How To Choose a Mobile Phone for an ICT4D Project

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ABSTRACT
At the beginning of an ICT4D project where mobile phones will be used, the question that researchers and practitioners ponder is: what mobile device will be best for the project? In this paper, we present guidelines for making this choice, based on lessons drawn from a review of 30 ICT4D projects, and the reflection of our own work with Community Health Workers in Lesotho in the last four years, during which we used three types of devices in the field. We discuss the considerations that can guide the process of selecting the best device or mobile platform for each project and context, and discuss the recent upsurge of smartphone preference over feature phones in ICT4D projects, and the factors to consider when selecting smartphones for fieldwork.

Categories and Subject Descriptors
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design, Human Factors.

Keywords
Mobile Phone, Device Selection, Feature Phone, Smartphone.

1. INTRODUCTION
Many ICT4D projects leverage the widespread availability of mobile phones to achieve their development goals. Mobile phones are often used as the ultimate intervention because they are familiar to many potential beneficiaries, while also incorporating a multitude of capabilities, including communications, Internet access, multimedia, and games. However, each ICT4D project faces a difficult decision: what phone or mobile platform should they use? Should they buy new devices for the project or should they make use of the devices that their participants already own?

While 82% of mobile phones currently in use in Africa are still basic or feature phones, smartphones are overtaking feature phones in other developing regions [2]. In rural Africa, many still predominantly own low-end phones due to requirements around battery life and repair infrastructure [19]. Yet, smartphones have more computing capabilities and are seen as forward-looking for the research community. These, combined with increasingly declining smartphone prices, have made smartphones attractive choices for some ICT4D projects, even in Africa; yet still, feature phones continue to be the best options for other projects.

We present a review of 30 mobile-phone-based projects recently published at DEV, ICTD, and CHI conferences. In addition, we include a specific case study of our work in Lesotho - the *Bophelo Haeso* project - that has used three different phones in the field to facilitate mobile video sharing by Community Health Workers (CHWs). We then present guidelines for phone and platform choice, based on the lessons learned from the reviewed projects and the *Bophelo Haeso* project. The analysis is broken up into two sections: project considerations for the selection of the device, and the rationale, motivation and challenges of smartphone use.

2. BACKGROUND
2.1 ICT4D Mobile-Choice Review
We went through research papers published at ICTD, DEV and CHI conferences between 2012 and 2014, in search for those that describe direct deployments or experiments with mobile phones in development projects, and found 30 such papers. For each paper, we sought to learn the nature and objectives of the study, technical requirements, applications and features developed/deployed, study location, users or participants, mobile phones used, mobile platforms supported, reasons for choosing a specific phone/platform, and the lessons learned from the use of the chosen phone/platform.

Of the 30 projects reviewed, 18 were implemented on smartphones (15 of which were Android-based), four on feature phones, and the remaining eight were platform independent - they leveraged features on users' existing phones, such as text messaging (SMS), interactive voice response (IVR) system calls, unstructured supplementary service data (USSD), and the mobile web.

2.2 Case Study: Bophelo Haeso
The *Bophelo Haeso* project started in 2011 in Lesotho, with the initial aim of helping rural-based nurses to create and distribute non-textual reference materials to community health workers (CHWs) on their mobile phones [11]. The project provided Nokia C2-01 phones for the CHWs involved in the study, but in addition to these, CHWs who already owned other multimedia-capable phones joined to participate as well. The role of the CHWs' mobile phones, then, was simply multimedia consumption, and the videos were consumed from the phones' native video players. In 2013, we changed the CHWs' phones to the Nokia Asha 201, and later in 2014, to the Nokia Lumia 520.

At the beginning, the Nokia C2-01 was selected because of its price ($60 in 2011), good battery life, durability, and its outdoor usability. By 2013, emerging research demands led us to begin developing mobile applications for CHWs. At that point, we decided to develop the Bophelo Haeso CHW application for feature phones, and since we had an opportunity to procure more

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devices then, we chose the Nokia Asha 201. The Nokia Asha 201 was preferred because it cost the same as the Nokia C2-01 in 2013, but is a slightly smarter device with a bigger screen, and is just as durable and more suitable for outdoor use. As we continued iterative co-design and development, however, we learned that our future applications would require more computing resources, beyond the capability of the Nokia Asha 201. To meet these resource needs, we changed the deployed devices to smartphones (the Nokia Lumia 520) in 2014. Our objective, when making this choice, was to find a "budget-smartphone" that could work in the field, looking at robustness, battery life, outdoor screen visibility and speaker loudness. We found several devices that met our criteria, including the Nokia Lumia 520. There were cheaper options (starting at $40), but since our funding restricted us to use Nokia devices only, we chose the Nokia Lumia 520.

The lessons from the choices and uses of the three phone types in the project are included in the analysis in the next two sections.

3. PROJECT CONSIDERATIONS

3.1 Purpose and Feature Requirements

When selecting a device, the team needs to outline the expected purpose(s) of the devices to be used in the project. Would the purpose be to run a new mobile application, browse the web, make phone calls to an IVR system, consume multimedia content, or get notifications via SMS? What phone features (e.g. camera, GPS, WLAN) will be needed for the desired solution? Where a mobile application will be developed, what computing resources and capabilities will be needed for the application? What interactions are envisioned or preferred (e.g. swipe, typing, etc.)?

