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28-29 February 2012
New Delhi, India

Vikas Kumar and Jakob Svensson (eds.)
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Foreword

The 1st international conference on Mobile Communication for Development (M4D) was held in Karlstad, Sweden, in 2008 and set the foundation for a platform supporting research practice and development in the emerging field of M4D. From the beginning, the conference encouraged academic discourse as well as disseminating practitioners’ experiences. The conference managed to gather participants from all over the world. The 2nd conference held in Kampala, Uganda in 2010, continued with the successful formula of the academic/practitioner two-tier structure and also transformed M4D into a regular event in the academic calendar. For the 3rd conference it was our determination to bring the conference to India, a country with exiting developments in many different kinds of areas such as economy, democracy and not the least in ICTs. Here we would like to express our deep gratitude to the host of this year’s conference SERD (the Society for Education and Research Development) who were willing to make the efforts of organizing this event and hence assure the M4D trajectory set by the previous two conferences. SERD entered the stage at a time when the conference was facing difficulties; hence the M4D community will always be grateful for SERDs courage and determination to make M4D2012 happen. After many meetings, numerous phone calls, long distance travels and endless e-mails conversations it is our profound pleasure to welcome you to the exciting Indian Capital, New Delhi and to introduce these conference proceedings selected from a collection of more than 125 contributions representing 30 different nations.

This years conference contributions cover a wide field of mobile technology uses, from mHealth to mAgriculture, from mCommerce and mGovernance to mLearning and m-Empowerment. The papers encompass aspects from ICT developments in sub-Saharan Africa to mobile telephony in Latin America, from oral telemedicine in Botswana to privacy issues in Bangladesh, from traffic management in India to mobile money use in Uganda. These few examples from the rich diversity of papers in this volume bear witness to the prominence and importance of mobile technology for development. The present volume will certainly be of great use to the researchers, practitioners, academicians, policy makers, development agencies, industry leaders & Start-up and everyone who wants to contribute and lean from the M4D field.

On behalf of the conference committee we would like to express our sincere thanks to all the paper, poster and demo presenters, who in this volume share their works and ideas with all of us. We would also like to express our gratitude to all the reviewers who have dedicated time from their regular work tasks to thoroughly read and comment papers. Thanks are also due to the keynote speakers, Dr. K.R. Srivathsan from the Indus World School of Business and Mr. Abhishek Sinha, the founder of Eko Financial Services Pvt Ltd for accepting our invitation.
We are also happy to acknowledge the contributions from several sponsors and partners: Spider for travel grants, printing costs, conference dinner and workshop organization, Microsoft India for travel grants, NOKIA for organizing a crowd sourcing challenge and inviting the winners to the conference, UNCTAD for presenting their latest work, World Wide Foundation for organising the pre-conference workshop, Central University of Jharkhand for Academic Partnership and Uniphore Software Systems for technical partnership.

We want to thank all of you, who have contributed to M4D2012 and hope to see you in 2014 in another place but with the same amplitude, focus and determination!

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Keynotes
Dialing Numbers 4 Development

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Abstract—Mobile phone users are able to read numbers. Number literacy or numeracy far exceeds language literacy. Mobile phone users-and there are reportedly over 800 million of them in India-can without exception do two things with their phones. One, switch it on or off; and two, dial a number. The mobile phone is also the first low cost, energy efficient, connected computing device to penetrate Indian households as a “consumer good”!

At Eko India Financial Services, the insights above have been combined to deliver financial services to over a million customers. This has been achieved through a desire to simplify the user experience at the front-end, while accomplishing complex back-end integration with one of the world’s largest installations of a Core Banking Platform deployed by the State Bank of India.
Integrating Mobile Applications into Community Knowledge Enterprises in Different Sectors

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Abstract – With the number of mobile phones in India crossing 900 million and growing, the tablets, iPads and smart phones setting up a new wave of mobile access and productivity environment, various kinds of sensor network and remote monitoring becoming possible, it is about time that we understand how to leverage upon these developments and launch a whole new world of ICT enabled Community Knowledge Systems and Enterprises (CKSE). To build these whole new CKSEs, we may learn from how people are already using the mobile environment in several imaginative ways. We also need effective systems paradigms that help us build and launch these CKSEs in a number of different areas. We expect the next wave ICT revolution will be the ushering in a whole new world of CKSEs.

We first outline the nature of any CKSE. Then we develop a ‘Knowledge Plant’, or K-Plant model’ of ICT enabled services for different kinds of CKSEs. Such a K-Plant is set over the integrated environment of mobile access, relevant network of sensors and field observation instruments, Internet Access, Cloud supported CKSE and managed through an ICT enabled framework of services. We call the ICT Enabled Framework as the ‘Vedyadhara Community Enterprises Framework’, or, VCEF. We show how we use the VCEF to implement and manage the K-Plant for complex ICT enabled services wherein the mobile access, cloud supported applications linked to them and diverse other systems that form parts of the total CKSE system,

Then we illustrate examples of K-Plant based CKSEs in Healthcare, ‘Community Instrumentation over Geography’ that helps predict potential crop disease conditions in specific agriculture situations that activate preventive measures, for Tourism sector, polycentric systems of e-governance and so on. The lecture, through the models and framework of CKSE portrayed will help build the necessary kind of Systems and Services Integration that will help launch large numbers of mobile supported community services.
mHealth
Strengthening Community Health Systems with Localized Multimedia

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Abstract—Many Information and Communication Technology (ICT) systems are currently used to support Community Health Workers (CHWs) in impoverished populations. However, the majority of these systems are text-based, making them difficult to use in areas of low literacy. We have added multimedia to one such system, CommCare, to aid CHWs in counseling clients and promoting healthy behaviors in their communities. This paper explores the benefits and challenges introduced by using multimedia CommCare through a qualitative review of CHW/client interactions and implementer interviews. We find that multimedia increases client engagement as well as CHW credibility and suggest identifying an engaging speaker and determining optimal audio message length as potential strategies for creating effective multimedia.

1. INTRODUCTION

There are number of Information and Communication Technology (ICT) systems in use today [1][2][3][4][5] which support community health programs and Community Health Workers (CHWs) in Lower and Middle Income Countries (LMICs), known informally as ICT4CHW. To date there have been few studies evaluating the utility of multimedia in such systems; rather most studies have focused on the effectiveness of the ICT4CHW systems as a whole. In this paper we will discuss the benefits and challenges introduced by adding multimedia to one such ICT4CHW system, CommCare.

In a recent study DeRenzi et al. identified six Health System Functions (HSFs) in which mobile tools support CHWs: data collection, training and access to reference material, communication between health workers, decision support, supervision, and promoting healthy behaviors in the population [6]. Although CommCare supports many of the HSFs defined above, we will focus on promoting healthy behaviors in the population, as this function is most affected by the addition of multimedia.

We will first discuss motivation behind adding multimedia to CommCare and the process of creating multimedia content. We will then describe eight different multimedia CommCare deployments implemented during 2010 and 2011 and present qualitative data collected through interviews with the implementers involved. Through review of this data we will describe the benefits of using multimedia, namely that it improves engagement in CHW/client interactions, increases CHW credibility, and is more desirable to use and more portable than conventional job aids. We will also describe the challenges introduced by the inclusion of multimedia, namely the difficulties of finding a good illustrator and speakers, design challenges of creating appropriate imagery and audio messages, and the time commitment needed to properly refine content.
In summary, the main contributions of this paper are to provide preliminary evidence that multimedia is a powerful tool for ICT4CHW systems and suggest potential strategies for creating effective imagery and audio messages.

2. BACKGROUND

2.1 Community Health Workers

CHWs in LMICs are the first and often only link to healthcare in rural communities. Since many CHWs work in the villages where they live and their training is likely to take place in a central location more readily accessible to trainers, the cost of education and training is expensive considering travel expenses and the social cost incurred by the absence of CHWs from their communities [7]. The burden of travel also results in poor attendance of training sessions and group meetings. Although CHWs perform vital functions in the communities where they live and work, studies have shown that their performance is often suboptimal [8][9][10][11], which contributes to suboptimal use of health facilities by those in their communities. However, increased CHW performance could increase utilization of healthcare facilities by vulnerable populations [8].

