in the summary step and coded as multiple units. Once codes had been assigned to all statements they were grouped and categorized using an iterative comparison process. Items with identical codes were grouped into categories. Remaining items were systematically examined and either placed into an existing category or placed into a new

category. The categories were frequently examined and revised during this process. Once categories were established such that all statements had been accounted for aside from identified outliers, the categories were described according to their underlying themes. These descriptions are listed in the following section. Finally, these themes were compared and relationships established to describe the general perceptions participants had about the introduction of smartphones to their program, which are described in the discussion section.

Results

RQ1: Prior to receiving smartphones, what perceptions do field level extension staff and their supervisors have about how these devices might be useful to them?

In the interest of studying hierarchical differences, the coding for each research question was done separately for PEO responses and CBT responses. Coding each set of responses separately helped reduce bias because each category was created with only the statements of the group being studied.

After coding PEO responses for research question one, the following category descriptions emerged. The numbers in parentheses indicate the number of PEOs and CBTs who mentioned the specific category (example: 6/6 means all PEOs mentioned this category):

- Smartphones will allow for more efficient use of time and resources (6/6)
- Smartphones will allow outreach efforts to be more effective and have a greater impact (5/6)
- Smartphones will increase connectivity between staff (4/6)

- Smartphones will increase the ability for documentation, monitoring, and evaluation (4/6)
- Smartphones will motivate staff and make work easier (4/6)
- Smartphones have applications that will be useful (3/6)

The CBT responses yielded the following category descriptions:

- Smartphones will make staff efforts to train farmers more effective (11/12)
- Smartphones will make staff feel proud (9/12)
- Smartphones will and make work easier (9/12)
- Smartphones will increase transparency within the organization, allowing for documentation and reporting (5/12)
- Smartphones will enable communication to get support from colleagues and superiors (4/12)
- Smartphones will allow for more efficient use of time and resources (2/12)

While CBTs and PEOs each offered a unique perspective, there were many places where they held similar expectations. Four main areas are examined in greater detail: photos and videos, monitoring and evaluation, connectivity, and motivation/pride.

Photos and Videos

The use of photos and videos did not generate its own category in either analysis. This is because the ideas that each group had concerning their use were so broad and varied that this particular function of smartphones cut across almost every category. The ideas that participants had for how they could use pictures and videos illustrates the way they view technology as being able to influence every part of their work. Participants envisioned photos being used to aid in communicating with each other, providing

motivation, improving the effectiveness of farmer training sessions, and enhancing documentation efforts. Table 1 shows evidence of this richness.

Table 1: Participants' Ideas Regarding Use of Photos

PEO	Photos can be used to track progress over time
	Photos can be used to provide evidence for a need
	Photos can be sent to colleagues to help diagnose a problem
	Photos can be used to enhance reports for management and donors
	Photos can show farmers dangers to look out for
	Photos can be used to document achievements
	Photos can supplement farmer training sessions
CBT	Photos can be shown to PEOs to get advice
	Photos can be used to document several stages of a process
	Photos of successful farmers can be used to motivate other farmers
	Photos of good practices can be used to teach other farmers
	Taking photos at an event will motivate farmers to attend
	Photos can be used to document attendance at a meeting
	Photos can be taken to provide evidence of work that was done
	Photos can be used to document allocation of resources to client farmers
	Photos can be used to document progress
	Photos can be used to share ideas between farmers in different locations
	Photos can be used as personal memos
	Photos can be used to document needs in the community

Monitoring and Evaluation

Both PEOs and CBTs frequently mentioned applications of smartphones that could help with the task of monitoring and evaluation. Topics mentioned span the entire hierarchy of the organization, from CBTs providing proof of work to their supervisors to improving reports that are sent to donors. Table 2 shows the responses from each group.

Table 2: Participants' Ideas Regarding Use of Smartphones to Improve Organizational Monitoring and Evaluation

PEO	Photos can be used to track progress of a household over time
	Photos can be used to provide evidence for a need in the community
	Photos can be used to document achievements
	Photos can be used to enhance reports for bosses and donors
	Smartphone will record what time a photo was taken for documentation
	GPS enables location-tagged photos for documentation
CBT	Using pictures as evidence of work
	Voice recordings as evidence of work
	Photos can be used to document attendance at a meeting
	Photos can be used to document allocation of resources to client farmers
	Photos can be used to document several stages of a process
	Photos can be used to document progress

Connectivity

Another main theme that emerged from the interviews was the idea that smartphones would allow for greater connectivity between staff members. PEOs want to be able to supervise their CBTs and also be readily available to advise them. Reciprocally, CBTs mention wanting more ability to consult with their PEOs and alert them of needs and problems in the community. Both groups want technology to allow them to communicate with their colleagues more frequently, more reliably, and with more information richness. They also hoped to enable communication with more parties than before. Participants mentioned extending their reach both to client farmers to capture and share their ideas with each other and with the organization, and communicating to higher tiers of management including the main VEDCO office in Kampala and personnel at Iowa State.

Table 3: Participants' Ideas Regarding Use of Smartphones to Increase Connectivity

PEO	Will have an increased ability to supervise their CBTs
	Can more reliably reach CBTs in the field
	Will have more regular access to email
	Can be contacted by CBTs more reliably
	Smartphones could provide a platform for staff to easily share ideas
	Will have the ability to work even when away from office
	Having smartphones will improve communication
	Can use videos to share farmer ideas and innovations
	CBTs can use pictures to consult with PEOs on problems found in the field
	PEOs could send pictures to colleagues to help diagnose a problem
CBT	CBTs could show pictures to PEOs to get advice
	Could use email to communicate with upper management, including ISU
	Could use pictures to document needs they find in the community

Intrinsic Value of New Technology

Another theme that was shared by many participants in both groups was the idea that the new smartphones would offer many benefits beyond those tied to specific aspects of their functionality. The main ideas expressed were that the new technology would simplify or otherwise ease the work, they would motivate staff and clients alike due to their novelty, and they would engender feelings of pride or loyalty among the staff.

Table 4: Participants' Ideas Regarding Their Beliefs in the Intrinsic Value of Smartphones

PEO	The smartphones will increase the loyalty of staff members to the organization
	The smartphones will motivate staff to improve performance
	The smartphones will help locate client farmers more easily

Table 4 continued

	Voice recording is easier than creating paper reports
	Showing pictures on the phone is easier than printing them out
	GPS mapping easier and faster than traditional methods of land measurement
	The smartphones will make it easier to calculate measurement conversions
	The smartphones will make the work easier
CBT	Seeing pictures on the smartphones will motivate farmers
	The smartphones will motivate farmers to purchase their own phones
	The smartphones will bring feelings of pride
	The smartphones will make work easier
	The smartphones will reduce the amount of writing needed
	Replaying recordings of demos will ease the training workload

RQ2: Based on their current knowledge of mobile phones and their perceptions of smartphones, what concerns do field level extension staff and their supervisors have about using these devices in the field?

When asked about their concerns about the new technology, both groups had similar responses. The PEOs' responses were categorized into the following categories:

- Expense as a barrier to successful phone use (5/6)
- Infrastructure as a barrier to successful phone use (3/6)
- Lack of training as a barrier to successful phone use (3/6)
- PEOs concerned about CBTs (2/6)
- Quality of phones (2/6)

CBT responses yielded the following categories:

- Expense as a barrier to successful phone use (1/12)
- Infrastructure as a barrier to successful phone use (1/12)

- Training as a prerequisite for successful phone use (4/12)
- Phone incompatibility to the setting as a barrier to successful phone use (2/12)

Analysis yielded two main concerns that the groups shared: maintenance issues and training concerns.

Maintenance Issues

Many of the concerns voiced by participants in this study had to do with how to keep the phones functioning well. This encompasses concerns about the cost of keeping the phones loaded with airtime credit, the cost and inconvenience of keeping the battery charged in areas with intermittent or no electricity, and the problem of weak cellular network coverage in many areas where staff live and work. These concerns are listed in Table 5.

Table 5: Participants' Ideas Regarding Their Concerns about Smartphone Maintenance

PEO	The expense of airtime
	It could be hard to keep battery charged
	The CBTs who live in areas without power will need to pay to charge their phone batteries at booths
	Poor network connectivity
	Some networks are stronger in certain areas than others
	It more expensive to contact people who use a different network
CBT	The expense of airtime
	Weak network signal is a challenge in many areas

Training Needs

Another concern that appeared frequently was the need for training. Both PEOS and CBTs voiced the concern that CBTs, with their limited experience with technology,

would require comprehensive training in order to make use of the new equipment. The responses that make up this category can be seen in Table 6.

Table 6: Participants' Ideas Regarding Their Concerns about Training Needs

PEO	Need for training
	Staff sometimes turn their phones off during work hours; there is a need for training on protocol
CBT	Needs training to use it
	Don't know how to use it, but once trained it will be simple
	Will not know how to use it unless training is given; then they will know how to use it

RQ3: What are differences in expectations between field agents and their supervisors, and how might those differences affect training needs and future organizational functioning?

While the first two research questions focus on the similarities between the two groups' responses, some key differences were also revealed. First, PEOs expressed many concerns, not for themselves, but for the CBTs. They cited reasons including the CBTs' limited education and literacy skills and their more remote living and working conditions. CBTs did not mention any concerns about their own skills, but talked mostly about how the new phones would help them work with their project farmers. Similarly, while both PEOs and CBTs talked about the need for adequate training, the CBTs had a more optimistic view. The CBTs expressed the need for training along with a confident assertion that once they received it that using the phones would be "easy." The PEOs expressed a need for training, but remained concerned that the CBTs would have trouble using the phones due to their complexity. While both groups were interested in

transparency, reporting, and documentation, they were approaching the topic from two different sides. CBTs were very focused on documenting proof of their work to their supervisors, while PEOs were more interested in how to obtain faster and higher-quality reports. These discrepancies make sense, given the two groups' differing job descriptions, and highlight the value of obtaining each groups perspective when planning how these devices will be used.

Discussion

Often the champions of technology adoption have very different ideas than the actual users of the innovation. In this case, the champions of these smartphones chose them with the intention of improving the monitoring and evaluation practices within the organization. The staff that will be using the phones had many more ideas about their usefulness. Luckily, they were also thinking about monitoring and evaluation, but the ideas they generated were broad and varied. This illustrates the richness of information that can be obtained from interviewing the end-users about their own ideas. This information is invaluable for creating a training program that can take advantage of the multiple perspectives to solve problems in creative ways.

One problem that was not addressed by users, however, was a system for implementing many of these ideas. This brings up the earlier discussion about the electronic bulldozer idea. While identifying the most desired uses and focusing training on those specific issues can ease the insertion of the new technology into an existing work schema, another important step must be taken to ensure project success. This step is creating a scaffolding within the organization to support the new practices. For example, if CBTs want to use pictures to alert the office to a problem in the community, such as a

malnourished child, to whom do they need to show the pictures? How do they get the picture to that person? What happens to the picture after it is shown to the correct person? Is it stored somewhere? Without a system, it is likely that the idea of using pictures to report problems will go unfulfilled.

The idea of the autonomy paradox is also relevant to themes brought up in this discussion. Both PEOs and CBTs seemed very excited about the prospect of increased communication and connectivity. They were eager both to have more access to and to be more available to their colleagues. Contrary to predictions about the autonomy paradox, they made no mention of any concerns about how this might take away their privacy or interfere with their time off. Whether or not this becomes an issue remains to be seen.

The concerns about maintenance that were brought up by participants closely match the concerns described in the literature, specifically concerns about access to electricity and the cost of Internet coverage (Masuki et al., 2010). It is interesting to note that 6 out of 6 PEOs voiced concerns while only 8 out of 12 CBTs did. Additionally, 5 of the 6 PEOs voiced multiple concerns while only one CBT voiced more than one concern. This could be explained by the fact that most of the PEOs had either owned or operated a smartphone before and therefore had more experience with them on which to base their ideas. Another possible explanation is that due to both their higher education levels and more experience managing others, the PEOs were more used to thinking critically about new ideas than the CBTs, many of whom have only a primary school education and are used to following preset work plans rather than generating them themselves.

Even PEOs, however, fell subject to technological utopianism. While they were more able to imagine some challenges with the phones, they too held the belief that the phones

would make their work easy without considering the added tasks they may bring. Modern technologies are designed to make life easier, but all too often they introduce new challenges and demands that actually make life more hectic. Neither PEOs nor CBTs voiced any concerns about the phones increasing their workload. They also held a firm belief that the phones would make their tasks easier and save time, and never considered how technological problems, such as software malfunctions or poorly-designed user interfaces could make using the phones more time- consuming and frustrating than traditional methods. Becoming aware of these perceptions before introduction is important because if these ideas are addressed in training it can prevent frustration and disillusionment if phones do not meet idealistic expectations.

The analysis of the differences between the views of the PEOs and those of the CBTs illustrates the themes of organizational hierarchical theory, specifically that members of different tiers of an organization exhibit different communication behaviors and have different goals. For example, both CBTs and PEOs see the possibilities of using photos to document field activities. However, CBTs are interested in documenting problems for PEOs, while PEOs see photos as something that could be used to inform or persuade donors. These differences in perception might result in a desire for very different types of photos. Similarly, several CBTs saw the possibility of documenting meeting attendance by and activities by taking a photo. Given the need of the PEOs to provide standardized field reports, what would happen if photos were used to document attendance? How could these photos be used to fit into needed tables or materials? These examples illustrate how attention to the needs of each level of an organization are important. More research is needed to ascertain exactly how each of these groups make

use of their new communication opportunities, but it can be very clearly seen that an understanding of each group's perceptions can be useful in creating a training program and organizational procedures that will pave the way for more successful communication.

CHAPTER 3

PHASE 2: HOW TRAINING AFFECTS THE INITIAL USE OF SMARTPHONES BY EXTENSION STAFF IN RURAL UGANDA

Abstract

Training is essential when introducing information and communications technologies. It is especially important when the participants have little or no prior experience with similar technology. This observation-based study evaluates the training methods used to introduce smartphones to rural agricultural extension agents to determine the aspects of training that worked well and those that need revision. It also seeks to understand how the training influenced the participants' use of their devices in the weeks that followed. It was found that hands-on practice, working in groups, and participating in a role-playing scenarios were helpful for participants. However, the training sessions were too long and moved too quickly into complex topics that the participants were not ready to learn, resulting in poor retention of trained skills. Training also failed to focus on the most relevant applications. In the weeks after the training, participants mainly used simple functions with which they had previous experience, but remained excited to learn more complex functions. Effective introductory training should be provided in short sessions focused on the applications that align with participants' skills, needs, and interests, coupled with follow-up meetings for participants to review, troubleshoot, and learn new skills.

Keywords

Training, ICT, Development, Smartphones, Uganda, Africa, Extension

How Training Affects the Initial Use of Smartphones by Extension Staff in Rural Uganda

Introduction

The use of smartphones and associated applications to alleviate communicative and social challenges within developing countries is a growing area of research. Stories of success can tempt development agencies to regard the technology as a silver bullet that can lift recipients out of poverty. Simply having the technology, however, is not enough – various factors must be aligned for individuals and groups to learn to use such technology and move toward long-term integration. In addition to understanding the basics of how to operate them, users also need to be familiar enough with their functions to identify appropriate uses for the new technology (Clark & Kalin, 1996; Douglas, Wojcik, & Thompson, 2012; Gakibayo, Ikoja-Odongo, & Okello-Obura, 2013). Participants must also understand how to maintain their new devices to avoid abandoning them when they inevitably need repair (Jackson, Pompe, & Krieshok, 2011).

Regarding technology as a silver bullet is not limited to development agencies. Recipients can also be prone to unrealistic expectations and become disappointed to discover that the devices, while making some tasks easier, bring their own new set of problems and frustrations (Hosman, 2010; Jackson et al., 2011; Jones, 1999). Users need to be prepared for the realities of using new technology, including an understanding of its capabilities and limitations, for adoption to continue. To create a suitable training program, users' education level, previous experience with technology, and their ideas and goals must be taken into account (Hosman & Elizabeth, 2012). Hosman stresses that "by understanding what the technology recipients in the developing world truly want and

need…projects are more likely to address existing needs and, as such, stand a much better chance of succeeding than those thought up by a research and development team in a far-off locale with the aim of selling a product that their company already makes (Hosman & Elizabeth, 2012).” Providing the proper training when introducing these technologies is therefore essential to the adoption and long-term integration of the technology (Du Toit, 2015; Hosman, 2010; Oosterlaken & Hoven, 2012).