3.2 Funding and Project Nature

Not all projects need to provide handsets for participants. The decision depends on the nature of the project, the envisioned purpose, and the funding available.

Where there are limitations with funding or where the objectives do not call for new devices to be bought, projects can decide to use phones that participants already own [9]. In such cases, it is not ideal to develop native applications, but solutions that support multiple platforms and phone types. These are solutions that use USSD, SMS [7], IVR [13], or the mobile web [4]. The challenge with web, SMS, and IVR applications in most developing regions, however, is the data/call/SMS costs involved [16]. Projects taking these options would have to plan upfront whether the charges will be borne by the project for its duration, or whether people will be expected to pay to access the services.

When a project plans to take advantage of devices already in people's possession, it is important to first discover the variety of phones that are owned by the targeted group. While smartphone prices are declining and many people will own them in rural areas in the years to come, in reality, many people still own feature phones [10]. So in many areas, feature phones may still be the devices to target when designing such ICT4D solutions.

Where smartphone capabilities are needed in order to reach project goals, but the people participating do not yet own or cannot yet afford to buy smartphones of their own, the implementing NGO or research team can provide the phones to the participants for the duration of the project, or lend out the devices for a period of time if the application is needed for short-term use [12]. Another reason to buy phones for the project is the desire for uniformity - if the project requires all participants to have similar phones or a common mobile phone platform.

3.3 Context

It is in understanding the context in which the devices will be used that the project team will discover the aspirations of the user group, properly identify the problem to solve, and devise the right solutions. Not every development challenge needs a new smartphone application - sometimes simple solutions prove to be more effective [6]. When the context is understood, the important environmental factors to consider when making a phone-model choice are durability, visibility of the screen in sunlight, audio quality for use in noisy environments, and battery life (especially in contexts with intermittent power). There are devices, smartphones and feature phones, that are specifically designed to survive rugged environments (e.g. dust, humidity) [18].

4. SELECTING A SMARTPHONE

In the history of ICT4D projects, feature phones have been the most preferred, because for many years, they were the most affordable, have good battery lives, and are the most prevalent in rural communities. As some of these variables are changing, more ICT4D projects are choosing smartphones for their experiments and deployments (60% of 30 reviewed ICT4D projects published between 2012 and 2014). There are advantages to smartphone use that motivate their choice for ICT4D projects, but there are also challenges associated with them, that need to be well understood. Both are discussed in this section.

4.1 Higher Specification Needs

As we discovered in the case of the Bophelo Haeso project, some of the solutions that can address the developmental challenges in different projects require devices that are more powerful that the traditional feature phone. By wide margins when compared to feature phones, smartphones provide greater memory, larger screens, bigger storage, and faster, more fluid interactions. This is the main reason for preferring smartphone use in some ICT4D projects, if the research context and other project factors permit the choice.

Taking advantage of the processing power of smartphones gives the project team better opportunities for the creation of innovative features and solutions that were not easy to achieve with the computing constraints of feature phones [10,18]. In particular, many developers find it less strenuous to develop Android applications because of the free and open nature of the operating system, and because with Android, the development experience has less restrictions than on many other platforms [5,18].

4.2 Prices Decreasing

While projects have always aspired to the resource offerings of smartphones in the past, the phones were never considered for a typical ICT4D project because of their high costs. However, some smartphone prices have begun to decline, to a point of competing with the prices of the feature phones that were once considered affordable. For instance, we purchased the Nokia C2-01 handsets at around $60 per device in 2011, but in 2014, there are Android smartphones in Southern Africa that sell for as little as $40. In the phone market in Africa and other developing regions today, there are increasingly more smartphones that are priced the same as feature phones, but offer much better device specifications. This decline in pricing is encouraging many individuals to buy

smartphones, and is the reason that has influenced many ICT4D project planners to start deploying solutions on smartphones [12].

4.3 Aspiration

While smartphone prices are continually declining, there are challenges to adopting the phones in rural areas (Section 4.6). Even with the contextual challenges, however, it has been observed that many rural-based individuals find smartphones more desirable. People aspire to own and be seen with more sophisticated phones [8,12]. In the Bophelo Haeso project, CHWs often remark of the pride they feel in the villages when seen with touch-screen devices. We have observed increased zeal in the project as a result of the new Nokia Lumia devices. This continues to demonstrate that even amidst the constraints in which they live, people still aspire to own better phones. We find that this zeal through aspiration is made possible when the CHWs are allowed to use the phones for personal activities that are not related to the project. In fact, it is believed that the non-prescribed use can also advance project objectives, because when people are allowed to enjoy the wider benefits of the smartphone, they afford more value to owning the phone, they take better care of it and feel more urged to keep it charged [15,18].

4.4 Improved Interactions

Our experience, and that of other researchers who have worked with user groups of low digital literacy like CHWs, is that most of them did not have any experience with touch screen devices before the project, but after training and being encouraged to use the phones often and independently, they got comfortable with the phones [3].