CHWs and the populations they serve in LMICs have low levels of education and literacy, especially among women. Regardless, in such populations mobile phones are widely accepted and used [12]. CHWs often keep in touch with their clients with mobile phones and clients know to call, or give a missed call, to their respective CHWs in case of an emergency. This existing acceptance of mobile phones can be leveraged to better support CHWs as healthcare providers [13], as well as creating a support network between CHWs, their supervisors, and other supporting healthcare providers.

2.2 India

The World Health Organization reports the highest number of maternal deaths per year in India [14]. In many rural communities childbirth is seen as a normal process and few women make any preparations for emergencies [15]. In the rural Indian home, the decision maker on matters regarding delivery and child rearing is often the mother-in-law. The newly pregnant wife holds low status in the family and is sometimes restricted from leaving the home to seek health services [16].

Over 60% of deliveries occur at home without the assistance of a skilled birth attendant [17]. However, studies have shown that by moving deliveries from the home to the hospital, maternal mortality can be reduced by half [18]. The Indian government has taken measures to promote institutional deliveries in rural areas including a comprehensive maternal health program through its National Rural Health Mission (NRHM) [19].
The NRHM incentivizes the use of government health facilities in rural areas and provides services to underserved communities including vaccinations, nutritional supplements, and family planning methods. Its services are facilitated by a cadre of CHWs including Auxiliary Nurse Midwives (ANMs), Anganwadis (AWWs), and Accredited Social Health Activists (ASHAs). ASHAs are the most mobile of these three CHWs and are expected to visit the homes of clients in their respective villages to promote the use NRHM health services and facilitate pediatric and prenatal visits to local Primary Health Centers (PHCs) and Community Health Centers (CHCs). ASHAs receive the least amount of training, 23 days broken into 5 training sessions, which are spread out over the span of 5 years in some locations.

2.3 ASHA Program

“ASHA will be the first port of call for any health related demands of deprived sections of the population, especially women and children, who find it difficult to access health services” [20]. The ASHA program was initiated in 2005 with the goal of connecting every villager in rural India to local health services. One ASHA is selected by local officials to cover every village of population 1,000, although in practice some ASHAs are responsible for more than 1,000 people or multiple villages. The three criteria for becoming an ASHA are that she is a married, permanent resident of the village, preferably 25 to 45 years old, and literate with 8 years of formal education. However, the NRHM states that these requirements “may be relaxed if no suitable person with this qualification is available” [20]. The authors and other studies involving ASHAs [15][16] have found that the actual education level of ASHAs varies quite widely and although most ASHAs tend to be literate, some are not. Another opinion shared by the authors and Ramachandran et al. [16] is that the proposed training of 23 days in 5 sessions is of poor quality and is not well attended (personally witnessed).

ASHAs typically do not receive any monthly salary (this may vary depending on location), but receive different monetary incentives for each of the services they are instructed to deliver. These incentivized services include the following: facilitation of immunization programs; follow-up and counseling of patients; maintaining birth, death, and village health registers; organizing group meetings; and primarily, escorting patients from the village to available PHCs or CHCs. The highest monetary incentive is escorting a pregnant woman from a rural village to a government health center at the time of delivery, for which the ASHA can receive up to 600 rupees (~13 USD). Although an ASHA is expected to follow-up on her clients and counsel them frequently this work is often neglected as it is not heavily incentivized. Disproportionate attention is given to other one-time services like facilitating polio inoculations on a pre-programmed day. Ramachandran et al. also found that “house visits as we imagined did not generally occur” [16].
ASHAs often have low status in the community due to the fact that no ASHA originates from the village where she works, rather she is married into it, and low credibility due to the perception that her work is performed solely for personal gain because of financial incentives. In LMICs where corruption and bribery are common, agents of the government, or those who receive money from government agencies are easy targets for accusation [16]. There are often delays in payment or insufficient payment from the PHCs to the ASHAs for completed incentivized services. All of these challenges have a strong adverse effect on an ASHA’s motivation [15].

In some areas, ASHAs are provided flip-charts or booklets that contain written information on one side for an ASHA to read during counseling sessions and illustrations and key points on the other side for her clients to look at. Despite instruction by supervisors, these flip-charts are often left behind when an ASHA leaves home to visit a client because she simply doesn’t want to carry them. Although books and other reference materials are useful for trainers, they are not appropriate for CHWs unfamiliar with the concept of seeking information inside a text [16].

2.4 CommCare

CommCare is an open-source mobile platform built using the JavaROSA code base [21] which can run on a wide variety of Java-enabled phones. The mobile platform is supported by a server, CommCareHQ [2], which allows implementers to design CommCare applications, manage a number of users, monitor data submitted by users, and correspond with users via SMS. Any number of unique CommCare applications can be created with easily customizable Xforms [22], through which a designer can define all form data viewable by a user including questions, selectable answers, informative prompts, skip logic, data calculations, and image and audio files. CommCare uses UTF-8 encoding [23] and supports the use of many languages and scripts, allowing an application designer to define translations for as many languages as desired in an Xform. CommCare applications can be designed to provide a variety of tools to a CHW including client registration and tracking, decision support, and educational job aids.

CommCare has been used for numerous ICT4CHW deployments in 10 countries to date [2] and has been shown to be effective at improving adherence by CHWs to clinical protocols [24].
3. MOTIVATION FOR MULTIMEDIA

In this section, we draw on existing evidence and field observations that support the potential for improving ICT4CHW systems with multimedia.

3.1 Multimedia Improves Health Worker Performance

The amount of information that CHWs are expected to remember from limited training sessions is often unrealistic, leading to poor protocol compliance. In a CHW study using the GuideView system [5] in which subjects were presented with audio, image, and video cues on a mobile phone to guide them through procedures, Florez-Arango et al. showed that rich media guidelines presented in a highly structured manner increased protocol compliance, since the need to remember complicated procedural information was removed [7]. In another study in which ASHAs used videos on mobile phones as a tool for counseling, Ramachandran et al. report that ASHAs were more comfortable counseling with use of the mobile phone’s video cues than without them and expressed concern that they might forget key points if conducting counseling without the phone [15]. In the same study it was shown that the effectiveness of the video tool depended on the ASHA’s technical ability to pause the videos and discuss key points before resuming, implying that a more structured multimedia system would promote more effective counseling.

CHWs infrequently carry paper flip-charts and registers with them on client home visits due to their weight and bulk, despite instruction by their trainers and supervisors to always carry such materials. A mobile phone is easily portable and unlikely to be left at home. Additionally, informative messages are played aloud instead of having to be read, allowing use by low-literate CHWs.

“Before women in the village thought that we had nothing better to do, so we came to their homes to pass time. But now they don’t say that. They see that we’re working. They see how we’re working better with the phones.”

—ASHA, Rajasthan
“Before if we met a woman on the road, I would talk to her for a couple of minutes and consider that as part of my quota or work. Now I sit down and go through each point. Nothing gets missed.”

—ASHA, Rajasthan

3.2 Sensitive Topics—Multimedia Speaks When People Can’t
Topics like HIV testing and reproductive health can be particularly sensitive. CHWs often work in their own communities which makes these topics even more difficult to broach. Presenting sensitive subjects on a mobile phone in the form of audio messages makes it easier for the CHW and client to discuss as dialogue can be directed to or from the phone, which acts as an anonymous third party in the conversation.

Another way in which a phone can become a benevolent third party in a conversation is in advocating for the CHW. As previously mentioned, ASHAs and other CHWs receive monetary incentives for successfully providing services, which may generate suspicion or distrust from clients. An audio message directed to a client like “remember to call your ASHA when you go into labor, she will help you get to the health facility in time for your delivery,” could dissuade suspicion and encourage clients to utilize ASHA services.