This study examines a series of smartphone training sessions offered through a rural agricultural outreach program in Uganda to explore which aspects were beneficial to the user’s adoption of the technology and which aspects created challenges. Likewise, this study compares the content of the training sessions to the actual use of the smartphones over a few weeks following their completion. This information is used to determine how the users incorporated the training into their daily routines and what content they want from future training. Answering these questions helps identify practical guidelines for improved introduction of smartphones in similar developmental contexts.

Study Context

This study is part of a larger project that explores how smartphones are integrated into a rural agricultural outreach program in Uganda over a three-year period. VEDCO (Volunteer Efforts for Development Concerns) operates in Kamuli, Uganda and seeks to provide assistance to food-insecure households in this area. Staff routinely teach large-group seminars and visit individual client households to monitor their progress. They are also available to make house calls and help clients troubleshoot problems they encounter. The field team consists of 12 Community Based Trainers (CBTs), who are local citizens already well known and respected in their communities that are trained and employed to

provide VEDCO's services to their neighbors. VEDCO also employs six Project Extension Officers (PEOs), who are experts tasked with managing a particular facet of the extension programs. Each PEO supervises a team of CBTs. Iowa State University's Center for Sustainable Rural Livelihoods (CSRL) partners with VEDCO staff and clients to carry out development extension and research in the area. The resulting knowledge is used to guide the program.

In a first phase of this research program described and published elsewhere, all 12 CBTs and six PEOs working in the study area were interviewed to collect their thoughts and attitudes about the possibility of using smartphones to aid in their work. Participants overwhelmingly expressed excitement about the prospect. The interviewees noted that although mobile phones are relatively new to the area, using them had already revolutionized VEDCO's outreach efforts. Participants viewed mobile phones as an essential tool for their jobs. They felt optimistic that upgrading from standard mobile phones to new, more powerful smartphones would similarly transform their organization again.

The feature that participants were most excited about was the camera function. They had many ideas about how they would use pictures and videos to improve their work, including using photos to track progress of households, prove that they carried out a task, and train farmers on new techniques. They were also intrigued about the possibility of more advanced options, such as browsing the internet, checking the weather forecast, and having access to GPS. They believed having smartphones would (a) increase communication between staff, (b) make the gathering and sharing of information faster, (c) improve transparency within the organization, (d) enhance monitoring and

evaluation, (e) generally make work easier, faster, and more efficient and (f) increase staff motivation and personal status. These responses were taken into account when CSRL planned the purchase and implementation of the smartphones for this current phase of the project. This phase examines the introduction of the smartphones: the training received by the participants and the resulting use of the smartphones in the weeks after their introduction.

The importance of proper training when introducing new technologies has long been established in communication technology settings. Staff from universities and public libraries that were not offered training feared or hesitated to use new internet-based information systems (Spacey, Goulding, & Murray, 2003; Gilmore, 1998). Appropriate training has been found to increase staff productivity, motivation, and confidence in using new technologies (Williamson, 1993) and increase an individual's use of a new device (Gilmore, 1998; Meera & Meera, 2015). Feedback from participants in various computer training sessions indicate that hands-on practice is an important element when training on a new technology (Tedd, 2003). Training modules that allow individuals to participate on their own are advantageous because this approach allows individuals with different skills to move at their own pace, yet in-person sessions have the benefit of sparking valuable conversations between participants (Jones, 1999; Tedd, 2003).

The challenges of providing training sessions in developing countries where participants have little to no experience using electronic devices, have low levels of formal education, and often have limited literacy complicate how training sessions can be planned and executed. Yet, such challenging contexts are the very ones that could benefit

most from adoption and integration of new technologies. Therefore, examining the successes and challenges faced by the development and execution of training sessions in such a context can identify potential best practices as well as potential problems for other technological training settings in similar ICT contexts.

Therefore, the objective of this study is to identify aspects of the training provided to VEDCO staff that were the most effective as well as areas where the training fell short. Specifically, it analyzes the smartphone training experience in the context of a rural agricultural outreach program in Uganda to answer the following research questions.

RQ1: What aspects of the training session were beneficial for the users?

RQ2: What aspects of the training session were challenging for the users?

RQ3: How did the participants use their smartphones in the weeks following the training sessions?

RQ4: For what needs did participants request additional training after using the smartphones for a few weeks after training?

Methods

The method of participant observation was used to collect the data. This is a method where researchers become "active and involved members of an existing group" in order to "gain insight into the obligations, constraints, motivations, and emotions that its members experience as they complete their everyday activities" (Lindlof & Taylor, 2011). Specifically, the researcher took the role of an *observer-as-participant* -- someone who largely watches others participate and takes notes on their observations, rather than on their own experiences in the context (Brennen, 2013). The role of observer-as-participant was chosen because it best suited the parameters of the study. The short

duration of the researcher's visit made it necessary to be clear, direct, and overt in data collection (Lindlof & Taylor, 2011). Likewise, since the objectives and purpose had been established with the participants in the previous phase of the project, as described in Chapter 2, there was no benefit to downplaying or disguising the research intentions. The researcher needed to be able to join the group and accompany participants in their day-to-day activities. Acting as an observer-as-participant permitted both the opportunity to observe participants' activities closely and the freedom to discuss their experiences with them.

The researcher arrived to the research site a few days prior to the scheduled delivery of the phones. Grameen Bank provided the smartphones and developed some of the specific applications to be introduced. They also provided a staff member to conduct a full-day training seminar for all CBTs and PEOs who would be receiving smartphones.

The researcher attended the training seminar, collecting data on the content of the training sessions and the experience of the participants. Regarding the training content, observations focused on what topics were covered, how much time was devoted to each topic, the use of teaching strategies such as visual aids or hands-on practice, and any questions that were asked and the answers that were provided. Regarding the experience of the participants, observations focused on what topics were easily understood and which were deemed difficult, as well as the explicit emotions portrayed by the participants. Conversations with the participants helped to augment and contextualize their experiences. Unexpectedly, the participants needed help more frequently than the trainer could offer and they approached the researcher as another expert, asking for

assistance in how to use the smartphones. As such, the researcher began to fill the role as a co-trainer, assisting participants as requested while documenting their experiences.

The trainer agreed to return for a second day of training once it became clear that one day would not be sufficient. This second day proceeded like the first. Only CBTs attended and the trainer spent the day reviewing and practicing what had been covered on the previous day. Because many PEOs were not able to attend either training session, it was decided that a third training session was necessary. The trainer asked the researcher to finish the training session as he could not return the following day. The researcher agreed and led a training session the following day for the PEOs. This session was a compressed version of what was covered during the previous training sessions; the researcher decided that because many PEOs had some previous experience with smartphones and all routinely use computers for their work, they did not require as much in-depth training on how to use the phones themselves as did the CBTs. The training provided consisted of a brief overview of smartphone operation, followed by short introductions to some of the applications: weather, internet browser, CKW Search and Survey, and the camera function.

After the training sessions, the researcher met with each participant according to their normal working practices -- some worked individually while others typically worked with a partner or group. These follow-up discussions and observations took three weeks to meet with all the participants. Each meeting began with a discussion about how they were using their smartphones and progressed to questions or review of topics with which they were struggling. The researcher then followed the participant for the day, documenting and photographing their activities and any interactions with clientele

involving their new smartphones. Data collected during this phase focused on documenting the functions participants were trying or successfully using, what functions they needed more training to use effectively, what tasks they hoped to achieve with their phones, how easily the participants were able to integrate the new technology into their work routines, and their perception of how having the phones was changing how they do their work.

On the final day of the visit, the author held a meeting with all of the participants to allow them to share with each other how they had been using their phones and to discuss problems and new ideas. They discussed what features each group used the most, what challenges they faced, what they would like to learn next, and any changes they had noticed as a result of their new smartphones. They also suggested ideas for some of the problems they experienced over the time period of study.

Results

Training Benefits

The first research question asked what aspects of the training sessions were beneficial for the users. Three training strategies in particular appeared to be the most beneficial to the participants as they learned to navigate their new devices: hands-on practice, peer-to-peer training, and role-playing exercises.

The first strategy was hands-on practice. The smartphones were distributed at the start of the training session so that participants could practice on the actual devices they would be using. Because many participants had never operated a smartphone or computer before, being able to follow along with the step-by-step practice helped them learn the more abstract concepts of how the navigate the device. It also alerted the trainer to

necessary training topics that had not been expected. For example, many participants struggled with how to use the touchscreen on their phones. Once aware of this problem, the trainer took some time to help the participants learn how to use the touchscreen, from identifying buttons and learning how to tap them successfully versus swiping the screen to reveal a different page of icons. The trainer's unfounded assumption about the users' baseline understanding would not have been challenged and ultimately addressed without the benefit of hands-on practice.

Participants also received a solar charging kit and were instructed to practice setting it up and charging their phones. Each CBT was in charge of unpacking and setting up his or her charging unit. The binary feedback – either the phone charged when plugged in or it did not – was a helpful aspect as it forced participants to acknowledge if they did not understand how to hook it up correctly. Fellow participants and the trainer aided participants who were having trouble until everyone had successfully set up their charger. After this exercise, participants expressed feeling confident that they knew how to use their new equipment and would be able to operate it themselves at home. Conversations during follow up visits revealed this to indeed be the case; some concerns were voiced about how well the chargers worked but all participants appeared to operate them with no trouble.

The second successful strategy was peer-to-peer training. For much of the training program, participants worked in small groups consisting of both CBTs and PEOs. This proved useful since they were familiar with this format – PEOs meet weekly with their CBTs to assign work schedules and consult on problems. The main benefit of the small group work was that those who grasped the concepts sooner were able to help their

fellow group members. Groups that included PEOs were particularly successful because the PEOs had experience operating computers, which share many commonalities with smartphones, and were able to navigate the phones with relative ease. Participants shared a similar level of experience and a common framework and were thus able to clarify concepts for each other in ways that were more familiar and accessible than the trainer's explanations. The small group setting allowed them to lapse into local language rather than staying in the formal English of the training session, which seemed beneficial to group members who were less capable of conversing in English. Participants also seemed more willing to ask questions during the small group activities, rather than posing questions in front of the whole group.

The third successful strategy was role-playing. After introducing the survey program, the trainer led the entire group through an exercise where he pretended to be a local farmer whom they interviewed him using a survey tool application on the phone. This exercise not only helped them practice using the application and gave them the opportunity to ask questions as they arose, but it had the significant benefit of forcing them to think critically about how they would handle different situations in the field. For example, when they asked the trainer for his email address he made a point of not understanding the question. They repeated the query several times and then realized that many of their client farmers will have likely never heard of email and would be confused by the question. They then took a few minutes to discuss how they would handle that situation – their original suggestion was to try to explain to the client what email was, but finally decided that it would be more productive to first ask if they had an email address and then if they seemed confused to move on and avoid the time-consuming and

ultimately frustrating conversation. Of the three training strategies, role-playing had the most potential to train participants how use the technology itself and to stimulate critical thinking about how to use it well in the context of their field duties. It should be noted that role-playing is a commonly used training strategy in this culture.

Training Challenges

The second research question addressed what aspects of the training sessions were challenging for the users. One of the most obvious shortcomings of the training sessions was the unrealistic expectation of teaching users everything they needed to know in a single, daylong format. A one or two-day seminar might have been sufficient for PEOs who routinely use computers and many of whom had used smartphones in the past, but it was not sufficient for CBTs who had never handled a smartphone before to learn everything they needed to successfully operate the new technology in the field. Not only was the training session too short to cover the broad range of topics necessary, but the individual sessions were also too long for intense learning. It was obvious by the afternoon session of both training days that many of the participants seemed to shut down, feeling overwhelmed and frustrated. Toward the end of the day, many participants had simply stopped participating at all or were doing something different on their phones than the trainer was teaching. Others were trying to follow along but became increasingly anxious, pressing the first button they saw rather than reading the prompts and choosing the correct button. During the review at the end of the session, many participants had already forgotten the basic functions that they had practiced earlier in the day, indicating that they had not internalized the information, or were simply too flustered to recall them. This lack of internalized knowledge persisted into the following weeks. Many of the

individual interviews following the training sessions began with questions and problems that they had since encountered, often prolonging the interview by several hours. It was clear the participants both needed and desired a review of information they had previously learned and a chance to troubleshoot tasks they found challenging.

Another shortcoming was that the training did not focus on the basic skills the participants would need to operate their smartphones or the specific applications they had expressed interest in using during the previous phase of the project. Although care had been taken to learn the needs and interests of the participants, it was not used to design the training program. The trainer sent by Grameen Bank had not been told that this group needed training on the basics of phone operation. He had been sent to teach our group how to use the two applications provided by Grameen: CKW Search and CKW survey. He arrived to find out that most of the participants had no prior experience operating smartphones or computer interfaces and were struggling to learn how to operate the touchscreen and understand the phone's layout. He was not prepared to present these basics and had not scheduled enough time for even a brief overview. The trainer offered to come back for a second day of training so that the first day could be devoted to covering the basics. As it turned out, that was still not enough time to adequately introduce these concepts. The result was that the training provided was not suitable for the participants' experience levels and did not align with their training interests. The trainer came prepared to talk about two specific applications, neither of which were top priority for the participants and both of which were out of reach of the CBTs until they became more familiar with operating their new phones. As a result, CBTs did not receive

adequate training on the basic applications that they wanted and needed to use right away.

This shortcoming manifested itself during the first few weeks of use. For example, many CBTs had trouble answering phone calls, ending phone calls, or both. Participants had revealed in Phase 1 that making phone calls was one of the most important skills they used during their daily activities, but this skill was not covered during the training. As a result, many had been avoiding using their smartphones for calls at all, relying on their old mobile phones instead. On one visit, almost two and a half weeks after the training sessions, the author tried to call a CBT who was late to a scheduled interview. He did not answer either his new smartphone or his old mobile phone. He later explained that this old phone had a dead battery and his new phone was ringing but he did not know how to answer it.

The training sessions did not address the features the users were most excited to try either. Participants were very excited about the smartphone's camera function, yet this was not covered by any of the training sessions. Regardless, the majority of the users either asked for help or experimented until they discovered how to use it. Both PEOs and CBTs used the camera frequently to take both photos and videos. However, the CBTs struggled with telling the difference between the two settings. One CBT attempted to video-record a community meeting on nutrition but begin tapping the phone button as if taking photos. The result was several short choppy video clips. Later during the same event, another CBT was showing the pictures and videos he had taken and the videos only consisted of one or two seconds focused on a still subject, then many seconds of footage of the ground. It looked like he thought he was trying to take pictures but

accidentally had the camera set to video mode. The later interviews revealed that many of the users were not aware that using the camera function rapidly drained the battery, resulting in phones dying long before participants were done with their daily rounds. While practice and experience will help CBTs learn to use this function better over time, it would have been helpful to include the basics in the training seminar, especially since their desire to use this feature was known. The notepad function was another such feature that participants were initially excited to use, but the lack of training led participants to forget about it and keep using the previous paper and pencil methods for recording information.

Ironically, the two applications that were the main focus of the training sessions ended up not being used much at all. The CKW Search application, designed to allow users to search a database for information about agricultural topics relevant to the local area, was only used by a few participants and they reported having little success. While visiting a client farmer, one CBT noticed that some of the crops were damaged and discovered small insects on the underside of the leaves. She could not identify the pest, so she decided to use her camera to take a photo of it to show her PEO later. The author suggested that she might also try looking it up using the CKW Search. She was interested and requested help using the application, but she could not find any information matching the insect she saw. Later that day at another farm she had the idea to use the application to help her diagnose the cause of a skin rash on a litter of piglets. She coached another CBT through the process, which was encouraging, but was the only time a CBT mentioned trying the application. During the final meeting several PEOs reported trying

the function, but expressed disappointment in the amount and relevance of the information it provided.