Importantly, we discovered that once one is comfortable with the phone, touch-screen phones are easier to use for data collection, multimedia consumption, and feedback generation than the feature phones we used in the past. It is easier to touch and swipe than to navigate menus with keys on a much smaller screen. Vitos et al. [18] observed that sliding a finger across a touch-screen interface to draw out a pattern for access control seemed easier and quicker than typing a complex password on a feature phone. What we observed, beyond this, is the importance of training at the beginning of a deployment, especially when people are new to touch-screen devices. Beyond the initial training, we observed that many CHWs' comfort levels increased after a month with the phone in the field. They were encouraged to explore the devices on their own without fear of breaking them, and this helped most of them to get used to the new interaction.

Apart from this, as much as possible, it is important to set up the appearance of the device before release, to remove many intimidating applications and widgets from the user's home screen – most phones come with many irrelevant applications installed and placed on the home screen(s), which can contribute to making the device feel foreign and difficult to use. For the Nokia Lumia devices used in the Bophelo Haeso project, we set up the home screen to include only six tiles – the Bophelo Haeso app, dialer, phone book, messages, camera and photos. During the training session, it was demonstrated to them how to access the rest of the applications when needed. We confirm from the experiences of our CHWs that the Windows Phone, when simplified in this manner, is easy to use. We found that many CHWs benefitted from the option of hitting the Windows key to easily return to the home screen, should they feel lost at any point while using the phone or a specific application.

4.5 Future Mobile Phone Landscape

One of the questions we asked when comparing the different mobile platforms was: does the platform have a future in emerging markets? We would spend three years developing different applications for the mobile phones used by our CHWs, and would not want, by the end of the project, to have designed applications for a platform so uncommon, then, that it would not be duplicable in other settings without complete redesign and development for new platforms. We learned that there is a better future for smartphone platforms than for feature phone platforms.

4.6 Smartphone Challenges

While we have learned from experience and literature that there are benefits to adopting smartphones for development projects, some challenges still exist that affect adoption.

4.6.1 Battery Life

When smartphones are used in a rural project, plans for charging them ought to be thought through upfront. Many rural villages still do not have electric power, although in Lesotho, increasingly more households are acquiring small solar charging panels. The reality, however, is that many people still struggle to charge their mobile phones. In most villages, the cost of charging at the homes or business establishments of those with electric or solar power is around $0.50, which most people cannot afford to pay several times in a month, or at all. The CHWs in Lesotho report that the Nokia C2-01 used to last up to two weeks without charging, the Nokia Asha 201 up to one week, and the Nokia Lumia 520 up to four to five days. However, with all three devices, when the phone is used to play videos several times a day (the primary purpose of the devices), the battery depletes much quicker. The Nokia Lumia 520 has the same battery as the Nokia Asha 201, and as advertised, offers longer battery life during video/music playback, but on standby, the battery depletes faster than that of the Nokia Asha 201.

On the Nokia Lumia 520, we employed battery saving tactics like switching off background apps, GPS, mobile data, and activating battery-saving mode on all the devices. These help improve battery life. Our plan for the next cycle is to purchase small solar charging devices for the CHWs who have no power options at home ($25 each). Other projects are already exploring different ways to charge devices in areas with no power, such as mobile charging kits, bicycle chargers and the *Hatsuden Nabe* [18,19].

4.6.2 Cost of Use

While smartphone prices continue to decline, projects ought to consider what is referred to as the "fully loaded" price of the device, which includes the buying price, SIM cards, data costs, repair and maintenance, peripheral devices and charging costs [17]. These prices are higher for smartphones than for most basic phones, and should be considered in advance during project planning. This includes making the decision of whether certain costs will be borne by the project or the device custodians [15].

4.6.3 Liability and Security

To device custodians, with the pride of using a smartphone for an ICT4D project comes fearful caution - the fear of remaining liable in case the device breaks, or is stolen. In projects where devices store sensitive data like patients' records, people would feel more concerned about the financial and legal implications of losing such a device [1]. It is recommended that people be allowed to use the phones more on their own, because with increased use will

come comfort and a decline in the fear of breaking the device [14]. For instance, with increased use, our CHWs observed that they are more free to use the Bophelo Haeso devices in their villages – they explain that because of the unity of their communities, no one would get away with stealing from a CHW. Even with the reassurance, it is useful that plans like data backup and encryption are made in cases of device loss or theft.

5. CONCLUSION

We reviewed recently published ICT4D deployments on mobile phones, and our work with the *Bophelo Haeso* project, then presented guidelines for phone selection in ICT4D projects. Depending on the context and objectives, the project can leverage phones that people already own, and plan platform-independent interventions using USSD, SMS, IVR and the mobile web. However, for projects that opt to provide phones, we discuss various project considerations relevant to the choice of phone model, whether it is a feature phone or a smartphone. Smartphones require additional considerations because of poorer battery lives and higher costs of use, but are trending upwards due to declining prices, higher computing offerings, improved interactions and future potential in developing regions.

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