In general, multimedia messages presented on a phone are often taken more seriously than messages delivered by CHWs themselves. A CHW may hold no higher status in the community as his or her clients and may inherently be distrusted due to monetary incentive systems whereas messages on a phone are often assumed to have come from “doctors” who are held in high esteem.

3.3 Multimedia Improves Engagement and Credibility
Multimedia draws attention. In the authors’ experience, when an ASHA shows her phone to a client and plays a message within earshot of anyone else, they immediately come over to see what is happening. Ramachandran et al. similarly report that their video tool engaged not only clients, but family members, who may ultimately be the health decision-makers [16]. In Figure 2 a photo shows a client’s family member becoming involved in a counseling session, after having asked to see the information displayed on the mobile phone more closely.

When used as a tool for counseling, a mobile phone that presents multimedia becomes an anonymous third party in the conversation. The phone becomes a focus point and helps direct discussion to the topics displayed on the screen. Clients will often assume that recorded messages presented by a CHW have come from a higher authority like a doctor or health expert, which increases the credibility of those messages. This in turn increases the credibility of any further counseling provided by a CHW. Continued use of recorded messages may increase the overall credibility of a CHW in his or her community.
“When we give time to the whole family and ask for their permission to show CommCare and also invite them to listen and watch they feel like we’re giving them lots of respect. In return, they also give us respect.”

— ASHA, Rajasthan

“They think that someone higher-up is speaking, someone who knows more than us. This is why they listen and believe what we’re saying even more.”

— ASHA, Uttar Pradesh

4. MULTIMEDIA COMMERCARE

Eight different multimedia CommCare deployments were implemented during 2010 and 2011 as 3 to 5 month pilots with possible scale up afterwards, summarized in Table 1. Different field staff from Dimagi, Inc. supported each of the deployments, resulting in shared knowledge and resources like illustrations. The goal of each deployment was to assess the usability of multimedia in CommCare as a support tool for CHWs in Maternal and Child Health (MCH) initiatives. In most deployments CommCare was used specifically by ASHAs, but one deployment mentioned here and other deployments outside of India involved different types of CHWs with similar roles in counseling clients and conducting home visits.

4.1 Content

Each of the implementations discussed here started with an MCH protocol for CHWs designed by the implementing organization. The implementation team spent a period of approximately one month defining visible and audible content using the spreadsheet exemplified in Figure 3. This content was reviewed and iterated upon by MCH specialists to validate information in each message and ICT specialists to ensure optimal message length, image size, and image detail for use on a mobile phone.
Protocol content was translated from English to the language most commonly spoken by the CHWs at each implementation site and some terminology was changed to appropriately fit the culture and educational level of clients. State policy at each site was taken into consideration when modifying content, ensuring that information was consistent with state guidelines and available health resources.

Content was organized such that it could be presented in a single counseling session between a CHW and client, using skipping logic to display only information pertinent to the client being counseled, based on answers to preceding questions. For example, after recording a pregnant woman’s expected delivery date, information most pertinent to a woman in either her first, second, or third trimester would be displayed. If recorded that a client had previously completed her tetanus vaccination then on subsequent visits the tetanus vaccine question would no longer be displayed, keeping the length of the counseling session short.

### Illustrations

For deployments in India, an initial set of color illustrations intended to fit the MCH protocols were drawn by a compensated, native Indian illustrator to ensure that they were culturally appropriate. All illustrations were reviewed by each implementation group and iterations were made in cases found to be inappropriate or not easily understood. In each case, illustrations were reviewed by both MCH specialists from the implementing organization and selected CHWs who were the intended users of the application. Illustrations were then post-processed to fit CommCare image dimension specifications by an ICT specialist from Dimagi.

#### Table 1: Multimedia CommCare Deployments Implemented between June 2010 and June 2011

<table>
<thead>
<tr>
<th>Site</th>
<th>CHWs</th>
<th>Implementing Organization</th>
<th>Subject</th>
<th>Objective</th>
<th>Multimedia</th>
<th>Languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bareilly, Uttar Pradesh, India</td>
<td>10</td>
<td>Intra Health International</td>
<td>Maternal Health</td>
<td>Client counseling</td>
<td>Image, Audio</td>
<td>Hindi</td>
</tr>
<tr>
<td>Bareilly, Uttar Pradesh, India</td>
<td>10</td>
<td>Intra Health International</td>
<td>Maternal Health</td>
<td>Client counseling</td>
<td>Image, Audio</td>
<td>Hindi</td>
</tr>
<tr>
<td>Kaukambi, Uttar Pradesh, India</td>
<td>10</td>
<td>Catholic Relief Services</td>
<td>Maternal Health</td>
<td>Client counseling and tracking, CHW monitoring</td>
<td>Image, Audio</td>
<td>Hindi</td>
</tr>
<tr>
<td>Deogarh, Bundelkhand, India</td>
<td>10</td>
<td>NEEDS</td>
<td>Maternal Health</td>
<td>Client counseling and tracking, CHW monitoring</td>
<td>Image, Audio</td>
<td>Hindi</td>
</tr>
<tr>
<td>Kishangarh, Rajasthan, India</td>
<td>10</td>
<td>Save the Children, UNFPA</td>
<td>Maternal Health</td>
<td>Client counseling and tracking, CHW monitoring</td>
<td>Image, Audio</td>
<td>Hindi, Marwari</td>
</tr>
<tr>
<td>Chhindwara, Madhya Pradesh, India</td>
<td>10</td>
<td>Real Medicine Foundation</td>
<td>Child Nutrition</td>
<td>Data collection, referral generation</td>
<td>Audio only</td>
<td>Hindi</td>
</tr>
<tr>
<td>Dodoma, Tanzania</td>
<td>32</td>
<td>ITDCF</td>
<td>Newborn-care</td>
<td>Client counseling, CHW monitoring</td>
<td>Image, Audio</td>
<td>Swahili</td>
</tr>
<tr>
<td>Chitrakoot, Uttar Pradesh, India</td>
<td>10</td>
<td>World Vision</td>
<td>Maternal Health</td>
<td>Client counseling, CHW monitoring</td>
<td>Image, Audio</td>
<td>Hindi</td>
</tr>
</tbody>
</table>

#### Fig. 3: Example of Collaborative Spreadsheet Used to Define Visible And Audible Content
4.3 Audio Recordings

Audio recordings for each site were recorded by an area native speaker whose primary language was commonly shared amongst the CHWs. In some areas more than one language was commonly spoken amongst the CHWs. In these cases the official language as defined by the state was used, but speakers were instructed to use local terminology to ensure better understanding by the targeted population. Recordings were performed in a quiet room and were conducted by an ICT specialist from Dimagi who then post-processed and encoded the recordings for use in the CommCare application.

Audio recordings often underwent a series of iterations through review by both MCH specialists and CHW focus groups to ensure their clarity, appropriateness, and ease of understanding. In some cases only a few messages were re-recorded and in others all of the messages were re-recorded by the same or different speaker.

4.4 Content Refinement

After a complete application was compiled, the CHWs were trained as a group (between 5 and 15 at a time) to use CommCare during routine visits to their clients’ homes. Often during training sessions, which involved role-playing by CHWs, small mistakes in audio messages or misinterpretations of illustrations were identified by CHWs and noted by the implementation team for later correction. The implementation team spent a number of weeks following individual CHWs on routine visits to observe their interaction with clients. Based on observations, more improvements were made to the content and typically 2 to 3 revisions were made to the application during the first 3 months of implementation. For each revision, anywhere from a few to 60 new audio recordings were made, and occasionally a few new illustrations were created.

5. Results

5.1 Method

We conducted independent, qualitative interviews with 8 implementers to achieve a better understanding of common benefits and challenges introduced by the inclusion of multimedia to CommCare. We analyzed notes taken during interviews, identified recurring concepts, and assigned a weighted score for each concept mentioned, based on the contextual importance of the concept as described by the interviewee or the number of times the concept was mentioned. Concepts with highest frequency and ranked with highest importance are compared here.