Even though participants were excited about the prospect of using the second application, CKW Survey, to replace writing weekly paper reports, no supporting system was put in place to facilitate such a process to take place. Without an appropriate survey document file and a plan for how often and to whom reports should be sent, it remains a vision rather than a reality. The same situation occurred with the idea of sharing and using pictures and videos. Individual use, such as taking a picture at one farm and then showing it to a client in a different area, was widespread. However, participants' ideas of long-term or collaborative uses, such as storing photos to track progress of a household or consulting with a PEO who is the expert on that problem by sending photos, were not occurring. Before this can happen a system must be created. How will pictures be sent to PEOs? How can the photos be stored so that they are easy to locate again? Who is in charge of deleting them when they are no longer needed? These are questions that can best be tackled by VEDCO staff members. Although participants expressed great excitement about the possibility of using photos in this way, it has not yet happened. Collaborative uses cannot develop without a system-wide framework to guide the use of such technologies, even if everyone is excited about them.

Additional Challenges

There were a few additional challenges unrelated to the content of the trainings themselves that nonetheless contributed to the limitations of the training. The first setback occurred when the phones did not arrive when expected. They needed to be charged, initialized, and set up prior to training and there simply was not enough time as

they arrived the night before training was scheduled. Charging was an especially challenging obstacle since electricity is intermittent in the area. This resulted in a delay in the training start time. The first several hours of the training session were spent trying to get as many phones as possible in working order, cutting into the available teaching time. Many phones could not be set up so many people did not have a phone to use when the seminar started, and had to share. Although this did lead to working in groups, which as mentioned above was a positive outcome, it also meant that many participants merely got to watch rather than getting hands-on practice themselves. Even though they were encouraged to share the phones and take turns, unfortunately the more timid participants generally gave way to their more confident peers, resulting in those who needed the most practice getting the least.

Another factor that inhibited training is that many of the PEOs did not show up for the scheduled training or for the additional session on day 3. It was unclear whether there were unplanned issues that came up at the last minute or they had simply not prioritized the training day. Many PEOs had used smartphones at some point in the past and may not have felt that they could learn to use their phones on their own. Their absence created two problems. The first is that the PEOs were not there to help the CBTs learn how to use the phones. During the seminar usually the PEOs would learn a new skill much faster than the CBTs and their help was a valuable resource for CBTs. The presence of more PEOs would likely have been helpful during the training. This is especially true of the small group exercises: groups with PEOs had more success than those without. The second problem is that although many PEOs had experience operating computers and smartphones in general, they still needed to learn how to use these specific

devices. Being comfortable operating a device is helpful, but insufficient when specific knowledge and skills are required in the given environment (Sheridan & Herschede, 1997). The PEOs successfully operated their new phones over the next few weeks, but initially they were not familiar with the applications covered during training. This means that although they were generally able to answer their CBTs questions on basic uses, they did not have the knowledge of the phones' many applications necessary to prompt CBTs to try new skills and make better use of the applications and features available to them.

Additionally, most participants were unwilling to ask questions or admit that they needed help. The CBT who had shown the video clips that looked like they were supposed to be pictures would not admit that he needed help. After viewing his videos, the author asked if he was trying to take videos or photos. He repeatedly affirmed that he had meant to take videos. Yet, when the supervising PEO spoke to him, he finally admitted, after some admonishment, that he had wanted to take photos and couldn't figure out how to switch it to photo mode. She remarked that she really had to "corner him" and force him to admit he needed help. Similarly, when meeting with another CBT for a follow up interview, his smartphone was completely out of battery life. He admitted that he had not charged his phone because he couldn't find the charging port. A nearby CBT who often worked alongside him joined us later that day and was amused when she found out because she knew how and could have shown him easily had he asked.

Self-Reported Initial Phone Use

The third research question asked how the participants used their cell phones in the weeks following the training sessions. CBTs and PEOs shared the applications they had been using during their first few weeks after receiving their smartphones in

individual, follow-up interviews. Figure 1 below shows the percentage of CBTs and PEOs who reported using each feature during this time.

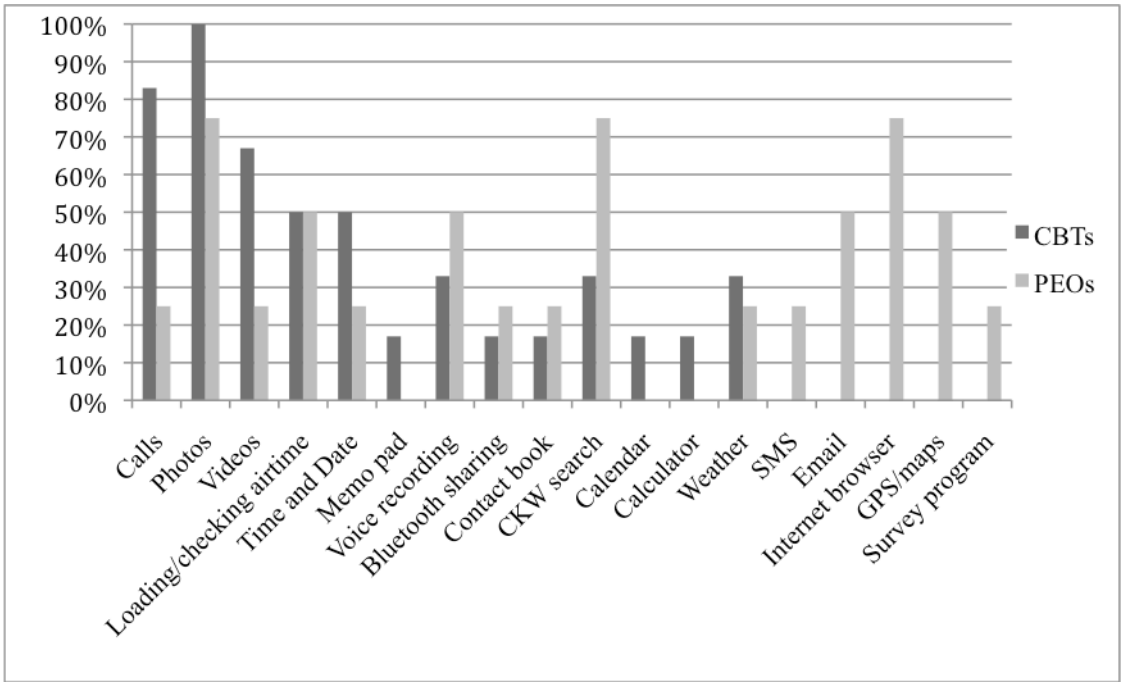

Figure 1: Percent of CBTs and PEOs Using Smartphone Features in the Weeks Following Introduction

CBTs favored the more basic uses, the most popular including placing calls, taking photos and videos, loading and checking the balance for their airtime, and checking the time and date. PEOs also used many of the basic applications, but also favored more advanced uses, such as using CKW Search, Email, Internet, and GPS.

Participants also shared their ideas about how the smartphones were changing their work routines. Although the phones had only been in use for a few weeks, they had already perceived many changes. The recording capabilities of the phones, including photos, videos, and audio recordings, granted them a new ability to record events. This allowed them to provide evidence of work and eased the task of writing reports at the end of the day. Pictures and videos were also used to share one farmer's good practice with

other farmers in a different area. Participants reported that their client farmers like seeing information from pictures and videos. The phones impressed and inspired their client farmers, leading to more enthusiastic participation. The phones also increased enthusiasm and motivation among staff who took great pride in carrying them.

The fourth research question asked what new needs participants wanted to be included in additional training sessions after using their phones for a few weeks. Many CBTs reported not knowing how to use features they wanted to use, such as how to delete or send photos, how to switch between photos and video, or use the SMS function. Despite these numerous challenges, the overwhelming response of participants was optimism and they were excited for additional training. The top training topics requested were: (1) browsing the Internet, (2) using SMS texting, (3) sending photos and videos via SMS, (4) sharing files via Bluetooth, (5) filing electronic reports instead of paper, (6) looking up market information, and (7) using the GPS function. These requested topics all represent new skills that they want to learn, rather than reviews of skills already introduced during training. Some are uses that they have heard about or seen demonstrated – such as browsing the internet, SMS texting, and using the GPS – but others are new, creative extensions of their smartphone applications. An example of this is their idea of using the SMS function to send photos, which is an extension of their current strategy of taking photos and showing them to colleagues. Another is their idea to file reports electronically, a creative application of the CKW Survey program they were introduced to during training. The absence of training requests on features they are already using is encouraging, as it indicates that they feel confident that they can master those skills with the resources already available to them.

Discussion

This article examined a series of smartphone training sessions offered through a rural agricultural outreach program in Uganda to detail their successes and challenges in meeting the needs of their clientele. This study also compared the content of the training sessions to the actual use of the smartphones over a few weeks following their completion to determine how the training impacted participants' use of the smartphones.

A number of aspects were beneficial for the trainees and should be implemented in future training sessions in similar contexts. Hands-on practice, role-playing, and working in groups in particular were successful. These findings align with previous research indicating that "role-playing exposes participants to learning complex or ambiguous concepts more easily than most other pedagogical approaches." Role-playing is also thought to be one of the fastest methods for skills acquisition (Agboola, 2004). Working in small groups provided a more comfortable space to ask questions, as well as encouraging participants to learn from each other and work together to solve problems they encountered. This not only helped participants learn the new concepts during training, but also paved the way for them to seek similar support as they work to master these skills and learn new applications in the future. It is suggested that in future training sessions, however, working in pairs rather than groups may help to keep all individuals engaged such that no one could "coast," letting their more confident group-mates do all the work. This structure is supported by other research: participants in a UK study introducing ICT to academic support staff found that semi-formal support in the form of workshops and a buddy system to be both helpful and motivating (Kukulska-Hulme & Pettit, 2007). Finally, the hands-on nature of the workshop proved helpful for

participants. Practicing on the actual devices they would be using facilitated their learning and gave them confidence in their ability to use the devices effectively after training, but also alerted the trainer to unforeseen challenges that could then be addressed.

While these aspects were beneficial, it is clear that the training provided to the VEDCO staff fell short in many other areas. A major shortcoming was that it was not based on participants' needs and desires. This information was available and should have been used to create a training schedule that focused tightly on just a few relevant applications. The best initial training for this particular group should have focused on applications that the users are already familiar with, such as placing calls, and applications that they are most excited about and that they anticipate being the most useful in their fieldwork, such as taking photos.

As a result of not focusing the training sessions in this way, the other main problem was the amount of information covered was overwhelming for the participants. Participants would have been better served by a seminar that only introduced the basics of phone operating and care, broken up into a few short sessions, followed by regular meetings to review what they have learned previously and to learn new skills. This idea has also been put forth in other similar situations ("Teachers, Teaching and ICTs | infoDev," n.d.). A plan for continued learning and support would have been beneficial even if participants had fully absorbed the information presented in the training seminar.

It became clear over the following weeks of observation after the training sessions that additional sessions would have been helpful to review and answer questions on topics they had already learned and to introduce new topics of interest. This pattern

echoes the adoption of mobile phones in the area as studied by Martin and Abbott (2011); participants reinvented the phones by coming up with "uses that were not employed at the onset of adoption, but were added as familiarity with the mobile phone device grew." During the current study, once participants mastered the more basic uses of their smartphones they then discovered more complex uses that they would have been interested in learning, as evidenced by the list of training requests they proposed during the final group meetings. Thus, a system for reviewing skills, asking questions, sharing ideas, and learning new skills would be beneficial. Since PEOs already meet with CBTs weekly, a structure for such a system already exists. It would also allow users to focus on perfecting one new skill at a time.

This idea is also supported by researchers in other settings. A study conducted in Australia found that educational staff prefer to learn new technological skills in small "professional development" sessions led by colleagues with whom rapport has already been established (Burnett & Meadmore, 2002). The authors concluded that this format is a more sustainable form of support than centrally organized seminars and workshops. Another study in the United Kingdom found that university staff seeking to acquire new technological skills benefited greatly from accessing peer support by participating in a learning community of other staff members (Kukulska-Hulme & Pettit, 2007). Another Africa-based extension agency, Self-Help Africa, found that their staff benefited from forming a network of other technology users, both experts and similarly-skilled peers (Wellard, 2011).

PEOs holding these supplemental training sessions could also provide a solution for the problem of participants not wanting to ask for help. Multiple participants were

unsure about certain aspects of the technology but were unwilling to ask for help or even admit they had a problem. Only when CBTs were asked to demonstrate a skill would they be forced to admit if they were unable to do it and ask for help. Creating a system of regular meetings where they would be asked to demonstrate skills and encouraged to ask questions could be used to create an atmosphere where it is both more necessary and easier for them to seek help. CBTs would also benefit from receiving field assignments at each meeting to encourage trying new skills and ensuring that what they learn is practiced and put into use. This idea is not new; several studies during the introduction of new computer systems to libraries or academic settings emphasize the importance of asking staff to put their skills to use immediately after training (Spacey et al., 2003; Quinn, 1995).

Ideally, there should also be a system to allow both CBTs and PEOs to meet in a large group setting to share ideas and knowledge, ask questions, and request training. Monthly meetings would allow the use of the phones to adapt organically to the needs of the organization. This would also serve as a platform for creating the framework necessary to implement new collaborative practices such as electronic reporting and photo sharing.

An additional question explored in this research concerns how the content of the training compared to how individuals actually used the technology in the few weeks following the sessions. Aside from basic use, the topics covered in training and the applications that participants tried in the field had little to do with each other. Basic use training covered switching the phone on and off, using the touch screen to navigate, and checking the data balance for the phone. All participants, obviously, used these skills in

order to operate their phones at all. An important exception was that making phone calls was not included in the training, and was thus not widely used in the field. The applications introduced in training were CKW Survey, CKW Search, and internet browsing -- none of which were used significantly by CBTs in the field. The most popular features – pictures and videos – were the features identified in the previous study as being most anticipated, but were not covered in the training.

It is worth noting that while their training was similar, CBTs and PEOs demonstrated different training needs and use patterns. It was anticipated that CBTs and PEOs would require different levels of training and support and also would have different priorities for smartphone use. However, this was not taken into account for the purposes of training. During the originally scheduled training day, PEOs took on the role of teachers rather than learners for the majority of the seminar. Even when PEOs got their own training day, their training session followed the same format and content as the earlier sessions, although it was compressed.

It was obvious that the majority of PEOs in the session were either already familiar with the basics of operating their smartphone or were easily able to figure it out for themselves. Many seemed bored and frustrated by even the brief introduction they were given to the basics, as evidenced by the fact that they kept playing around and doing other things on their phones instead of paying attention and contributing to the discussion. Their training may have worked better as a quick overview of the basics, for orientation purposes, and specific care notes. This could be followed by short, single-topic sessions in the following weeks as PEOs identified which applications they would like more information about. This style of "self-serve" learning, more informal and

voluntary, has been shown to work well for support staff in educational contexts and may work well in this instance (Kukulska-Hulme & Pettit, 2007). Most notably, in Kukulska-Hulme's study, this style of development proved to be a more long-term and self-sustaining system than a specified training program. This is highly desirable in a development context where the ultimate goal is independence from intervention.

While the CBTs stuck to the more basic uses, PEOs tended to branch out and try more complex applications. One PEO noted that GPS was one of his most-used features while no other PEOs mention it. As someone who uses this application frequently, he is likely to understand it well and perhaps even come up with creative new ways to use it. Since VEDCO's organizational scheme already puts each PEO into a specific "resident expert" role, a useful extension of this model would be to regard this PEO as the expert on GPS. He could use his new expertise to teach a seminar, either to other PEOs or to all participants when they are ready to share his knowledge and ideas about the applications. Since staff are already used to thinking of each PEO as having a specialty, this would be a familiar concept and might make it easier for those who are struggling or wish to learn about a certain application to take steps to do so. Perhaps others using the application would even feel driven to share any insights or new uses that they discovered with this PEO, thereby creating a central location to collect knowledge that otherwise may not get shared.