5.2 Design Challenges

The addition of multimedia to CommCare introduces new challenges to system design, including the procurement of multimedia and ensuring
its quality. Implementers consistently stated that audio messages were more important than illustrations because audio messages contain more information whereas illustrations act solely as visual cues. Figure 4 shows that identifying an engaging speaker for the audio recordings was most crucial to creating an effective application. Five implementers noted that keeping audio messages “short enough” or including only key points to create “optimum messages” was essential for better counseling compliance by CHWs. The constraints of a mobile phone, including message length and image detail, made content revision time consuming by requiring multiple iterations to get the content right.

Three implementers worked with pre-existing images from external sources including MCH handbooks and illustrated, paper flip-charts. These images were not designed for use on a mobile phone, which is limited by screen size and resolution. In such cases implementers described difficulties introduced by poor quality images from paper scans and the inability to modify the images. In one case the original illustrations were scrapped and new illustrations were created by a professional illustrator. In two cases time constraints limited the implementers’ ability to seek alternative illustrations and this limitation of available images was cited to have restricted the amount of content that was included in the final application. Most of the deployments in India shared illustrations made by a native Indian illustrator, which were designed specifically for use on mobile phones.

Fig. 4: Design Challenges Introduced by the Inclusion of Multimedia to CommCare Ranked by Importance to Implementers

5.3 Benefits of Multimedia CommCare over Conventional Job Aids

Fig. 5: Benefits of Multimedia CommCare over Conventional CHW Job Aids Ranked by Importance to Implementers
The most important benefits to using multimedia CommCare were related to the simple fact that multimedia were presented on a mobile phone. Mobile phones are a status symbol in LMICs and the fact that CHWs could use them to show their clients images and play audio messages was seen as “cool” and “fun”. Implementers cited that mobile phones are far more convenient and portable than conventional job aids which are often “heavy” or “bulky”, resulting in them being left behind at CHWs’ homes while out on counseling sessions. At a recent, unrelated CHW training attended by one implementer and her cadre of CommCare-using ASHAs, the trainers handed out illustrated flip-charts on a new topic. The implementer quoted one ASHA saying, “we have mobiles, why do we need another flip-chart?”

Another important benefit is that a mobile phone playing audio messages becomes a live actor in CHW/client interactions, who is assumed to be an “expert”, “doctor”, or other “credible authority”. One implementer mentioned that clients would often ask who the speaker was, to which CHWs would respond “a lady doctor.” In most cases the speaker was another CHW and in some cases was actually a female physician. In either case, implementers believed that having the message come from an anonymous “expert” or from a known CHW increased the credibility of the message and counseling value performed by the CHW as a result.

5.4 Multimedia can be Reused
In all cases, implementers expressed the belief that illustrations from their deployments could be reused in other deployments involving similar subject matter.

Audio messages for each deployment were recorded on site by an ICT specialist from Dimagi. Although messages were recorded from scratch at each site, implementers expressed the belief that those messages could also be reused in other deployments as long as the site was geographically close enough that differences in dialect would be insignificant. Only one implementer commented that the time required to record and post-process audio messages was a significant challenge, while all others expressed that once an engaging speaker had been found, recording and post-processing was a trivial matter which required only a couple days of work.

Seven implementers believed that multimedia from their deployment would still be useful if used with CHWs who had higher education or training, but were less certain that the multimedia would be useful if presented alone to a client instead of by a CHW. Two implementers stated that such multimedia would not be useful for clients alone because of technical challenges of using the phone and lack of motivation to do so in the first place.

5.5 When Multimedia is Not Appropriate
Figure 6 shows a series of questions that can help decide whether or not to use multimedia for a given ICT4CHW intervention. Implementers
concluded that the only situation in which multimedia was not potentially beneficial was if the ICT4CHW system was only used for data collection (and not counseling) and the CHWs were fully literate. In such a case, it was stated that a multimedia component may slow the CHWs down in their data collection tasks.

Four implementers expressed concern that standardization of messages is not always helpful since it may hinder the CHWs ability to deliver personal messages to his or her clients. The goal of CommCare in these implementations was to support the CHWs in counseling sessions, not act as a crutch. However, implementers noted that the ability to play audio message on demand (CommCare currently supports one-button play for audio) mostly averts this issue as CHWs can play any message only when desired. It was also noted that playing audio served as a helpful reminder for the CHWs on what to say and that for poor performing CHWs playing only the audio messages was still better than no counseling on the topic at all.

![Flowchart: When is Multimedia Appropriate to Use?](image)

The most agreed upon failure of multimedia is its use in noisy or crowded places or with multiple clients at once. The mobile phones’ technical limitations of small screen size and low speaker volume make them difficult to use if there is extraneous noise, for example when a generator is running outside of a client’s house, or if multiple people are trying to see the screen at once. Implementers stated that multimedia CommCare should be used only as a one-on-one counseling tool and that paper-based tools like flip-charts might be more appropriate for group counseling.
6. **DISCUSSION**

Based on the experiences collected in implementer interviews, we suggest potential strategies for designing effective multimedia for ICT4CHW deployments.

6.1 **Identify Good Sources—Illustrator and Speakers**

Finding a good illustrator and speaker can take a substantial amount of time. The illustrator should ideally be native to the intervention area to a degree that he or she is familiar with the typical style of dress, foods available, personal appearances, habitats, and general way of life of the target population. One should assume that multiple iterations on the illustrations may be required to get them right, so availability of the illustrator throughout the design and initial implementation stages is important.

Pre-existing images can be used, but they must first be tested for usability on the mobile device and all available images should be inventoried. If using pre-existing images it must be taken into account that content outside of the existing inventory will not be covered which may cause future problems if modifications are needed or new content is desired.

The speaker should ideally be native to the intervention area to the degree that he or she speaks the same language shared amongst the CHWs and the majority of the target population. If the intervention covers a geographical area including multiple different dialects, use the CHWs as the common denominator. If the CHWs themselves speak different dialects, it may be worth the time commitment to create different version audio recordings to appropriately cover each primary language spoken. The speaker’s voice should be clear and annunciated and he or she should be able to speak naturally at a pace slower than normal conversation for better clarity. We recommend giving auditions to a number of potential speakers and possibly choose one or more to perform the audio recordings, allowing for choice between multiple sets of recordings and different actors. Messages may need to be recorded many times for correct content and presentation, so availability of the speakers throughout the design and initial implementation stages is also important.

6.2 **Getting the Audio Right**

Audio messages should be designed to be as short and concise as possible, focusing on the key components of the information. A message that is too long may become a crutch for CHWs or hinder their ability to counsel. A message of optimum length will act as a reminder and prompt the CHW to give additional information or counseling on the topic described. Close attention should be paid to the terminology included in the message to ensure understandability by both CHWs and the target population. Messages should be reviewed by the CHWs and, if possible, CHW/client interactions should be observed periodically to ensure maximum understandability.
Setting up a comfortable and quiet recording environment is essential for clarity. Use a quiet room without interruption. Ensure removal of potentially noisy jewelry, such as bangles. If possible, use a high quality microphone with a windscreen to avoid capturing the speaker’s breathing. The speaker may hold the microphone to his or her mouth or it may rest on a stand, but in either case the implementer should connect a pair of headphones to monitor the recorded audio. If possible, the implementer should monitor the audio with headphones for the duration of the recording and note down whenever a mistake is made or the recording is not clear. It is best to wait until all intended messages have been recorded and then ask the speaker to re-record certain messages.

To produce more natural speech, it may be useful to record messages in the form of a dialogue between two people. In this case be sure to instruct the speakers to speak at a pace slower than normal and to pause before responding to each other.

6.3 Getting the Images Right

Color illustrations were the preferred imagery in the implementations discussed here. As mentioned by one of the implementers, color can be used to highlight specific important elements or objects in the illustration. Specific attention should be paid to details like clothing, which may signify status or a profession, and the appropriateness of objects or symbols for the target population. For example, skull and crossbones may not signify danger for certain cultures and a depiction of a calendar may not be understood as pertaining to a date. A potentially useful test to determine image comprehension is to review images alongside their respective audio messages with the CHWs, then review the images alone and ask the CHWs to explain the message.