Finally, the future training topics requested by the users unsurprisingly aligned with the uses that participants expressed interest in and excitement about in phase 1 of this project. Many participants hoped that the new smartphones would increase connectivity among the staff participants and requested training for several phone uses

that would help them communicate easily with each other, including SMS texting, sharing photos and videos, and other files, and filing electronic reports. They also hoped that the smartphones would make it easier and faster to access to information and requested training on how to browse the internet, access market information, and use the GPS.

Despite the shortcomings in the training, the introduction of the smartphones can be considered a success -- after three weeks of use, all phones were in working order and being used. This is a tribute to the determination and excitement of the participants. All participants knew how to do at least a few basic things on the new phones after several weeks of use. Although they did not know how to do everything they wanted, participants were improvising and using the phones however they could. For example, although there was no electronic reporting and most participants did not know how to use the phone's notepad function, they still used the phones to ease their report-writing duties by doing something they knew: taking photos of their activities during the day to refer to as they wrote. Although they hadn't developed a method for sending their photos to their PEOs, they still took photographs to show them in person next time they met. Furthermore, participants all expressed great positivity and excitement about the new phones, even in the face of challenges. This indicates that the participants' excitement and motivation to use the new technology is a powerful force, and perhaps can be harnessed for future technology introductions.

CHAPTER 4

PHASE 3: HOW UGANDAN EXTENSION WORKERS INCORPORATE ORGANIZATIONALLY MANDATED SMARTPHONE TECHNOLOGY

Abstract

Smartphones are gaining popularity as a tool to enhance the work of extension services in developing countries. This study investigates how employees of an organization in rural Uganda incorporated mandated technologies into their work routine. A survey tool was used to gather information from 14 employees six months after receiving smartphones to support their work duties. The survey captured which applications the participants were using most often, if they were using the phones in any unexpected or innovative ways, and how they perceived different aspects of the phones. This data was compared to information from previous phases of the study and demographic information. The most used features were either features that the participants had previous experience with or that they had expressed excitement about prior to obtaining the technology. Lack of training and hardware issues were cited as problems, but participants overall expressed positive feelings about the new technology. Participants noted that carrying the phones made them more respected, and that the phones' functions helped them be a better resource for their clients and to do their jobs more quickly and easily. Age was not shown to affect how participants used their phones, but status within the organization, gender, education level, location, and hardware problems all were shown to influence participants' use patterns.

Keywords

Smartphones, Extension, Gender, Age, Organization, Location, Perception

How Ugandan Extension Workers Incorporate Organizationally Mandated Smartphone Technology

Introduction

Extension services, particularly those that operate in rural areas of developing countries, have been turning to smartphones as a key tool to aid in the diffusion and collection of information in these areas (Wade, 2002). Numerous applications have been developed to allow subsistence farmers better access to information (Qiang, Kuek, Dymond, & Esselaar, 2012) as well as helping researchers collect data about individuals using the phones (Dennison, Morrison, Conway, & Yardley, 2013). Most users view these apps in a positive light (De Silva, Goonetillake, Wikramanayake, & Ginige, 2013) and feel that they have benefited from using them (Hübler & Hartje, 2016). Mobile applications have been used in agriculture-based development settings for many purposes including distributing relevant farming information (Aker & Mbiti, 2010), improving supply chain access (Aker, 2011), and allowing users to compare market prices (Aker, 2009).

Using these devices in developing areas, however, is not without difficulties. The challenges of living in these rural areas include intermittent electricity and lack of safe storage for the device (Parikh, 2006). Individuals using the phones often have limited education and literacy (McCole, 2014; Parikh, 2006) and limited disposable income either to purchase the device (Banerjee & Duflo, 2006) or pay for the cost of its operation (Ibrahim, Salisu, Popoola, & Ibrahim, 2014). Maintenance is also a challenge -- finding trustworthy people with the knowledge and resources for both hardware and software upkeep can be difficult in isolated areas (Jackson et al., 2011) . Poor connectivity or

limited internet access can limit usability and create different outcomes than anticipated (Chang et al., 2012; Ibrahim et al., 2014). Lack of skills, created by insufficient training or support are also barriers to effective use (Ibrahim et al., 2014; Lu, Sears, & Jacko, 2005; Masters & Al-Rawahi, 2012). Physical aspects of the hardware, including short battery life and small screen size, can limit uses beyond simple tasks (Ibrahim et al., 2014; Masters & Al-Rawahi, 2012). These limitations, which can prove challenging in developed countries (Lu et al., 2003), may be prohibitive in developing countries.

Similarly, an innovation's success is determined beyond the step of adoption, and only when there is "confirmation" (Rogers, 2003). Diffusion of Innovations (Rogers, 2003) is a framework that describes how innovations are adopted and emphasizes that individuals will make their own meanings from and reinvent the innovation to fit their needs. In the case of individuals as the units of adoption, five perceived attributes of an innovation can increase its likelihood of adoption (Rogers, 2003). Relative advantage is how the new innovation improves over what it is replacing. Compatibility is how well the innovation fits in with established values and practices. Complexity is how difficult an innovation is to understand and use. Trialability is the degree to which an innovation can be tried before a commitment to adopt must be made. Finally, observability is the degree to which use of the innovation is visible to others.

In the case of adoption occurring at the organizational level, even though the decision does not lie with the users, they still must also accept the device individually in order to use it well (Frambach & Schillewaert, 2002). Even if participants feel positive about the innovation initially, research suggests that if their expectations are not met they may develop resistance to the new innovation over time (Ram & Jung, 1991). Therefore,

it is important to identify both how users are reinventing information communication technology (ICT) to meet their needs and to understand their attitudes toward the innovation in order to predict whether continued adoption will occur or if changes need to be made to increase the likelihood of confirmation by users.

This study uses this framework to explore how extension agents in rural Uganda have incorporated smartphones into their daily work routines. Individuals within this group were required to begin using a smartphone by their organization, even if they otherwise wouldn't have adopted the technology on their own. This research represents the final study of a three-phase project. Phase one was conducted a year before smartphones were scheduled to be distributed and extension staff were interviewed to determine how they used mobile phones and what they anticipated would change once they were equipped with smartphones. Phase two was conducted one year later when the new smartphones arrived and examined the training given to the extension agents about their new smartphones. This third and final phase of data collection was conducted after the smartphones had been in use for six months.

The information gathered about how participants are making use of their smartphones at this time can be used to inform future training priorities that will be applicable to similar situations, as well as support systems for this and other organizations. It will add to the body of knowledge about how to successfully introduce ICTs for development and can be useful for identifying best practices.

Literature Review

Diffusion of Innovations

Diffusion of Innovation is a theory describing how innovations become adopted or rejected by societies. The theory argues against the idea of technological determinism – the belief that technology is a force that can cause change in society semi-autonomously (Rogers, 2003). Instead, Rogers argues that individuals will "redefine" the innovation to fit existing needs, sometimes in ways that may have been unintended or unexpected.

Early work within diffusion of innovations theory focused on individuals as the units of adoption (Rogers, 2003). When it became apparent that the model was insufficient when applied to organizations as the unit of adoption, however, an additional framework was developed. Organizational adoption has two stages: the first stage, called initiation, occurs before the decision to adopt is made by the governing body of the organization and is followed by the second stage, called implementation.

The initiation stage consists of two sub-stages: agenda-setting – when a problem creates a perceived need – and matching – when an innovation is identified that fits with the identified problem (Rogers, 2003). After the decision to adopt has been made, the implementation stage occurs. Within implementation, there are three sub-stages: redefining, clarifying, and routinizing. During redefining, individuals within the organization learn how to use the innovation and determine how it best fits into their routine. It is expected that the organization will change and that the innovation itself will change and be used in unanticipated ways. The following sub-stage, clarifying, is an organization-wide process where the new uses of the innovation become widespread and

lead to a new understanding within the organization of how the innovation is used. The final sub-stage, routinizing, occurs when the innovation ceases to be a new, separate idea and simply becomes a part of everyday routines (Rogers, 2003).

Studies have used this framework to explore how both individuals and organizations adapt to and redefine new technologies. The smartphone is just the latest in a series of ICT that has been adopted and mandated by organizations, leaving employees to figure out their own ways of dealing with it. When personal computers (Appelbaum, 1990) and email (Korsching, Hipple, & Abbott, 2000) were introduced to the workplace, how employees handled the transition was a subject of intense study. Studies investigating how employees dealt with learning to use computers in the workplace or in educational settings found that high computer self-efficacy and increased willingness to adopt new technologies were found to be correlated (Compeau & Higgins, 1995; Park & Chen, 2007) as were education and technology use (Meera & Meera, 2015). Older individuals tended to have more negative attitudes towards technology, most likely due to intimidation and lack of experience (Meera & Meera, 2015) and were more likely to experience technophobia than their younger counterparts (Anthony, Clarke, & Anderson, 2000; Appelbaum, 1990; Meso, Musa, & Mbarika, 2005; Palvia & Palvia, 1999). Gender was also related, with females correlated with greater technophobia and lower IT satisfaction (Brosnan, 1998; Moore, 1994; Palvia & Palvia, 1999; Sanders & Galpin, 1994).

Technological determinism is often at the heart of programs that are based on the idea that supplying individuals in developing countries with technology is sufficient to lift them out of poverty. Because ICTs have the potential to increase productivity within

work routines, it becomes important to challenge assumptions of technological determinism and use a diffusion of innovation framework to examine how extension services in rural areas of developing countries adopt smartphones and how their agents incorporate them as a new technology (Wade, 2002).

Extension Services In Uganda

The idea of introducing ICTs to aid subsistence farmers in Uganda is not new. In 2010, Grameen Foundation armed their Community Knowledge Workers (CKW) with smartphones with the goal of closing "critical information gaps" for smallholder farmers in the area (Van Campenhout, 2013). The main outcome from this program is an increase in farmers growing high-value crops and a notable increase in the prices they receive from selling them. Another advantage of using smartphones in this way is that it enables two-way information flow, allowing outside organizations to monitor and collect data about rural farms more readily than every before (McCole, 2014).

Kamuli, an agricultural region within Uganda, has been a focus for technology in recent years. A previous study in the area looked at how farmers in this area were making use of standard mobile phones (Martin & Abbott, 2011). It found that use of mobile phones in the area was increasing and that there was a focus among local farmers on using the phones for agricultural purposes. Farmers viewed mobile phones as "as a tool that will allow for more efficient response to economic opportunities or threats" (Martin & Abbott, 2011).

Two organizations partner to serve smallholder farmers in the Kamuli region of Uganda: Iowa State University's Center for Sustainable Rural Livelihoods (CSRL) and a local non-governmental organization called Volunteer Efforts for Development Concerns

(VEDCO). The program's goal is to address poverty and food insecurity from multiple angles by developing demand-driven extension services. This is accomplished through a farmer-to-farmer model in which extension agents are selected from and then work within their own communities. Community Based Trainers (CBTs) are selected based on nominations from their neighbors. They are in a unique position of being a familiar and trusted member of the community, but also respected due to their status from training and association with VEDCO. Each CBT oversees up to 12 farmer groups of 20-30 members. They hold training meetings on season-specific topics, respond to questions and requests from their client farmers, and also visit their farmers' households regularly to observe progress. CBTs are supervised by Project Extension Officers (PEO) who each have specialized knowledge and can consult on cases brought to their attention by CBTs.

As with many agricultural extension programs, scaling up a successful project often necessitates an increase in both the efficiency and organization of the staff, a problem often tackled with the help of technology. Recently CSRL has partnered with Google and Grameen in a data-collection project involving smartphones. In the summer of 2014, each PEO and CBT was issued a Samsung Galaxy smartphone, loaded with two applications designed by Grameen for their Community Knowledge Worker program. One application, CKW Search, allows the user to search through a database of locally relevant agricultural information (McCole, 2014). The other, CKW Survey, is used to collect data about the farmers that the user interacts with. This data is added to a large database to help researchers and corporations understand the audience in these rural areas (McCole, 2014). The smartphones and the two specialized applications were purchased by CSRL, along with 12 solar charging kits (one for each CBT). VEDCO is responsible

for the care and maintenance of the smartphones. The individuals carrying the smartphones are responsible for purchasing any airtime and internet data that they wish to use. Use of the phones was mandatory, but how the individuals use the phones was not dictated. Participants were encouraged to use the phones for both work and personal purposes. Since diffusion of innovation would expect some reinvention of the smartphone uses (Rogers, 2003), participants were encouraged to use the smartphones however they liked and were given no restrictions or set expectations.

Two previous phases of the current project examined the expectations, introduction and initial adoption of mobile phones in this context. Phase 1 was conducted prior to the delivery of smartphones where participants shared how they used their current mobile phones to aid in their work duties and what they hoped from the smartphones they would be receiving. Participants saw the primary function of their mobile phones to allow agents to contact their client farmers and consult with other staff members remotely. They hoped that the new smartphones would allow for even more of this remote communication and were excited about the new camera function. Pictures, they said, would allow them to track the progress of households, provide proof of their work, and more easily consult with colleagues on a problem.

Phase 2 took place as the smartphones arrived and were initially put into use. Participants were invited to attend two sessions of training when they received the phones. The first session introduced the new technology and covered the basics of how to operate and care for it. The second session covered the two applications developed by Grameen, along with several other applications that the participants had indicated interest in using. The training involved step-by-step practice activities on the actual phones they

would be using. Observations were made during training seminars and during the first few weeks of the use in the field. Participants were optimistic and excited, but did not receive adequate training on how to operate their smartphones. Most participants figured out how to use the camera function on their own, but left most other novel features unused.

The current phase now seeks to understand how agricultural extension workers are making use of new smartphones six months after their introduction and training. After the training sessions, participants were encouraged to use their phones as much as possible not only for business uses, but for personal uses as well. Participants were not given set procedures or limitations, but were encouraged to use the phone however they saw fit. The intent of this decision was twofold. First, in the interest of research, this freedom would identify which functions that participants valued and found to be useful. Second, it was anticipated that encouraging increased use of the phone would lead to faster acquisition of essential skills.

Study Objectives

This study seeks to identify how individuals have incorporated an externally mandated smartphone into their work routine. In this context, the introduced smartphones replaced traditional cell phone technology and the participants have had access and been using the smartphones for six months. Because diffusion of innovation expects users to modify the technology to fit their own needs, the following research questions seek to identify how participants were currently using their smartphones and how that use compared with both their previous phone technology use and what they expected from

the new technology. Additionally, this research explores if participants were reinventing the devices and creating novel, unexpected uses.

RQ1: What were the most frequently used smartphone features?

RQ2. How do the most frequently used smartphone features compare with:

RQ2a. the previous uses of mobile phones?

RQ2b: the features most requested before training?

RQ3: Are there other innovative uses or reinventions of the technology developed by the participants?

Individual perceptions about a new technology focus on certain perceived traits of an innovation (Rogers, 2003). One of these traits, trailability, is not relevant because the decision was made and mandated by the organization. The other perceived attributes, however, may play a role in how participants view their new technology. The following research question explores the perceptions that begin to describe these perceived attributes of relative advantage (RQ4a and RQ4b), complexity and compatibility (RQ4c).

RQ4: How do participants perceive:

RQ4a. the smartphone's intrinsic value?

RQ4b. how the phones are changing the organization?

RQ4c. problems or suggestions?

Additional factors can impact adoption in other organizational contexts. For instance, previous research in Kamuli indicated that leaders of farm groups make use of their mobile phones in different ways than non-leaders, indicating that holding a leadership role is correlated with a different perspective on technology use (Martin & Abbott, 2011). Therefore, it is possible that an individual's place in the organization's

hierarchy will affect how he or she uses the smartphone. The amount of formal education an individual has will likely influence how they make use of new technology as might age. Gender also has tremendous cultural implications in rural Uganda that can contribute to differences in attitude towards technology use. Women tend to use mobile phones less than their male counterparts, often due to lack of knowledge about the device (Gill, Brooks, McDougall, Patel, & Kes, 2010; Masuki et al., 2010). However, Martin and Abbott (2011) found that in Kamuli, Uganda, this was beginning to change as more women adopted mobile phone technology.

Two additional factors not based on literature were also examined based on the knowledge gained in previous phases of this study. Participants in this study work in tight-knit groups that are geographically isolated from each other. Along with variations in the resources available in each area, such as road quality, cell signal strength, and availability and cost of electricity, this may have an impact on how smartphones are used in each area. Similarly, malfunctions in the smartphones themselves and issues with charging stations may limit how some participants use their devices.

RQ5. How is smartphone use influenced by:

RQ5a: status in the organization?

RQ5b: education level?

RQ5c: age?

RQ5d: gender?

RQ5e: location of their assigned work area?

RQ5f: functionality problems?

Methods

Participants

Eighteen participants received a smartphone six months prior to this study. At the time of data collection, 14 of the original study participants, 12 CBTs and 2 PEOs, were surveyed. Four staff members, all PEOs, left the program or were reassigned to other projects and had to leave their smartphones behind. These four PEOs consisted of one female and three males. One of these phones was reassigned to a new staff member, whose survey data was not analyzed because this individual was not a part of the original study. To protect participants' privacy their names were not used. Each participant was given an identifying code: either CBT or PEO followed by a number.

Protocol

Data was collected using a survey developed by the principal researcher at Iowa State University and administered in an interview format by a researcher from Makerere University in Uganda. The full questionnaire is available as Appendix A. Questions were asked in either English or Lusoga, depending on the preference of the participant, and answers were recorded in English. Completed surveys were placed in a sealed envelope and then carried back to the United States by an Iowa State student and transcribed and coded by the principal researcher. The survey contained two main types of questions: Likert scaled questions that asked participants how often they used their smartphones for different tasks and open-ended questions that asked participants about their perceptions of different aspects of the smartphones and their impact on the organization.

Variables

Smartphone functions

Four function variables were collected: current functions used, previous functions used, expected functions, and innovative functions.

Current functions used represents how participants are currently using their smartphone. This data was collected by asking participants to estimate how many calls and messages they sent and received during a typical week during harvest season -- their busiest time of the year. They were also given a list of functions available on their smartphones and asked to select from these four choices for how often they used the function: never, monthly, weekly, or daily.

Previous functions used represents what functions participants used on their standard mobile phones and was collected during the initial phase of the project, one year before participants received their smartphone. This data was collected by asking participants during an interview to describe how they used their mobile phones and recording all uses they volunteered.

Expected functions represents what participants expected or hoped from the new smartphones and was also collected during the initial phase of the project. This data was collected during the interview by asking participants what they hoped the new smartphones would be able to do. Because it was already known that the smartphones would be equipped with the CKW Search agricultural index, the researcher also described that application and asked participants if they thought it would be useful to them.

Innovative functions represents novel functions beyond those asked in the previous measures and was collected through an open ended "other" field at the end of

the section where uses were collected, allowing participants to add in additional uses that were not covered in the survey.

Participant Perceptions

Three areas of participant perceptions were measured: intrinsic value, changing the organization, and problems or suggestions. All relevant questions were open-ended and were coded using the constant comparative method (Wimmer & Dominick, 2011), grouping like responses together until clear categories emerged.

Intrinsic value represents a personal dimension of relative advantage and was collected by asking participants "Do you feel like you are viewed differently in the community now that you have a smartphone?" and "Do you feel like having this phone has changed your life?"

Changing the organization represents to an organizational dimension of relative advantage and was collected with the following questions: "How has having this smartphone changed the way you communicate with your colleagues," "How has having this smartphone changed the way you communicate with farmers," and "Has having this smartphone changed anything else about how you do your job?"

Problems and suggestions represents a measure of complexity and compatibility of the smartphones and was collected with two questions: "Have you found any limitations with your smartphone" and "Is there anything you wish could be improved on or done better, regarding your smartphone and how you use it?"

Demographics

Six demographic factors were calculated: status, education, age, gender, location and technical problems. Status represents whether the participant is a CBT or a PEO and

was collected from the employee roster. Of the 14 participants involved in the study, there were 12 CBTs and 2 PEOs. Education was collected by asking the surveyor to ask each participant for the highest grade they had completed and age was collected by asking the surveyor to ask each participant how old they are. Due to a miscommunication education and age for PEOs were not collected. The CBTs' education levels ranged from Senior 2 to Senior 4 (M=3.33, SD=0.65) and the CBTs' ages ranged from 32 to 58 (M=47, SD=8.14). Gender was collected from the employee roster (5 females and 9 males). Technical problems were collected by asking: "Does it [your smartphone/charger] still work?" and "Does it work well?"

Use pattern scores

Three Use Pattern Scores were developed and used to identify individuals who were using the smartphones differently than their peers: social score, innovator score and total use score. Responses from the current functions variable were used to calculate these scores.

Social score represents how often participants contacted other staff members via phone call or text message and attempts to differentiate the connectivity individuals have achieved with their smartphones. Social score was calculated by summing the number of calls and text messages that each participant reported sending and receiving in an average day during harvest season, which is usually the busiest time of their year (M=14.6, SD = 7.5) The range is shown in Table 1.

The Innovator Score shows breadth of use by calculating how many different functions of the smartphone an individual has tried and was calculated by summing the

Table 1: Social Score

ID#	Texts sent	Texts received	Calls made	Calls received	Social score
CBT1	0	15	10	5	30
CBT11	4	4	10	5	23
CBT4	0	5	10	7	22
CBT7	0	4	10	5	19
CBT12	0	3	10	6	19
CBT6	0	4	10	3	17
CBT8	0	2	8	6	16
CBT10	4	3	3	3	13
CBT9	3	2	4	3	12
PEO2	2	2	1	4	9
CBT5	0	4	2	2	8
CBT3	0	2	3	2	7
PEO1	0	0	3	2	5
CBT2	0	2	2	1	5

number of unique functions an individual used at least once per month (M=7, SD = 2.7). The range is shown in Table 2.

The Total Use Score shows depth of use by combining how many different applications a participant uses and the frequency with which they use each. For each function, a value of 4 means that the participant reported using that function daily, a value of 3 means that they use the function at least once per month, a value of 2 means weekly, and a value of 1 indicates that they never use that function. These values were summed across all measured functions (M=13.6, SD = 5.7). The range is shown in Table 3.

Table 2: Innovator Score

ID Number	Check airtime	Check data	Save contacts	Voice recorder	Note pad	Time/ Date	Text messages	Maps/ GPS	Calculator	Timer/ Alarms	Calendar	Weather	CKW Search	CKW Survey	Score
CBT11	1	1	1	1	1	1	1	1	1	0	1	1	1	1	13
PEO2	1	1	1	1	0	1	1	1	1	1	1	1	0	0	11
PEO1	1	1	1	1	0	1	1	0	1	0	1	0	1	1	10
CBT2	1	0	1	1	0	1	1	0	1	0	1	0	0	0	7
CBT4	1	0	1	1	0	1	0	0	1	0	1	1	0	0	7
CBT3	1	0	1	0	0	1	0	1	1	0	1	0	0	0	6
CBT5	1	0	1	1	0	1	0	0	1	0	1	0	0	0	6
CBT7	1	0	1	0	0	1	0	0	1	0	1	0	0	0	5
CBT9	1	0	1	0	0	1	0	0	1	0	1	0	0	0	5
CBT10	1	0	1	0	0	1	0	0	1	0	1	0	0	0	5
CBT8	1	0	1	0	0	1	0	0	1	0	1	0	0	0	5
CBT12	1	0	1	0	0	1	0	0	1	0	1	0	0	0	5
CBT1	1	0	1	1	0	1	0	0	0	0	1	0	0	0	5
CBT6	1	0	1	0	0	1	0	0	0	0	1	0	0	0	4

Table 3: Total Use Score

ID Number	Check airtime	Check data	Save contacts	Voice recorder	Note pad	Time/ Date	Text messages	Maps/ GPS	Calculator	Timer/ Alarms	Calendar	Weather	CKW Search	CKW Survey	Score
CBT11	4	2	3	4	4	4	3	2	3	1	4	2	3	3	42
PEO2	4	2	4	3	1	4	3	2	3	3	3	3	1	1	37
PEO1	4	2	2	2	1	4	3	1	3	1	2	1	2	2	30
CBT2	4	1	3	2	1	4	4	1	2	1	2	1	1	1	28
CBT7	4	1	2	1	1	4	1	1	4	1	4	1	1	1	27
CBT10	4	1	3	1	1	4	1	1	3	1	4	1	1	1	27
CBT4	4	1	2	2	1	4	1	1	2	1	4	2	1	1	27
CBT9	4	1	3	1	1	4	1	1	2	1	4	1	1	1	26
CBT8	4	1	2	1	1	4	1	1	3	1	4	1	1	1	26
CBT12	3	1	2	1	1	4	1	1	3	1	4	1	1	1	25
CBT5	3	1	2	2	1	4	1	1	2	1	4	1	1	1	25
CBT3	2	1	2	1	1	4	1	2	2	1	4	1	1	1	24
CBT6	4	1	2	1	1	4	1	1	1	1	4	1	1	1	24
CBT1	2	1	2	2	1	2	1	1	1	1	2	1	1	1	19

Results

The surveys revealed that all participant smartphones were in use, meaning that no phones had broken down or been abandoned. All 14 participants surveyed reported that they used their smartphones on a regular basis. Each participant also provided the amount of airtime that they had purchased for the phone in the past month, proving that the phones were still being used actively.

In response to RQ1 examining the current functions used, all participants reported using the smartphones to place and receive calls. All participants reported receiving text messages but only four participants had sent text messages. Beyond calling and texting, the most popular uses were checking the time and date, using the calendar, taking photos, taking videos, using the calculator, and using the voice recorder. Figure 1 shows how frequently participants used functions of their new smartphones. The percentages listed indicate the number of participants who reported that they used each function at least once per month.

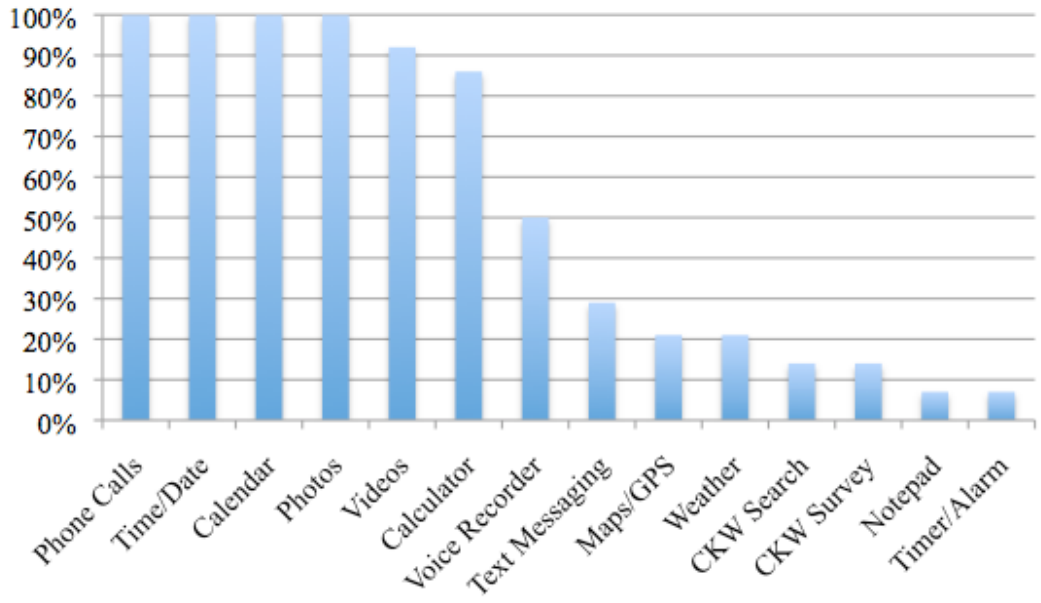

Figure 1: Frequency of Smartphone Application Use Six Months after Introduction

In response to RQ2a, examining previous functions used, Figure 2 shows how participant's current use of their smartphone compares their earlier use of standard mobile phones.

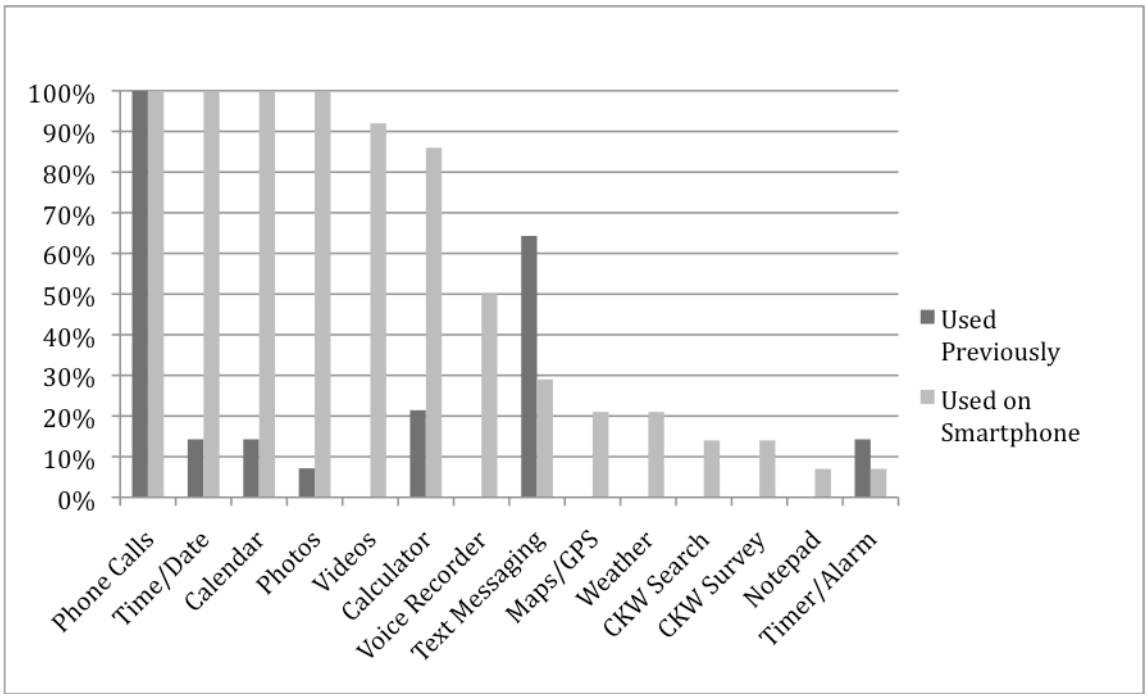

Figure 2: Features Used on Mobile Phones vs. Features Used on Smartphones

The most notable similarity is that all participants made phone calls from their mobile phones and with their new smartphones and more than half of participants mentioned using SMS text messaging on their mobile phones and with their new smartphones. Many of the most popular uses of smartphones, such as pictures and video, were not available at all on the standard mobile phones, which explains the large difference. One participant, PEO1, had a smartphone previously, which accounts for the ability to take pictures and access the internet when others could not.

However, other features the graph may misrepresent the differences due to the way data was collected in the first phase of the study. The current survey specifically asks about each feature but the measure of previous use only recorded features that participants

organically thought of and volunteered. For example, only 14% of participants mentioned previously using their mobile phones to check the time or date. In reality, many more individuals may have used this feature, but not thought to mention it. When prompted in the current survey, however, 100% of participants agreed that they check the time or date on their smartphones regularly. It is unclear whether this represents an increase in use or if this difference is merely the product of two different collection methods.

To answer RQ2b, examining expected functions, Figure 3 compares the smartphone features that participants requested or expressed interest prior to obtaining the smartphones with the features they currently use.