7. Conclusion

Through review of qualitative data we have identified benefits of using multimedia CommCare to support CHWs in promoting healthy behaviors in the population including increased engagement of both the CHW and client during counseling sessions, increased credibility of the CHW as a result of audio messages being perceived by clients as having come from a third party “expert” or “doctor”, and increased acceptability of multimedia CommCare as a job aid tool because it is “cool” and “fun” as well as more convenient and portable than “bulky”, conventional job aids.

By interviewing implementers of multimedia CommCare deployments we have also identified additional challenges multimedia brings to application design. Identifying an engaging speaker for audio recordings and a good illustrator or comprehensive set of appropriate images to use take a significant amount of time and should be addressed before starting the intervention. Audio messages help standardize care by reminding CHWs
what topics to counsel on, but must be kept to an optimally short length to prompt further counseling rather than become a crutch. Multimedia content must be reviewed by CHWs and iterated upon until its understandability and appropriateness for target populations is assured. Multimedia content is best delivered in one-on-one counseling sessions between a CHW and a client and may not be appropriate for group counseling or in crowded or noisy places.

Multimedia is a powerful tool for promoting healthy behaviors in LMICs and the ICT4CHW space would benefit from additional work evaluating such interventions.

8. DISCLOSURES

8.1 Potential Conflict of Interest

Derek Treatman and Neal Lesh work for Dimagi, Inc. which developed CommCare and is seeking further funding for CommCare through grants and contracts. They could benefit financially from a positive perception of CommCare.

REFERENCES


Mobile Based Health Care Solution for Breast Cancer Patients

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Abstract—Breast cancer patients in advanced stage of the disease need palliative care as well as traditional treatment which aim to cure and prevent cancer. For such patients, treatments and interventions concentrating on reducing the suffering and improving the quality of life might be the best possible alternative. In this paradigm, long term care is provided through an adaptive feedback-oriented treatment mechanism. It is essential that patients be assessed regularly and if needed, adjustments to the treatments be made without delay. This whole issue is almost absent in rural scenario of developing countries like Bangladesh. Here we have proposed a mobile and sensor based solution named AutoCare, which has been outlined with the assistance of International Breast Cancer Research Foundation (IBCRF). As part of AutoCare we have designed and deployed a mobile based remote patient monitoring system named e-ESAS. We have also summarized the desired design principals of such systems found through 3 field studies in rural Bangladesh.

1. Introduction

According to Bangladesh Bureau of Statistics cancer is the sixth leading cause of morbidity and mortality in Bangladesh [1]. Breast cancer is the 2nd most common type of female cancer in Bangladesh. Around 24.3% female cancer patients suffer from breast cancer with only 98 oncologists present in the whole country [2]. National Institute of Cancer Research and other hospitals in Bangladesh have the capacity to provide treatment to only 2% of all cancer patients per year (20,000 out of 1 million) [2]. In this scenario Government of Bangladesh has devised ‘National Non Communicable Diseases Strategy and Plan of Action’ with technical support from WHO in 2007. Government has committed to develop ‘National Cancer Control Strategy’ but the field study depicts a poor and concerned scenario. As part of this only 2 institutes (NICRH and BSMMU) have started hospital based cancer registry [4]. More than 22,000 new BC patients being added each year and 70% of them die due to lack of treatment [3] though it is possible to prevent at least one-third of the cancers based on early detection, availability of resources, and effective treatment [4].
In order to get first hand view we conducted 3 field studies (Jul’10– Aug’10, Dec’10–Jan’11, Jun’11–Aug’11) in Bangladesh. In a religiously conservative and low-income country like Bangladesh, the health-care facilities are scarce and other socio-economic factors become decisive in how regularly a patient can visit the facility in person, especially when the patient is a female. An assessment system that can monitor the patient’s health status regularly without requiring her to visit the health-care facility in person will be of great value. Fortunately, in Bangladesh, like many of the low-income countries, cellular phones have become ubiquitous. According to [22], the number of cell phone users in Bangladesh had reached 76.434 million by June, 2011. Cellular phones along with a body-area sensor network of small, wearable sensors can serve as a low-cost and suitable assessment system for regularly monitoring a patient’s health-status. Thereupon, as our initial step, we decided to use cell phones to build a remote symptom monitoring system (RSMS) for patients, which may notably reduce the necessity of visiting the doctors’ facility coupled with the benefit that doctors will have by getting regular patient data. We have developed the first version of e-ESAS based on Edmonton Symptom Assessment System (ESAS) [10].

In our paper, we propose the outline of a mobile based solution (AutoCare) for monitoring rural breast cancer patients from their home environment. We begin with the background information for setting up the environment in section 2. The challenges faced by patients have been elaborated in section 3. Section 4 contains the objective of the project AutoCare followed by supporting concepts in section 5. Design principles followed in designing e-ESAS have been elaborated in section 6. The design and development of e-ESAS have been stated in section 7. Section 8 contains the related work followed by conclusions and future work in section 9.

2. System Background

Amader Gram (literally ‘Our Village’) is an initiative of Bangladesh Friendship Education Society (BFES). In 2006 Amader Gram partnered with International Breast Cancer Research Foundation (www.ibcrf.org) to open Amader Gram Breast Care (AGBC) center and became one of 9 countries to participate in a clinical trial for breast cancer patients. The mission for AGBC is to reduce morbidity and mortality from breast cancer and other breast diseases in women. AGBC has three parts: The AGBC center Breast Care Center in Khulna, Primary Breast Care Centers in Bagerhat, Rampal, Tungipara, and Jessore, and a Research Unit. A trained female doctor and medical assistant attend each clinic, examining and keeping records of each woman who comes to the clinic. Women are provided advice and supportive care; those with more serious issues are referred to an affiliated doctor at Khulna Medical College. Patients need to pay one time registration fee of 100 taka ($1.5). Then the patient is given a registration card and her ultrasonogram and medical check-up is performed. From 2006 till 2010, the
total number of patients diagnosed with breast cancer is 1405. Number of
women receiving referrals for further care is 239. Total number of registered
cancer patients is 53. Till now 21 patients have died. Nine of the patients
have discontinued after being registered. AGBC center acted as our local
base in Bangladesh. We held several meetings, interviews, and focus group
sessions with breast cancer patients, doctors from Bangladesh and IBCRF,
health workers to outline the features and design principals of AutoCare
and e-ESAS. In total we met 39 breast cancer patients and 12 doctors in
Khulna and Dhaka division.

3. Challenges
Based on the view of doctors and patients we have categorized the existing
problems in the following categories.

3.1 Identification and Disclosure
Due to lack of familiarity most of the women identify BC really late. They
are very shy and sometimes afraid to talk with anyone regarding breast
problems. Most of the time they think this will be automatically cured as
time goes by. According to P3, “This is the 2nd time I am coming to hospital in
my life. I am having this lump for more than six months but I thought it would go
away automatically after some time. But it did not. How can I talk about this with
my husband or others? But for the last couple of days the pain became unbearable.
So I asked one of my neighbors to come with me and requested her not to tell
anyone”. At the same time they put their need as the last thing to be taken
care of in the family. All these issues make it difficult even to identify BC
patients in the rural villages.

3.2 Difficulties in Achieving Treatment
After being identified and decided to visit the health center patients become
doubtful about getting female doctors. According to Oxfam there are only
0.26 physicians per 1000 people [23]. In this scenario it is even hard to get
physicians let alone female doctors. Long standing superstitions and social
and religious beliefs also stand against visiting and receiving treatment.
In many rural families the husband and mother-in-law think of spending
money for the women as complete wastage where as the male members of
the family are treated differently. The statement of P23 summarized these
issues: “At first my husband did not permit me to go to the health centers saying
they have only male doctors. He was also worried about what others will say about
this. Later he told me to bring money from my parents for my treatment.” All
the patients had complaints about the physical pain of the communication.
Almost everyone had the same story like P33, “...this time it took more than 2
hours to reach here. I had to take rickshaw, then van, then bus, and finally rickshaw
again. The bus was very crowded and I had to wait a long time to get a chance to
get in the bus. I am feeling very sick now and I do not know how I will get back
through this again.” Long traffic jam, poor road condition, and long distance
to the health center create not only unbearable communication but also put
the patients in health risk.

3.3 Continuation of Treatment
From patients point of view the common complaint is the lengthy nature of
treatment. At some stage the BC patients become habituated with the disease
and start neglecting the treatment (fading out issue). They also mentioned
about the problems of managing a companion who will accompany her to
the health center. The patients visit the doctors with long delay and miss
appointments on regular basis. One patient (P9) said, "I am having medicine for
long 4 years. I do not feel like living. It seems that I am having medicine throughout
my life. I wish not to go to doctor or hospital or anywhere…I don’t remember when
I came here last time to visit doctors but I think it would be 2 months ago."

3.4 Environmental Issues
Though there are connectivity issues in some rural villages, in general the
mobile network is quite strong throughout the country. Load shedding
remains a long standing issue for charging the mobiles. During our visit to
Khulna we have faced around 5 hours of load shedding per day and this
increases during summer. We also found that there is no concept of privacy
regarding health information among village people. Rather it seems that
the concept of privacy is new term to rural women. All the patients echoed
what P7 said: "many people see my file (prescription and other documents) and I
don’t mind. I also always ask other patients about what the doctors said to them."
Loss of mobile is also a quite common issue. Sixteen patients said either
they or their family members have experience of mobile theft.

3.5 User Issues
Lack of education plays a big role in keeping women within closed doors.
We found only one patient who completed grade 12 with 35% of the patients
we interviewed as illiterate. Though 47.8% of them have mobile, 26.1% of
the patients only know how to receive a call. None of them has ever used
any mobile application. Finally harsh poverty is hindering the patients
from coming to the health center. The average family income of 61% of the
patients is less than BDT 3000 ($42) per month. In many cases health care
is at the bottom of their priority list.

4. Objective
The goal of the proposed project is to design and develop AutoCare (AC), a
cellular phone and other wearable sensors based health-assessment system
that facilitates palliative care for breast cancer patients in advanced stage
of the disease in Bangladesh. To achieve the proposed goal we plan to
accomplish the following objectives:

1. Develop cell phone based the Edmonton Symptom Assessment
   Scale (ESAS) in both English and Bengali.
Using cell phones and sensors, we will design and develop a system that automatically:

- Detects and quantifies pain, anxiety, and depression from facial expression
- Analyze the sleep pattern of the patient
- Measures the amount of verbal interaction of the patient
- Quantifies the fatigue of the patient
- Measures physical activity of the patient in a certain period

All these objectives share the following processes:

4.1 Data Collection
- Collection of assessment data using e-ESAS application
- Baseline and longitudinal collection of data via cellular phones and other wearable sensors.
- Data uploading to server

4.2 Data Analysis
- Algorithms to extract relevant information from the uploaded data

4.3 Information Presentation and Feedback
- Presentation of information in suitable formats to health-care personnel
- Recording of feedbacks from health-care personnel

5. Supporting Concepts
The proposed research makes provision for economically assessing the patient’s health-status in a regular basis without requiring the patient to visit the health center in person. Our system is a novel one, because automatic assessment of a patient’s emotional states along with physical states has not yet been covered by any cellular phones and sensors based health-care system. Figure 1 shows the high level architecture of the proposed system.

![Fig. 1: Architecture of Auto Care](image-url)
We have made the following assumptions in discussing the features of our system.

- **Level of Pain, Anxiety, and Depression**: Muscular action units of the face changes in recognizably different amount depending on the level of pain, anxiety, and depression.
- **Fatigued Gait**: Gait pattern changes recognizably depending on the tiredness of the person.
- **Sleep Pattern**: Quiets in acceleration data from the wrist-worn tmote correspond to quiets in the person’s activity.
- **Fatigue**: A person’s level of fatigue can be effectively determined from his answers to well-posed questions.
- **Verbal Interaction**: A person’s social interaction is reflected effectively in how frequently she involves in verbal interactions.
- **Physical Activity**: The more a person walks, runs, uses stairs, the more he is physically active.

Following are some innovative features of our system:

### 5.1 Pain, Anxiety and Depression from Facial Expressions

Research in Psychology has established that facial expressions can be objectively codified in terms of muscular action units (AU’s) and a sequence of these AU’s can be interpreted as an indication of the presence of a particular emotion like pain, sadness, joy, etc. We have already developed a lightweight Matlab module that can detect six basic expressions namely happiness, sadness, anger, fear, anxiety, and depression. The algorithm has been developed based on Principal Component Analysis (PCA) based Eigenface method and tested on a small database of 8 persons.

### 5.2 Gait Pattern

We have acquired data from the cellular phone’s 3-axis accelerometer corresponding to a person’s gait. We were able to show that people have distinct gait patterns.

### 5.3 Sleep Pattern

If a person has a tmote attached to his wrist, it is natural that acceleration data will be different for the time when he is sleeping from the time when he is awake. The acceleration pattern is different for sound and disturbed sleep.

### 5.4 Verbal Interaction

The reason we want to quantify verbal interaction is that patients’ quality of life is reflected by social interaction and verbal interaction is a reflection of social activity.
5.5 Fatigue/ Weakness
Fatigue is acknowledged to be the most frequent symptom experienced by patients with cancer. Fatigue is subjective, differs from normal tiredness and it decreases capacity for physical and mental work. Most of the instruments to measure fatigue are based on questionnaires. Some of these are BFI [5] and Revised Piper Fatigue Scale [6].

5.6 Physical Activity
There are 3 main reasons why we want to measure physical activity of patients: a) to estimate the true effect size, b) to specify which dimension of physical activity is of most importance for a particular health outcome, and c) most importantly, to quantify physical activity in order to measure the effect of interventions.

6. Design Characteristics
As a result of the meeting outcomes we have received several important issues and a guideline about the possible desired characteristics of an automated system.

6.1 User Friendliness
The user interface should be designed considering the background of the target people. Their familiarity with certain technology, education level, physical condition, and above all social and cultural norms should be considered during the design of the system.

6.2 Mobility
One key characteristic of the system is to maintain the mobility of the patients and doctors. Doctors are expected to view patient data using their mobile phones from anywhere anytime, even when they are travelling. Patients also should be able to transfer data from anywhere, even from remote places.

6.3 Continuous Data Collection
One of the problems doctor regularly face is that patients do not follow up regularly and the information about patients is irregular. Collecting the patient data should be continuous and regular. Once the system is deployed, it should be able to add new users (patients and doctors) and collect and store the data in the server regularly.

6.4 Quality over Quantity
Data collected in a health center can be biased by different factors. For example, when a patient travels a long distance in various mode of transport and wait in doctor’s chamber for her turn, the feedback she gives to the doctor may be distorted by her experience. The patient’s response is influenced by her current situation. So the quality of the feedback doctors receive in this kind of setting is not the best. Recording data in a natural
setting should increase the quality of the data. Another way to increase the quality of the data is to record data when it matters most. For example, recording pain level when pain is very high or very low should also increase the quality of data as the drastic change is being recorded.

6.5 Local Dialect
Instead of using English, local dialect should be used in the user interface as much as possible.

6.6 Configurable Data Representation
Viewing the data in right format is important for doctors. The pattern that is obvious from the graph may not be so obvious from a table. The system should provide the opportunity to doctors to view the data in different format.

6.7 Smooth & Comfortable
The system should be designed in such a way that users are comfortable with it and it causes little or no obstruction to the daily activities of the patient. Accessing the data by the doctors should be smooth with minimum possible obstructions.

6.8 Extensible
System design should ensure that some other useful services can be incorporated into the system later, i.e. the system should be extensible. Also it should be easy to incorporate suggestions from users during the later versions of the system.