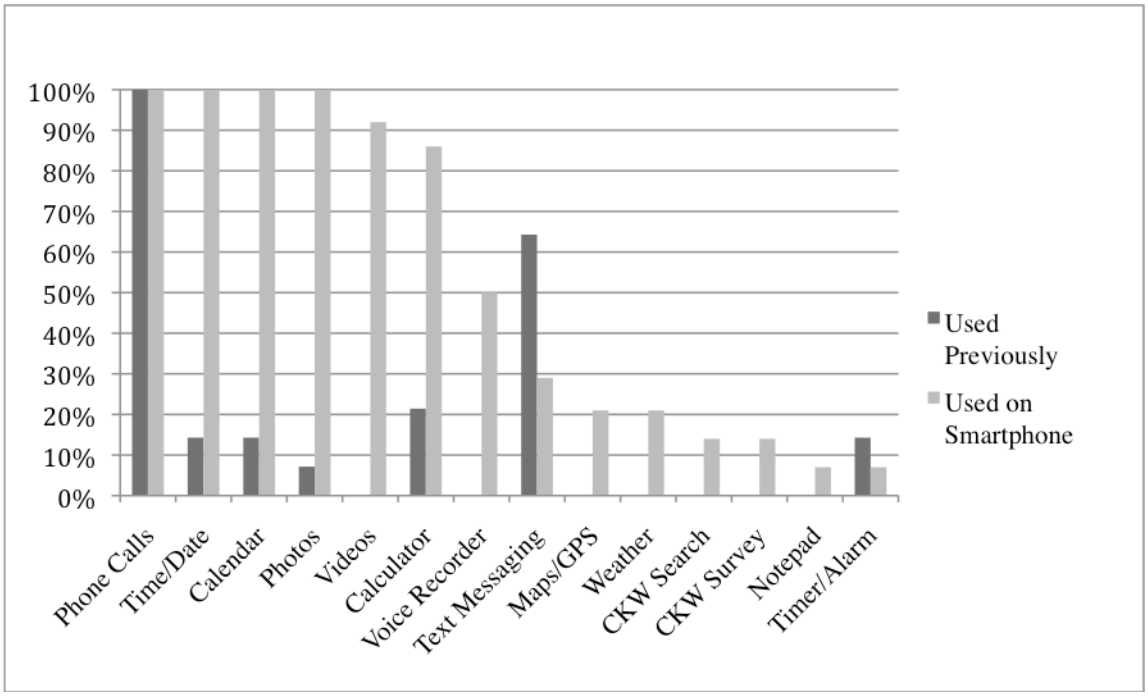

Figure 3: Requested Features vs. Used Features

The most significant similarities are pictures and voice recording, which were both requested by many participants and actually used by many participants. Most other features were not requested by a large number of participants and therefore are not being widely used currently by participants. Several other features have similar numbers of participants

requesting and currently using. However in many cases the participants requesting the feature were not necessarily the individuals using it. For example, the weather application was requested by one participant during phase 1, but this participant was not one of the three who reported using this application frequently.

Comparing these figures reveals two trends. First, functions that participants previously had access to on their personal mobile phones were among the most popular, likely due to the participants' familiarity with how to use them. Second, although many of the new functions are not being used as often, the ones that were being used most regularly are the ones that the participants had voiced the most excitement about before receiving the smartphones: photos, videos, and voice recording. Other new functions such as GPS, weather information, internet-based applications, and a text notepad have not yet become widely used, even by those who had initially requested them. It was also emphasized in training that participants were welcome to use the internet on their phones but would have to pay for their own internet data, which can be quite expensive. This may account for the disuse of internet-based functions.

RQ3, investigating innovative functions, asks what innovative uses and reinvention of the technology have occurred. This hasn't happened to a large degree yet, as participants are still getting used to the new smartphones. One unexpected use has arisen: several participants said that they are using the smartphones to call their friends to collect debts or ask for money. This represents a source of income which they could not take advantage of as well with their personal mobile phones. It is unclear why the smartphones were superior to mobile phones in this respect, but nevertheless this new ability was something that was mentioned frequently. CBT4 also reported that her daughter uses the smartphone sometimes to look up information

to help with her classes at university and CBT1 shared that he and his wife like to look at pictures he has taken on the phone as a way to relax.

RQ4a, asked how participants perceive the smartphone's intrinsic value to the individual. The participants largely agreed that the phones had personal value beyond their usefulness in the field. The one exception did not explain his reasoning for disagreement. Participants all agreed that having a smartphone caused them to be viewed differently in the community. They felt that their personal status improved among their peers, citing that carrying the expensive-looking phones makes them more respectable and important.

C1: "Most respectful people have smart phones – that's how my community regards me to be."

C6: "It is seen as an expensive phone so people respect me for that in the society."

Many participants shared that the farmers they served saw them as a better resource after they started using the phones.

C5: "People… consider me more knowledgeable."

P1: "Because I can now … search for any information required by farmers ay any time."

They also felt that they were able to teach farmers more easily because they could show pictures or videos of what they were trying to explain.

C12:"It has helped me to explain to my farmers by the help of pictures or photos I show to them."

C6: "Because they can easily see what their works after being able to watch the videos, the photos too."

In fact, photos and videos were brought up by many participants as one of the most impactful benefits of the phones. The ability to take photos alleviates many burdens that the extension staff face, such as spending a long time in the evenings to recount the activities they carried out that by submitting a report to their supervisors. This the enormous benefit of freeing up their time in the evenings for personal tasks.

C7: "I can now easily revise my daily activities conducted when I get home unlike before."

C8: "It has simplified my report writing, record keeping."

C10: "I can revise what I did yesterday and save my time to work."

Some participants noticed that photos also had a strong motivational effect on the farmers they serve.

C2: "It has greatly motivated my farmers to work hard so that I can capture them on video/photo"

C1: "I use [the] phone to capture pictures of farmers and their voices which has attracted many farmers because they want to be heard on the phone while talking"

The consensus among participants is that having the smartphones is a significant advantage. Having the phones makes them feel more respected and important in the community and they feel that the farmers they work with now see them as a better resource. They believe that the smartphones make their work easier, free up their personal time in the evenings, and inspire client farmers.

RQ4b, addresses participants' perceptions about how the smartphones are changing the organization. The participants all agreed that the smartphones have created significant

changes to how VEDCO functions. The main change participants mentioned is improved communication, both between colleagues and between extension agents and the clients they serve. One main aspect of the improved communication is that connecting with another person is quicker and easier:

C7: "There's quick information flow between me and the fellow CBTs and PEOs."

P1: "Easy access to my fellow PEOs and easy sharing of information."

C2: "Faster information flow to farmers."

C3: "It has simplified my work, I just show [my PEO] photos and videos, and call them in case I need some information."

One reason given for the improved communication is the reliability of the smartphones over the old mobile phones

P2: "CBTs' phones are always on all day so [I] am able to access them anytime, anywhere."

C1: "It very clear and does not lose [connection]..."

Another aspect of the improved communication is that the ability to capture and share photos, videos, and voice recordings allows for richer communication. This grants PEOs and CBTs the ability to exchange information and consult colleagues on problems without having to spend time and money to travel to the physical location of the problem.

P2: "Communication has become effective because I can emphasize my communication with pictures or video."

C12: "I send photos from the field to the concerned officers. I contact them on my smartphone."

Another major change photos and videos have brought about is improved transparency and documentation within the organization:

C3: “I can easily trace the impact I have made in a farmer's household, also get solutions to pests and diseases affecting their crops.”

C5: “Farmers can easily see what they are doing on the project, the inputs they even received.”

C11: “I can show photos/videos to my PEO as evidence that I have been working.”

Beyond photos and videos, participants also mentioned some other functions of the smartphones that they felt improved their ability to do their job well. The time-consuming task of measuring land is greatly simplified by using the smartphones’ GPS function:

C5: “I can determine the size of the gardens easily unlike before and I share with my farmers, CBTs.”

And, while not used by many participants yet, the searchable agronomic database has enormous potential to improve access to information in the field:

C11: “I can easily give them adequate information on diseases and pests using CKW search.”

The overall impression shared by participants is that these new patterns of communication have simplified work for the staff and resulted in better information for the farmers using the service.

RQ4c, examining problems or suggestions, deals with participants’ perceptions about the challenges and limitations of the smartphones. Several participants reported no issues with their phones, but many others aired their complaints.

The main shortcoming of the smartphones is the short battery life and unreliable solar charging systems.

P2: “Battery cannot be used for training in the morning and afternoon.”

C1: “I took my phone to the chargers and it failed to charge.”

C5: “The [solar] charging system is faulty.”

Another concern brought up frequently is connectivity issues with the phones:

P1: “Signal which is not … opted for in the local network.”

C8: “[I] find problems in using some of the applications like surveys, GPS, weather forecast”

Half of the CBTs report that they did not have a solar charger or that their solar charger did not work well. Two of these never received a charger in the first place: when the chargers were distributed, each CBT unpacked and tested their solar charger and two were found not to function at all. These were sent back to the distributor to be repaired or replaced and while many attempts were made to rectify the situation, no progress has been made. While most participants stated that their phones worked well, a few had complaints about the hardware:

C12: “The screen touch is insensitive.”

C6: “It blacks out all of a sudden without my knowledge.”

Participants had some ideas for features that they wished the phones were equipped with:

P1: “At least should be with a dual SIM card than a single line.”

P2: “Especially when using video, the screen is small people cannot sit back and watch at once. I have to move the phone around.”

C2: “No torch for lighting”

It should be noted that it is likely that the phone does have a flashlight function but participant C6 did not know how to operate it.

Overwhelmingly the major concerns participants voiced about the smartphones centered on their ability to use the phones effectively. Their concerns fell into two categories. Their primary request is for more training

C10: “I don't know how to use some functions in the phone, yet they are important.”

C7: “I just need more training on the available applications on the phone.”

C8: “More refresher training on how to use the phones.”

The other concerns participants voiced dealt with the hardware and software available to them. They offered ideas for how to make their smartphones more useful and tailor them to the duties they need to perform:

C11: “[include] those applications the researcher thinks are important in simplifying our works.”

C10: “Provide us with headsets so that we can listen to radio programs on agriculture with information useful to farmers”

These responses are encouraging, painting a picture of users who appreciate and see the potential in their technology and have a clear idea of what is needed to move forward.

To address RQ5a-f, exploratory statistical analyses were performed as a diagnostic to suggest where meaningful differences may exist. Because the sample sizes are small and assumptions of equal sample sizes are not met, the results are not reported and merely helped to suggest which relationships were worthy of further exploration. Relationships were then further examined for each of the three use pattern variables. CBT11’s scores for Innovation

Score and Total Use Score were excluded from analysis, as her scores for Innovation (13) and Total Use (42) were unusually high and regarded as an outlier.

RQ5a asked how status within the organization influences smartphone use. CBTs tended to exhibit greater social scores (M = 15.92, SD = 7.33) compared to the PEOs (M = 7.00, SD = 2.83), yet the PEOs exhibited greater innovator scores (M = 10.50, SD = 0.71) than the CBTs (M = 5.45, SD = 0.93). The PEOs also exhibited a greater total use score (M = 33.50, SD = 4.95) than the CBTs (M = 25.27, SD = 2.45). The higher Social Scores may indicate that CBTs are contacting each other more frequently than they are contacting their PEOs, or it may indicate that they are communicating more frequently with client farmers than PEOs are. The higher Innovation and Total Use scores of PEOs are likely due to their familiarity with computer and smartphone operation. More knowledge of how to use these devices and what they are best used for enables them to make use of a wide variety of features earlier than CBTs with little to no experience.

Table 4: The Effects of Status within the Organization on Use Pattern Scores

Participant	Social Score	Innovation Score	Total Use Score
PEO1	5	10	30
PEO2	9	11	37
CBT7	19	5	27
CBT9	12	5	26
CBT10	13	5	27
CBT8	16	5	26
CBT2	5	7	28
CBT12	19	5	25
CBT1	30	5	19
CBT11	23	-	-
CBT3	7	6	24
CBT6	17	4	24
CBT5	8	6	25
CBT4	22	7	27

RQ5b asked how a participant's level of education affected his or her Social Score, Innovation Score, and Total Use Score. Table 10 below shows the results.

Table 5: The Effects of Education on Use Pattern Scores

Participant	Highest grade completed	Social Score	Innovation Score	Total Use Score
CBT2	4	5	7	28
CBT12	4	19	5	25
CBT1	4	30	5	19
CBT3	4	7	6	24
CBT6	4	17	4	24
CBT7	3	19	5	27
CBT9	3	12	5	26
CBT10	3	13	5	27
CBT8	3	16	5	26
CBT5	3	8	6	25
CBT4	3	22	7	27
CBT11	2	23	-	-

Education level seemed to show little relationship with Social Score (Senior 4 M = 15.60, SD = 10.09; Senior 3 M = 15.00, SD = 5.06), or Innovation Score (Senior 4 M = 5.40, SD = 1.14; Senior 3 M = 5.50, SD = 0.84). CBTs with less formal education tended to score slightly higher on the Total Use Score (Senior 4 M = 24.00, SD = 3.24; Senior 3 M = 26.33, SD = 0.82). This may mean that those with less formal education are more comfortable experimenting with and exploring how to use new applications rather than sticking with applications that they learned about during training.

RQ5c asked how a participant's age affected his or her Social Score, Innovation Score, and Total Use Score. Table 11 below shows the results.

Table 6: The Effects of Age on Use Pattern Scores

Participant	Age	Social Score	Innovation Score	Total Use Score
CBT10	32	13	5	27
CBT11	38	23	13	42
CBT8	40	16	5	26

Table 6 continued

CBT4	40	22	7	27
CBT5	45	8	6	25
CBT6	48	17	4	24
CBT9	49	12	5	26
CBT3	50	7	6	24
CBT2	53	5	7	28
CBT7	54	19	5	27
CBT1	57	30	5	19
CBT12	58	19	5	25

Age seems to be unrelated to any of the use pattern scores. Age has been shown to have a significant effect on comfort with technology in developed countries where the youth have grown up using technology and are therefore more familiar with it. In developing countries, however, it is unlikely that younger people will have had any more access to technology than older people.

RQ5d asked how a participant's gender affected his or her Social Score, Innovation Score, and Total Use Score. Table 12 below shows the results.

Table 7: The Effects of Gender on Use Pattern Scores

Participant	Gender	Social Score	Innovation Score	Total Use Score
PEO1	M	5	10	30
PEO2	M	9	11	37
CBT7	M	19	5	27
CBT9	M	12	5	26
CBT2	M	5	7	28
CBT12	M	19	5	25
CBT1	M	30	5	19
CBT3	M	7	6	24
CBT6	M	17	4	24
CBT10	F	13	5	27
CBT8	F	16	5	26
CBT11	F	23	-	-
CBT5	F	8	6	25
CBT4	F	22	7	27

Again, gender was not related to any use pattern variables, with males and females having similar Social Scores (Males: $M = 13.67$, $SD = 8.32$; Females: $M = 14.75$, $SD = 5.85$), Innovator Scores (Males: $M = 6.44$, $SD = 2.46$; Females: $M = 5.75$, $SD = 0.96$), and Total Use score (Males: $M = 26.67$, $SD = 4.95$; Females: $M = 26.25$, $SD = 0.96$). The lack of differences is surprising, as the local culture dictates that women often do not have much access to technology and are generally not encouraged to think creatively. However, the support, training, and equal treatment women receive as VEDCO employees seems to have compensated for this disadvantage.

RQ5e asked how a participant's work location affected his or her Social Score, Innovation Score, and Total Use Score. Table 13 below shows the results.

Table 8: The Effects of Location on Use Pattern Scores

Participant	Subcounty	Social Score	Innovation Score	Total Use Score
CBT7	Bugulumbya	19	5	27
CBT9	Bugulumbya	12	5	26
CBT10	Bugulumbya	13	5	27
CBT8	Bugulumbya	16	5	26
CBT2	Butansi	5	7	28
CBT12	Butansi	19	5	25
CBT1	Butansi	30	5	19
CBT11	Butansi	23	-	-
CBT3	Namasagali	7	6	24
CBT6	Namasagali	17	4	24
CBT5	Namasagali	8	6	25
CBT4	Namasagali	22	7	27

There were only modest differences between location and Social Score (Bugulumbya: $M = 15.00$, $SD = 3.16$; Butansi: $M = 19.25$, $SD = 10.53$; Namasagali: $M = 13.50$, $SD = 7.23$) , Innovation Score (Bugulumbya: $M = 5.00$, $SD = 0.00$; Butansi: $M = 5.67$, $SD = 1.15$;

Namasagali: $M = 5.75$, $SD = 1.26$) and Total Use scores (Bugulumbya: $M = 26.50$, $SD = 0.58$; Butansi: $M = 24.00$, $SD = 4.58$; Namasagali: $M = 25.00$, $SD = 1.41$).

However, members of a subcounty group seem to have scored similarly in the three user category measures, which suggest that they are sharing knowledge with the colleagues they work with most closely. Responses to other questions in the survey among CBTs from the same subcounty were also often similar and in many cases different than responses from the CBTs in other areas. For example, Bugulumbya was the only subcounty not to have a CBT use the voice recorder function of the phone. They took fewer videos on average and only one of them had downloaded pictures from the smartphone onto a PEO's computer, while the majority of CBTs in other areas had done so. The CBTs in Namasagali also reported some unique challenges. For example, while all other CBTs reported having successfully deleted photos and videos from their phones, none of the CBTs from Namasagali had done so. These patterns show that CBTs within a subgroup have knowledge gaps that CBTs in other areas do not, indicating a lack of communication with CBTs in other areas. This is not surprising, considering the relatively large distance between subcounties and poor road conditions in the area, which limits face-to-face interactions. Additionally, CBTs are used to training in their subcounty groups, sharing information, and working together. It is not surprising that CBT groups would share knowledge and use their phones in similar ways.

RQ5f asked how the functionality of the smartphones and solar chargers affected participants' Social Score, Innovation Score, and Total Use Score. Tables 14 and 15 below show the results.

Table 9: The Effects of Charger Status on Use Pattern Scores

Participant	Charger works well	Social Score	Innovation Score	Total Use Score
CBT7	Y	19	5	27
CBT10	Y	13	5	27
CBT2	Y	5	7	28
CBT12	Y	19	5	25
CBT3	Y	7	6	24
CBT5	Y	8	6	25
CBT9	N	12	5	26
CBT8	N	16	5	26
CBT1	N	30	5	19
CBT11	N	23	-	-
CBT6	N	17	4	24
CBT4	N	22	7	27

Table 10: The Effects of Smartphone Status on Use Pattern Scores

Participant	Phone works well	Social Score	Innovation Score	Total Use Score
PEO1	Y	5	10	30
PEO2	Y	9	11	37
CBT7	Y	19	5	27
CBT9	Y	12	5	26
CBT10	Y	13	5	27
CBT8	Y	16	5	26
CBT2	Y	5	7	28
CBT12	Y	19	5	25
CBT11	Y	23	-	-
CBT3	Y	7	6	24
CBT6	Y	17	4	24
CBT4	Y	22	7	27
CBT1	N	30	5	19
CBT5	No response	8	6	25

The data suggests that missing or poorly functioning chargers had little impact on any of the Use Pattern Scores (Social Score, charger works well: $M = 11.83$, $SD = 6.15$; charger works poorly: $M = 20.00$, $SD = 6.36$; Innovation Score, charger works well: $M = 5.67$, $SD = 0.82$; charger works poorly: $M = 5.20$, $SD = 1.10$; Total Use Score, charger works well: $M = 26.00$, $SD = 1.55$; charger works poorly: $M = 24.40$, $SD = 3.21$). However, means suggest a

negative relationship between Smartphone Functionality and Total Use (Social Score, charger works well: M =13.92, SD = 6.39; charger works poorly: M = 30.00; Innovation Score, charger works well: M = 6.36, SD = 2.25; charger works poorly: M = 5.00; Total Use Score, charger works well: M = 27.36, SD = 3.64; charger works poorly: M = 19.00). All six of the participants who reported problems with their chargers were CBTs, one of whom also had problems with the phone as well. This individual was the only participant to report problems with the smartphone itself. He had very low innovator and Total Use Scores, but a high Social Score. This would indicate that he is using his phone only for calling and texting and not making use of other applications.

Discussion

It is clear that the smartphones have tremendous value to the participants. This is indicated by their comments and backed up by the fact that they are willing to pay for airtime and charging costs out of pocket to keep the phones in working order. Participants feel that the new smartphones have greatly improved the organization by simplifying work for the staff and providing better service for client farmers. They reported that carrying a smartphone leads to increased personal pride and motivation, faster and richer communication, better access to staff and farmers, faster and more accurate reporting, and increased transparency in the organization.

The functions of the smartphone that were already available to participants on their standard mobile phones, such as placing calls and using the calculator function, are among the most used functions of the new smartphones. This is most likely due to the users' familiarity with those applications: they know not only how to use them, but what they were useful for, and make use of them frequently. Even though many of these features were not

covered in the training session, participants were able to teach themselves how to use these familiar functions on a new device.

The most popular new uses of the smartphone were pictures, video, and voice recording. Because the participants had some experience using cameras in the field, they already had many ideas about how photos would be useful to them. In the past, they had to check out a camera from the office in advance and were rarely able to travel with it. With a camera now at their disposal all the time, participants used it liberally. The video and voice recorder functions, although not something the participants had experience with, are natural extensions of the same uses they have for photographs and were also used frequently.

Based on the volume of reported uses for the camera and the enthusiasm expressed in the participants' comments about it, it can be concluded that at this stage of their use it is regarded as one of the most important aspects of the new smartphone. Many uses of photos and videos were reported and fell into two categories. The first is that this technology has allowed staff to be a better resource for their client farmers. Pictures and videos can help farmers understand a concept that is being presented, prove to them that others are implementing what is being taught, share a strategy that is being tried by another farmer, or inspire them to try something new or work harder. PEOs and CBTs can share pictures with each other to seek advice on a situation, diagnose a problem, report a situation that needs intervention, and share new ideas and strategies.

The second category of reported uses for photos and videos is improving how the organization itself functions. Of the uses reported, three stood out as the most transformative:

1. Sharing photos and videos allows for increased connectivity between the staff. Now all staff members have the ability to see what is going on in a particular region, even

if they themselves haven't travelled to see it in person. This allows for collaborative problem solving, which benefits the clients in that region, and greater understanding among the staff of what the organization, as a whole, is doing.

2. Having photos and videos saves time. PEOs no longer need to travel in person to give advice on a problem, which can often take up to half of their day for a single trip. CBTs report that referring to their photos and videos helps them write daily reports and saves them a lot of time that can be devoted to other work tasks or personal household responsibilities.
3. Providing evidence in the form of photos and videos relieves the burden of proof from staff members and increases the reliability of the organization. Participants report using photos to track the progress of a household or a project, they use photos to document attendance at meetings and keep a log of inputs that are distributed in the community. They can prove that they were working when they were supposed to be. In a country where bribery and corruption often go hand and hand in with doing business, this is a huge step in achieving a reputable and well-run organization.

Although the new camera feature was quickly accepted, lack of training can explain the underuse of many of the other applications, even ones that were requested by participants or specifically designed to aid them in completing their work duties. The weather application, for instance, was requested by many participants in the initial surveys, but is only being used regularly by a few participants. Participants were given training on how to use the CKW Search and Survey applications, but are still not confident using them in the field, even though many expressed enthusiasm about the potential benefits. This was found to be a problem during the training phase of this study and the problem persists six months later.

It is clear, both from participants' comments and the trends shown in the data, that ongoing training and support is essential if participants are going to take advantage of the full potential of the new technology. Training must go beyond introduction and provide support as they master the basics and begin to explore more complex uses. Weekly meetings to learn new skills, ask questions, and share new ideas would go a long way towards staff being able to use the new technology to the fullest. Research suggests that providing "user-friendly" manuals and helping users learn necessary technical skills can increase usage, as can peer-to-peer interactions (Ram & Jung, 1991).

Another major finding of this study echoes the suggestions from the phase of this project that examined the training when the smartphones were introduced: the lack of systematic practices contributes to the underuse of new technology. Six months is not enough time for collaborative uses to develop organically. For example, although pictures are enormously popular and many CBTs and PEOs are using them to help in specific scenarios, they have not developed a system for how to incorporate the photos into their standard practices. A formal expectation for what types of pictures need to be submitted to the office, how to get them there, and a plan for organizing and using those photos will take photos from a useful extra to an essential part of the organization's workflow. The lesson learned is that this is not going to happen automatically, at least not quickly. This is echoed in other studies that have found that structure is a necessary prerequisite for more complex innovations (Howard & Mazaheri, 2009).

One of the primary reasons that forced-adoption technology is slow to take off is that without prior knowledge or experience, users do not know what it is good for. Participants may be excited about new applications, such as the notepad function, but they don't have

enough experience with it to know what it is useful for and think to use it in the field. As they gain more experience with the phones, use of these newer features will increase. To speed up this process, role-playing style training sessions may give the participants experience and ideas for how to use their phones more comprehensively. Or, group breakout sessions could allow participants to share innovations and ideas with their peers as they discover new uses for themselves.

Social Score was not related to any of the investigated variables, and is likely more a product of personality traits being expressed through technology. Status within the organization seems to be related to using a more diverse range of smartphone functions as PEOs were using a wider variety of the smartphone applications than CBTs. One reason could be that the PEOs are more educated. No data was collected on PEO education levels, but it is assumed that they are more educated. Another reason for more innovative smartphone use by PEOs could be because their jobs call for more different uses of the smartphones. While PEOs and CBTs both use the phones extensively to contact others, share ideas, and organize events and meetings, PEOs are responsible for many more organizational and decision-making tasks. For example, while a CBT may rarely need to measure land, a PEO in charge of loan assessing must perform that task frequently. This means that the PEO would be more likely to make use of the phone's GPS function on a regular basis. While it would be no less useful to the CBT in the same situation, the PEO faces that situation more often resulting in more frequent use.

Finally, PEOs may use the smartphones more extensively because they have previous experience with computers, which could make the smartphone interface seem more familiar. CBTs with no computer experience have a much harder time just interacting with the

smartphone and until they are used to its operation will be at a disadvantage. PEOs have the benefit of understanding basic computer interface schemas. They also have the advantage of having used certain computer programs and being familiar with what situations they are useful in. For example, if they have used a web browser to look up information on a computer they will be more likely to think of using the web browser on their phone when they need to find out something in the field. CBTs without that previous experience may not often remember to use a web browser to look up information, or even realize that it is a viable option.

This idea is supported by the one exception to the trend of PEOs using the phones' applications more than CBTs: PEOs used the video function much less than the CBTs. Their responses about photo and video topics show a more refined understanding of how the videos and photos are best used. CBTs are very excited about the camera function and are taking photos and videos of everything they can, resulting in many photos and videos that do not serve a useful purpose. PEOs on the other hand show more discretion in what they take photos and video of. This is likely due to having more experience with the office cameras that were available before the smartphones were in use. Additionally, their position as users of the photos and videos gives them greater insight into which topics are useful and which are not useful for records and reports.

Regarding other factors, age was not correlated to any changes in Use Pattern scores while females were likely to have lower Total Use scores than their male counterparts. This is not surprising, given the culture in the area. Phone functionality was correlated with Total Use, indicating that a poorly functioning phone means the user cannot make use of as many different applications. Education was found to be a predictor of both Innovation and Total

Use, but in a negative direction. This is more difficult to interpret. It could be that individuals with less education are more likely to just try things rather than only using applications that they feel like they understand well.

Location was correlated with both Innovation and Total Use. CBTs from the same area tended to have similar responses to questions about how they use their phones. This suggests that the CBTs could have an influence on each other's behavior, as could the restrictions of the area they live and work in, such as access to electricity, distance between households, and the quality of the roads. Since these CBTs often work together, we can assume that some peer-to-peer teaching is occurring. Similar results among members of the same subcounty group, however, could also be the result of people being interviewed together. Because of the time to travel to different subcounty headquarters, members of the same subcounty were likely interviewed on the same day in the same location and may have overheard others' answers. This could have influenced them, consciously or subconsciously, to give similar answers. However if this happened it could also have the effect of giving them new ideas of how to use the phone, which is essentially peer-to-peer sharing.

Future research should investigate how personality attributes influence phone use. Not only would this be helpful when designing training materials, but also in identifying opinion leaders in the group could improve the peer-to-peer teaching that may already be occurring in small groups. Regardless of what causes some individuals to use technology more readily than others, if they are able to easily share their ideas with others all members of an organization can benefit. Providing a platform for this kind of knowledge sharing coupled with sufficient training could accelerate the successful incorporation of new technology into the workflow of an organization.

Limitations

One limitation of this study is the number of participants. With only 14 participants, statistical analysis can only be used to indicate where relationships might be occurring, but cannot reliably identify significant differences. Additionally, the disparate numbers of CBTs and PEOs analyzed (12:2) limits the usefulness of comparisons between these groups.

Another potential problem that could have impacted the quality of the data collected is the language barrier. The survey was written in English, the primary language of the researcher and the official language of Uganda. While most PEOs and many CBTs were comfortable conversing in English, many participants were more comfortable speaking in their native language. Some surveys were translated to Lusoga or Luganda and responses translated back to English. This introduces potential misinterpretations, both in how the question is understood by the participant and how the participant's response is translated and recorded.

For instance, one participant, CBT12, did not score highly on the Innovator or Total Use scales because although he said in one part of the survey that he was using applications that others were not like email, CKW search, CKW survey, and weather, in the part of the survey that was used to calculate Innovation and Total Use scores he answered "never" for some of these functions. It is unclear whether he has used these items or not.

Similarly, another area of conflicting data is how much participants reported using text messaging. At the beginning of the survey, participants were asked to estimate the number of text messages they sent and received. All participants reported receiving text messages, but only a few reported sending any. In a later survey question participants were given four options and asked to select whether they used each feature of their smartphones

daily, weekly, monthly, or never. When answering this question about text messaging, most participants marked that they "never" used text messaging. Based on this information, the percentage of participants who make use of text messaging represents only those who sent text messages. It should be noted, however, that the Social Score includes both sending and receiving text messages. Received text messages may be responses to outgoing communications, attempts by outside parties to contact them, or push notifications from subscription services; all are valuable indicators of how much an individual is seeking and being sought after via phone communication. Yet it remains unclear why participants seem to have sometimes provided different answers for similar measures.

Another potential problem is the desire of participants to appear grateful for the smartphones or sound like they are using them well. Some of the answers given may be inaccurate if the participants feared that being truthful would create negative consequences for them. Participants were assured during all stages of the research project that their responses would be kept confidential and that their stewardship of the smartphones would not be altered because of anything they said. Overly positive responses may be due to genuine excitement and belief in the technology, but may also be due to participants thinking that they must present a good image to retain use of the smartphones, despite assurances otherwise.

Nonetheless, this study provides some valuable insight into the ways that these individuals are using, adapting to, and reinventing their smartphones. Understanding how these Ugandan extension workers are incorporating smartphones into their work is valuable for other organizations looking to include smartphones or other ICT into their program. The

insights about how different factors influenced their initial phone use can be used to shape other training programs and lead to more successful introductions of ICT in other scenarios.

Conclusions

Despite the open-ended nature of this project, it started as a top-down directive: the director of CSRL in the United States made the decision to place smartphones in the field in Uganda with the goal of improving monitoring and evaluation tasks. In practice, however, the decisions, ideas, and practices of the participants illustrated several differences of priorities. Even when the interests of the CBTs, PEOs, and external decision-makers overlapped, such as wanting to improve the speed of reporting by moving from paper reports to electronic reports, the lack of imposing systematic practices to bring this about meant that it did not happen to an appreciable degree. In future scenarios, goals of all parties should be shared and discussed so that the appropriate actions can be taken to achieve them. Although in this case the participants shared many of the external goals, in other scenarios the potential for disagreement between the goals of the external organizations and the participants should be taken into account when designing new projects.

Many of the findings of this study warrant further investigation in future research. The differences in uses between supervisors and field staff is one such area, along with the differences in their training needs. The effect of gender and education should also be investigated further. Finally, the differences between subcounty groups, along with the other indicators that peer-to-peer teaching is occurring, point to a rich area of study that could lead to the development of effective training and support strategies for introducing new technology to extensions agencies.