7. Implementation
Based on our research findings we have designed and implemented a cell phone-based ESAS application. The application was developed for Nokia X6 phone. The reason behind is the widespread use of Nokia phone in Bangladesh. There are actually two parts of the system: A server and a client. On the server side, we used Tomcat 6.0 as the server and MySQL as database. The client in turn has two modules. We call these modules as doctors’ modules and patients’ module. For our first prototype, these two modules are integrated into single application. The reasoning behind this is flexibility. Anyone, doctor or patient, can use the application. A person can login as a doctor or as a patient.

If a user logs in as a patient, she is provided with an ESAS page. The page has 10 sliding bars each followed by a button. The sliding bars are labelled as pain, tiredness, nausea etc. Patient can drag the sliding bar to left or right by touching and set the value of it to any value between 0 and 10. The default value of the sliding bar is 0. Each button corresponding to a sliding bar has a Bengali text as a label. If pressed, it will play a voice in Bengali. The voice is an instruction on how to use the sliding bar. When the user presses the ‘submit’ button located at the bottom, it will send all
the sliding bar values set by the patient to the database server as a string. Sample figures of e-ESAS have been given below in figure 2.

Fig. 2: Screenshots of the Application e-ESAS
When a user logs in as a doctor, he/she is provided with an alphabetically ordered patient list. The doctor can choose a patient and select a menu item called ‘view chart’. Then he can choose one of the ten symptoms (pain, tiredness etc.) and the start and end date. For example, selecting pain will show a line graph of pain against the chosen duration of time. The starting and end date are shown below the graph. Doctor can change these dates anytime and choose to view a graph for a different time period.

8. RELATED WORK

We have divided the literature using mobile technology and hand held devices for bridging the information gaps in health-care management into two categories- urban and rural settings.

Based on urban setting, Hayes et al. [17] summarized the detailed overview of cancer treatment process and possible use of pervasive technology in several different stages of cancer care. Although, the use of pervasive technology is basically restricted in information collection and information management [18,19]. These projects focus on collecting information when the patients are at home only. Our proposal is free from this limitation. In recent works, Klasnja et al. [8] investigated the information work that breast cancer patients do in unanchored settings. In another approach, Skeels [9] et al. tried to utilize the power of social network to improve the quality of life for the cancer patients. Such approach is not feasible in rural settings of the developing countries.

The low cost and availability of mobile devices have greatly enhanced the prospect of mobile based applications being used in rural healthcare. These applications intend to focus on one of the following three areas:

8.1 Decision Support System

Several projects work based on implementing a guideline set by WHO or other standard organizations in computer or handheld devices [7,12,13]. Early Diagnosis and Prevention System [12], a computer based healthcare management software has been deployed in rural area of Tamil Nadu, India. The software registers patient history and uses this information to develop a screening method to decide about physician referral, and simple treatment advice. Mitchell et al. [13] implemented a HIV screening algorithm in PDA and tested the performance in two AIDS treatment centers in South Africa. e-IMCI [7] describes a PDA based system for administering the Integrated Management of Childhood Illness (IMCI) protocol. This system helped doctors to follow the simple IMCI guidelines with reduced deviations and played a major role to combat child mortality. All these projects just check the answers of the interview questions and suggest doctors what to do based on predefined set of rules. But our system feeds doctors with continuous, regular data and presents them in longitudinal fashion to help them in decision making in a better and efficient way.
8.2 Data Collection/ Survey
The feasibility of mobile applications for collecting health data or survey information has been proven in many developing countries including India [11], Ghana [14], and Uganda [15]. SATELLIFE PDA [14] demonstrated the viability of PDAs by successfully addressing the digital divide among healthcare workers and professionals in Ghana. HealthNet Uganda [15] incorporates PDAs to grant practitioners to access vital information in real time. PDAs have also been used in replacing paper based questionnaire in the context of HIV/AIDS programs in Angola [16]. Our project has two fundamental differences with these projects. Firstly, instead of health workers or trained professionals, patients or their attendants are filling the information by themselves. Secondly, patients are doing this from home and sending data by using the data network of mobile carriers. In all other projects either patient has to come to the health center or health workers need to go to remote houses of the patients to collect such information.

8.3 Telemedicine
Telemedicine is the other major area where computing technology proved to be crucial. Several projects like WiLDNet [21], Asynchronous Remote Medical Consultation [11], iPath [20] aim to connect physicians from urban areas or foreign countries to patients residing in rural areas. Telemedicine is especially useful in regions where transportation infrastructure is poor but the network infrastructure is capable of performing real time media connections in a cheaper way. Though we are using the mobile data networks we are only sending 10 bytes of information rather than using costly data network.

Current literature review shows that mobile applications intended to help cancer patients of developing world is yet to be implemented. Along with that, our paper is fundamentally different from the above-mentioned projects in several ways. We have performed a thorough field study and derived the possible issues that can be solved using mobile technology from both patient and doctor point of view where as all other projects focus on one module. The outcome of field study has been analyzed minutely to accrue primary elements of interface design. In contrast to other projects the primary user of AutoCare is the patients. We have exploited the data network of mobile carrier to reduce the huge burden of regular communication from remote villages to health care centers. As this data collection is done from home we would be able to collect data on a daily basis which will help us to develop a sequential parametric database for each patient. Graphical representation of these data would help the doctors to make better decision that they failed to make so far for lack of information.

9. Conclusion
Mobile technology can play a big role in improving the health care services for developing countries. Here we have proposed the high level architecture
of AutoCare and design and implementation details of e-ESAS. The features and design principals of the proposed system have been accrued by conducting thorough filed study in rural Bangladesh. The field studies also helped in understanding the psychology of the target users and their acceptance to mobile and sensor technology which is a ‘must do’ precondition for any application project to be a success. Along with that we have showed the design and deployment of initial version of e-ESAS. In future we will accommodate the user feedbacks of the system. We will evaluate the user perception based on easiness, comfort of use, impact of the system etc. Based on the success of the project we plan to implement electronic version of ESAS in cheaper cell phones. We believe the overall system will be able to bridge the information gap between patients and doctors and ultimately improve the quality of life of rural patients in Bangladesh.

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References


eCompliance: Enhancing Tuberculosis Treatment with Biometric and Mobile Technology

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Abstract—Operation ASHA (OpASHA) has used eCompliance as a novel combination of biometric and mobile technology to prevent drug resistant tuberculosis. eCompliance identifies patients through a finger print reader to verify that they are physically present for treatment. Through SMS, the system automatically synchronizes attendance data into a central medical record giving management up-to-date information on patient attendance. A separate text message notifies health workers of any missed doses that day, requiring them to follow-up within 48 hours.

During a one-year period, over 1,400 patients registered at 26 different eCompliance terminals installed in South Delhi, India. Using interviews and surveys, OpASHAs internal evaluation shows that both patients and health workers perceive that terminals have a positive impact on TB treatment. Analyses of the system’s performance show that drug default (defined as two consecutive months of missed doses) reduced to less than 1%.

1. THE PROBLEM

1.1 Tuberculosis in India
Tuberculosis (TB) is an airborne bacterial disease that primarily infects the lungs. It spreads easily through sneezing, coughing and spitting. This is particularly devastating in dense urban zones. For this reason, the epidemic has spread quickly throughout India, which carries the highest TB burden in the world with over 2 million infected [¹]. Although the disease is curable, the 6-7 month treatment time has made relapse and drug resistance an enormous public health challenge.

1.2 MDR-TB Multidrug Resistant Tuberculosis
A Tuberculosis bacterium that becomes resistant to first-line anti-tuberculosis drugs is medically known as multidrug resistant tuberculosis (MDR-TB). The resistance most commonly develops when TB patients stop taking their medication partway through their treatment. Furthermore, this strain is directly transmitted to a new victim. MDR-TB can take over two years to treat with drugs that are more toxic and 50-200 times more expensive, an unaffordable amount for India’s poor [²].