This form of peer-to-peer training has been used by VEDCO for many years and has been anecdotally shown to be quite effective. The evidence gathered in this study supports the idea that the CBTs learn from each other and tend to acquire more skills quickly when they have the opportunity to work in pairs or groups. This strategy could be employed in future development projects and studies to facilitate learning new skills. The Use Pattern Scores developed in this study can also be used and expanded upon in future studies. Social Score can be used along with other measures to identify opinion leaders, who can then be called upon to set an example and help their fellow participants learn and accept new ideas. Similarly, Innovation Scores and Total Use Scores can be used to identify participants who are mastering skills more quickly and identify them as a resource that other participants can look to for assistance if they are having trouble. By empowering the participants themselves to be architects of their own learning, the role of formal training seminars will be overshadowed by user-driven learning.

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APPENDIX I

CBT FOLLOW-UP SURVEY

Name: _____

CBT Survey

Section 1: Phone Status

Interviewer instructions: Ask participants each question and tick the appropriate box. For open-ended questions, please record participant's exact words if they answer in English or an English translation of their response if they do not. If answer to Q1 is "no," continue survey asking questions about the last month that the participant had use of his or her phone.

1	Do you still have your smartphone?	1 ❑ Yes 2 ❑ No
	If no, what happened?	
2	Does it still work?	1 ❑ Yes 2 ❑ No
	If no, when did it stop working?	
3	Does it work well?	1 ❑ Yes 2 ❑ No
	If no, please describe the problem	
4	Do you still have your solar charger?	1 ❑ Yes 2 ❑ No
	If no, what happened?	
5	Does it still work?	1 ❑ Yes 2 ❑ No
	If no, when did it stop working?	
6	Does it work well?	1 ❑ Yes 2 ❑ No
	If no, please describe the problem	

Section 2: Phone Uses

Interviewer instructions: Ask participants each question and fill in each blank with a number.

Communication

1. During the last harvest season, in an average day how many times did you do the following for work-related purposes?
   Send a text message? _____ Receive a text message? _____
   Make a phone call? _____ Receive a phone call? _____

Interviewer instructions: Ask participants each question and tick the appropriate box. Ensure that participants understand that questions 2&3, 4&5, 6&7, 8&9, and 10&11 are opposites and asking for unique information. If the participant had something to discuss with someone, but waited until their next scheduled meeting, mark "no" to the question of did they contact that person.

2	In the last month, did YOU contact a CBT who works in the same subcounty as you do? (if no, skip to question 3)	1 ❑ Yes 2 ❑ No
	Which methods have you used in the last month to contact a fellow CBT from your subcounty?	
	1. Go to visit them in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No
	5. Email	1 ❑ Yes 2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes 2 ❑ No
	Which one of these methods did you use most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6
3	In the last month, did a fellow CBT who works in the same subcounty as you contact you? (if no, skip to question 4)	1 ❑ Yes 2 ❑ No
	Have CBTs from your subcounty used any of the following methods to contact you?	
	1. Travel to visit you in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No
	5. Email	1 ❑ Yes 2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes 2 ❑ No
	Which one of these methods were you contacted by most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6
4	In the last month, did YOU contact your PEO? (if no, skip to question 5)	1 ❑ Yes 2 ❑ No
	Which methods have you used in the last month to contact your PEO?	
	1. Go to visit them in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No
	5. Email	1 ❑ Yes 2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes 2 ❑ No
	Which one of these methods did you use most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6

5	In the last month, did your PEO contact you? (if no, skip to question 6)	1 ❑ Yes 2 ❑ No
	Has your PEO used any of the following methods to contact you?	
	1. Travel to visit you in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No
	5. Email	1 ❑ Yes 2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes 2 ❑ No
	Which one of these methods were you contacted by most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6
6	In the last month, did you contact a CBT who does not work in the same subcounty as you? (if no, skip to question 7)	1 ❑ Yes 2 ❑ No
	Which methods have you used in the last month to contact CBTs outside your subcounty?	
	1. Go to visit them in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No
	5. Email	1 ❑ Yes 2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes 2 ❑ No
	Which one of these methods did you use most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6
7	In the last month, did a CBT who does not work in the same subcounty as you contact you? (if no, skip to question 8)	1 ❑ Yes 2 ❑ No
	Have CBTs from outside your subcounty used any of the following methods to contact you?	
	1. Travel to visit you in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No
	5. Email	1 ❑ Yes 2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes 2 ❑ No
	Which one of these methods were you contacted by most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6
8	In the last month, did YOU contact a PEO other than your PEO? (if no, skip to question 9)	1 ❑ Yes 2 ❑ No
	Which methods have you used in the last month to contact a PEO other than your PEO?	

	1. Go to visit them in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No
	5. Email	1 ❑ Yes 2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes 2 ❑ No
	Which one of these methods did you use most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6
9	In the last month, did a PEO other than your PEO contact you? (if no, skip to question 10)	1 ❑ Yes 2 ❑ No
	Has a PEO other than your PEO used any of the following methods to contact you?	
	1. Travel to visit you in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No
	5. Email	1 ❑ Yes 2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes 2 ❑ No
	Which one of these methods were you contacted by most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6
10	In the last month, did YOU contact any of the farmers you serve? (if no, skip to question 11)	1 ❑ Yes 2 ❑ No
	Which methods have you used in the last month to contact the farmers that you serve?	
	1. Go to visit them in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No
	5. Email	1 ❑ Yes 2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes 2 ❑ No
	Which one of these methods did you use most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6
11	In the last month, did any of the farmers you serve contact you? (if no, skip to question 12)	1 ❑ Yes 2 ❑ No
	Have the farmers you serve used any of the following methods to contact you?	
	1. Travel to visit you in person	1 ❑ Yes 2 ❑ No
	2. Text message (SMS)	1 ❑ Yes 2 ❑ No
	3. Call	1 ❑ Yes 2 ❑ No
	4. Beep	1 ❑ Yes 2 ❑ No

	5. Email					1 ❑ Yes	2 ❑ No
	6. Other:					1 ❑ Yes	2 ❑ No
	Which one of these methods were you contacted by most often?	❑ 1	❑ 2	❑ 3	❑ 4	❑ 5	❑ 6

Photos and Video

Interviewer instructions: Ask participants each question and tick the appropriate box. For open-ended questions, please record participant's exact words if they answer in English or an English translation of their response if they do not

12	Have you taken any pictures using your smartphone?					1 ❑ Yes	2 ❑ No
	If no, why not? (Record answer and skip to question 15)						
13	Have you shared any pictures with a colleague (CBT or PEO?)					1 ❑ Yes	2 ❑ No
	If yes, how have you shared pictures?						
	1. Showing them on my phone					1 ❑ Yes	2 ❑ No
	2. Sending via text message (SMS)					1 ❑ Yes	2 ❑ No
	3. Sending via email					1 ❑ Yes	2 ❑ No
	4. Transferring to a phone or computer using Bluetooth					1 ❑ Yes	2 ❑ No
	5. Transferring to a phone or computer using a cable or flash drive					1 ❑ Yes	2 ❑ No
	6. Other (please specify): _____					1 ❑ Yes	2 ❑ No
	Which one of these methods did you use most often?	❑ 1	❑ 2	❑ 3	❑ 4	❑ 5	❑ 6
14	Have you deleted any pictures from your smartphone?					1 ❑ Yes	2 ❑ No
	Please explain why or why not						

Interviewer instructions: Instruct participant to take out his or her smartphone and open up the photo gallery. On the next page, collect information about the first (most recent) 10 photo subjects. Do not include videos. Multiple photos of the same event count as one subject. In the first column, record the date the photo was taken. In the second column, record what the photo is displaying. In the third column, record the reasons the participant gives for taking the photo. In the final column record what they have done or plan to do with the photo, such as show it to a colleague or use it to help them remember something. In the final column, also record if any action was taken as a result of the photo (for example, if a photo of a pest infested plant was shown to a PEO and led to an intervention such as spraying the field with a pesticide or if a picture ended up being used in a report). If a picture is of a personal nature and the participant is uncomfortable with you seeing it, they need not show it to you. Simply record that item as "personal" and move on.

	Date	Subject of photo	Why did you take this photo?	What happened?
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10				

Interviewer instructions: Ask participants each question and tick the appropriate box. For open-ended questions, please record participant's exact words if they answer in English or an English translation or their response if they do not

15	Have you taken any videos using your smartphone?	1 ❑ Yes	2 ❑ No
	If no, why not? (Record answer and skip to question 18)		
16	Have you shared any pictures with a colleague (CBT or PEO?)	1 ❑ Yes	2 ❑ No
	If yes, how have you shared videos?		
	1. Showing them on my phone	1 ❑ Yes	2 ❑ No
	2. Sending via text message (SMS)	1 ❑ Yes	2 ❑ No
	3. Sending via email	1 ❑ Yes	2 ❑ No
	4. Transferring to a phone or computer using Bluetooth	1 ❑ Yes	2 ❑ No
	5. Transferring to a phone or computer using a cable or flash drive	1 ❑ Yes	2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes	2 ❑ No
	Which one of these methods did you use most often?	❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6	
17	Have you deleted any videos from your smartphone?	1 ❑ Yes	2 ❑ No
	Please explain why or why not		

Interviewer instructions: Instruct participant to take out his or her smartphone and open up the photo gallery. On the next page, collect information about the first (most recent) 10 video subjects. In the first column, record the date the video was taken. In the second column, record what the video is displaying. In the third column, record the reasons the participant gives for taking the video. In the final column record what they have done or plan to do with the video, such as show it to a colleague or use it to help them remember something. In the final column, also record if any action was taken as a result of the video (for example, if they regularly show the video for training purposes or if it inspired a neighboring group to adopt a new technique.) If a video is of a personal nature and the participant is uncomfortable with you seeing it, they need not show it to you. Simply record that item as "personal" and move on.

	Date	Subject of video	Why did you take this video?	What happened?
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10				

Internet Access

18	In the last month, have you done any of the following on your phone?		
	1. Checked my email	1 ❑ Yes	2 ❑ No
	2. Used CKW Search	1 ❑ Yes	2 ❑ No
	3. Used CKW Survey	1 ❑ Yes	2 ❑ No
	4. Checked the weather forecast	1 ❑ Yes	2 ❑ No
	5. Browsed the internet: (please explain what you did): _____ _____ _____	1 ❑ Yes	2 ❑ No
	6. Other (please specify): _____	1 ❑ Yes	2 ❑ No
19	How much internet data have you purchased in the last month?	_____(ugx)	
20	How was this data paid for?		
21	Does your phone have problems accessing the internet? Select one: 1 ❑ I almost never have a problem 2 ❑ I have problems in a few locations 3 ❑ I have problems in many locations 4 ❑ I can almost never access the internet 5 ❑ I haven't tried accessing the internet		

Other Uses:

Interviewer instructions: Please read aloud each statement and the following answer options each time: "never, a few times per month, a few times per week, or almost daily." Then tick the appropriate box for each question.

22	How often do you use the following functions on your smartphone?	Never [1]	Monthly [2]	Weekly [3]	Daily [4]
	A. Checking the airtime balance				
	B. Checking the data balance or buying data bundles				
	C. Saving contacts				
	D. Voice recorder				
	E. Notepad/ Memo Pad				
	F. Time/Date				
	G. SMS (Text message)				
	H. Maps/GPS				
	I. Calculator				
	J. Timers and Alarms				
	K. Calendar				
	L. Weather forecast				
	M. CKW search				
	N. CKW survey				

Section 3: Phone Operation Performance

1	When you are using your phone heavily, how long does the battery last between charges? _____ (hours)
2	When you are not using your phone much, how long does the battery last between charges? _____ (days)
3	Does your phone have problems picking the network? (For example, having trouble placing or receiving calls due to poor network connection) Select one: 1 ❑ I almost never have a problem 2 ❑ I have problems in a few locations 3 ❑ I have problems in many locations 4 ❑ I almost never have network connection
4	How much airtime have you purchased in the last month? _____(ugx)
5	How was this airtime paid for?
6	In the last month, how many times have you been unable to complete a work-related task because you lacked airtime? 1 ❑ Never 2 ❑ Once or twice 3 ❑ Three to four times 4 ❑ Five times or more
7	Are there any other troubles with your phone you have not yet mentioned? If yes, explain:

Section 4: Impacts

Interviewer instructions: Please record participant's exact words if they answer in English or an English translation or their response if they do not.

1	How has having this smartphone changed the way you communicate with your colleagues (both PEOs and CBTs)?
2	How has having this smartphone changed the way you communicate with farmers?
3	Has having this smartphone changed anything else about how you do your job? What do you do now that you couldn't do before?

4	Have you found any limitations with your smartphone?
5	Is there anything you wish could be improved or done better, regarding your smartphone and how you use it?

Section 5: Additional Uses

Interviewer instructions: Before asking these questions, please read the following statement: "While this phone was provided for you to use in your work, it is useful for many other things. You have been encouraged to use your phone not only for VEDCO-related tasks, but also to help you succeed in your personal life." Please record participant's exact words if they answer in English or an English translation or their response if they do not.

1	Have you used your solar charger to generate income?	1 ❑ Yes	2 ❑ No
	If yes, how much do you make in a month? If no, why not?		
2	Has your phone helped you generate income in any other way?	1 ❑ Yes	2 ❑ No
	If yes, please explain:		
3	What personal uses do you use your smartphone for?		
	A. Keeping in touch with my family	1 ❑ Yes	2 ❑ No
	B. Keeping in touch with my friends	1 ❑ Yes	2 ❑ No
	C. Reading the news online	1 ❑ Yes	2 ❑ No
	D. Entertainment (such as listening to music or watching videos)	1 ❑ Yes	2 ❑ No
	E. Social Media (networks like Twitter and Facebook)	1 ❑ Yes	2 ❑ No
	F. Looking up information online about personal interests or hobbies	1 ❑ Yes	2 ❑ No
	G. Helping me manage my personal farm or side business	1 ❑ Yes	2 ❑ No
	H. Other (please specify): _____	1 ❑ Yes	2 ❑ No

4	Does anyone other than you use your phone?	1 ❑ Yes	2 ❑ No
	If yes, who uses it and what do they do with it?		

5. Please draw a line dividing the box into two sections that reflect the amount of time you use your phone for work-related tasks and the amount of time you use your phone for personal tasks:

6	Do you use any other phones in addition to your smartphone?	1 ❑ Yes	2 ❑ No
	If yes, please explain what you use other phones for and why you use them instead of your smartphone for these tasks:		
7	Do you feel like you are viewed differently in your community now that you have a smartphone?	1 ❑ Yes	2 ❑ No
	Please explain why or why not		
8	Do you feel like having this phone has changed your life (in any ways not covered in the survey)?	1 ❑ Yes	2 ❑ No
	Please explain why or why not		

APPENDIX II

INSTITUTIONAL REVIEW BOARD APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 6/21/2013

To: Laura Funk
111 Curtiss Hall

CC: Dr. Eric Abbott
204C Hamilton Hall

From: Office for Responsible Research

Title: Implementation of Smart Phones as a Tool to Alleviate Poverty through Communication and Information Exchange Among Farmers in Rural Uganda

IRB ID: 13-235

Approval Date:	6/18/2013	**Date for Continuing Review:**	6/17/2015
Submission Type:	New	**Review Type:**	Full Committee

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp.**
- **Retain signed informed consent documents for 3 years after the close of the study,** when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.
- **Stop all research activity if IRB approval lapses,** unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 1/20/2015

To: Laura Funk
111 Curtiss Hall

CC: Dr. Eric Abbott
204C Hamilton Hall

From: Office for Responsible Research

Title: Evaluating Smartphones as a Tool to Increase Efficiency in Rural Extension Programs - Phase 2

IRB ID: 14-650

Approval Date:	1/16/2015	**Date for Continuing Review:**	1/5/2017
Submission Type:	New	**Review Type:**	Full Committee

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp**.
- **Retain signed informed consent documents for 3 years after the close of the study**, when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- **Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences** involving risks to subjects or others; and **(2) any other unanticipated problems involving risks** to subjects or others.
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