In 2008, the World Health Organization (WHO) estimated that 440,000 new cases of MDR-TB emerged globally with nearly half of these cases occurring in China and India [³]. Since the disease is highly contagious and spreads annually to an average of 12 others per infected person, TB spreads exponentially when not treated [⁴]. Between 2010 and 2015, it is expected that 1.3 million MDR-TB cases will need to be treated in 27 high burden countries at an estimated cost of US$ 16.2 billion [⁵].
1.3 DOTS (Directly Observed Therapy)

To prevent the development of MDR-TB, the WHO adopted the Directly Observed Therapy (DOTS) in the early 1990’s. The main component of this treatment requires patients to take TB medicines under the supervision of a healthcare worker. DOTS revolutionized TB treatment, remarkably doubling the cure rate among patients. While the results of the program were a vast improvement in comparison to self-administered treatment, patient default has not decreased enough to stop the growth of this man-made MDR epidemic.

Despite the enormous success of DOTS, the strategy currently suffers from three limitations: verification, slow response time and the lack of digitized records. The first criticism of DOTS is that the program is not always implemented properly because the program cannot verify when a patient has taken his or her medicines, and relies solely on the honesty of the health worker’s input. Similarly, it is difficult for DOTS to systematically respond to defaulting patients in a timely manner. Again, this process revolves around the health worker’s initiative to provide individual consultation. This is a symptom of the final weakness, which is the absence of digital records in many DOTS programs.

“DOTS alone is not sufficient to curb the TB epidemic in countries with high rates of MDR-TB and large proportions of re-treatment cases” [6]. The lack of verification has limited the effectiveness of DOTS, particularly in areas with low health education. In other words, there is no entity which supervises the supervisors. This has presented a problem when TB institutions offer health workers performance-based incentives, as many employees are inclined to falsify attendance records to reflect improved performance.

Early intervention is an effective method of preventing patient default. When a patient misses his or her first scheduled dose, immediate remedial counseling establishes dedicated compliance. However, the majority of DOTS programs are slow to respond to patients who repeatedly miss their doses when using manual reports. Especially in DOTS centers with high traffic levels, it is difficult to follow-up with patients in a timely manner.

This lag time between the initial missed dose and the remedial counseling is, again, largely because records are not digitized. This prevents information from being viewable by multiple levels of operational management and often the health worker is the only individual with access to such records. “Electronic datasets are also needed to facilitate analysis of data,” says the WHO, “for example, to check for internal and external consistency” [7].

2. The Solution: Operation ASHA’s eCompliance

2.1 How eCompliance Works

In 2010, OpASHA launched a biometric initiative called eCompliance (previously named eDOTS) at 17 treatment centers in South Delhi, India.
The program’s objective was to fill these common gaps in the DOTS strategy through an innovation that would be globally accessible, particularly in dense urban and low-literacy areas. In collaboration with Microsoft Research and Innovators in Health, OpASHA developed a terminal using fingerprint reader technology to record every dose taken.

Under the eCompliance initiative, each treatment center is equipped with an eCompliance terminal, consisting of a fingerprint reader and a low-cost SMS modem. When a TB patient visits the treatment center, they verify their visit by scanning their finger on the reader before taking their medicines. The terminal keeps a real-time attendance log. This gives health workers the option of quickly viewing which patients have visited the center, which patients still need to take their medicines and which patients miss their doses the previous day. With use of the fingerprint reader, the system provides unmistakable evidence that a patient was physically present for the treatment.

If a patient misses a dose, the eCompliance terminal automatically sends a text message to the patient’s health worker and program manager, notifying them that a follow-up visit is required within 48 hours. During this follow-up visit, the health worker brings an eCompliance terminal to the patient’s house and the fingerprint reader verifies the visit. This allows health workers to focus their counseling on patients who miss their scheduled dose the first time, reaffirming the importance of TB drug adherence.

At the end of each day, the eCompliance terminal compresses the daily attendance log into an SMS and sends it to an online SMS gateway. The gateway acts as an online cell phone where messages are viewable in a web browser, decompressed and automatically converted into readable reports. This allows all levels of operational management to view up-to-date information on the TB control program (fig. 1).
2.2 Data Security

The eCompliance server is managed by OpASHA’s technical staff. Private data is kept only on this secure server, which has undergone an independent SAS 70 audit. Apart from the patient’s name and attendance log, patient information is not stored in the terminal. All biometric data remains in the terminal in binary form and deletes automatically after the patient’s treatment is completed. Information sent through SMS to the third party SMS gateway uses unique ID numbers and does not contain any private health information.

3. Results of the eCompliance Initiative

OpASHA conducted the eCompliance pilot project in 17 different TB centers with 26 terminals in South Delhi slums and villages. Over 1,400 patients used biometric identification to verify over 60,000 visits and follow-ups. Over the period of a year, the default rate was reduced to nearly 1%, much lower than the Revised National TB Programme’s (RNTCP) 6-7% [8].

Interviews with the pilot’s health workers reported that eCompliance improved DOTS because patients were more likely to visit the centers themselves instead of sending a friend or relative to collect the medicines. The terminals also helped health workers quickly see which patients had not visited the center, allowing them to call and remind the patient before the missed dose.

In the most populous urban areas (OpASHA’s health workers cover an average of 100 patients) the real time attendance logs allowed health workers to keep better track of patients. OpASHA’s health workers also found that patients were more likely to visit a center with eCompliance because the technology demonstrated that the program was committed to high quality treatment.

Both patients and health workers commented on the simplicity of the system. Health workers—the primary users of the system—found that the color-coded interface allowed them to navigate easily through the system. They also found that patients had no trouble scanning their fingerprint before taking their medicines. One commented that patients enjoy seeing a photograph of their fingerprint each time they visit the center (fig. 2).

![Fig. 2](image-url)
4. CONCLUSION: THE WAY FORWARD

In India, the “RNTCP recognises that implementation of a good quality DOTS programme is the first priority for TB control in the country. Prevention of emergence of MDR-TB in the community is more imperative rather than its treatment” [9]. As the price of technology falls, technological and biometric approaches towards TB control are viable even in poor areas. The current DOTS program allows opportunities to apply novel technological solutions, which have thus far shown significant results in preventing MDR-TB.

eCompliance is that solution and has enhanced and improved the DOTS model. The system has been able to verify that patients were present for treatment by enhancing observation with biometric identification. It provides a method to quickly and systematically respond to missed doses by patients with up-to-date attendance information. Since this is done through SMS instead of an internet connection, eCompliance is functional in resource-limited settings. An automatic follow-up procedure reduces the response time to defaulting patients and focuses counseling on first-time and repeat missed dose patients. Lastly, eCompliance digitizes attendance information and automatically produces reports and analyses of the data.

DOTS is a historical landmark in tuberculosis control and public health, however the strategy has the opportunity for improvement through mobile technology. Enhancements such as eCompliance demonstrate that the TB community will benefit by studying new and best practices in TB control.

REFERENCES


Using Mobile Phones to Improve Delivery and Uptake of Medical Male Circumcision: Experiences from North Tanzania

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Abstract — The practice of Medical Male Circumcision (MMC) has been proven to be effective in reverting female-to-male HIV infections. Also, mobile phone technology has been demonstrated to be effective in spreading health awareness messages. Our aim was to explain the experiences of using mobile phone technology to influence uptake and delivery of MMC. This present work is an evaluation of the on-going MMC activities in North Tanzania. We obtained individuals’ mobile phone numbers through radio announcements and community outreaches. Three keywords were sent to their mobile phones with intentions of disseminating the advantages and accessibility of MMC, as well as Post-operation MMC information. In total, 37122 information requests were received from 14639 individuals, each individual making an average of 2.5 requests. Mostly, individuals requested to know the advantages of MMC (40.6%), and a combination of the advantages of MMC and where to access MMC services (34.4%). After four months, 3.7% individuals who requested for the advantages of MMC; and 3.7% individuals who requested to know the advantages and accessibility to MMC had requested for post-circumcision information respectively. This is concluded that the mobile phone technology approach is very effective to deliver MMC information. We recommend its use to perform quality MMC services at high volumes.

1. BACKGROUND

There is ample evidence from conducted studies to show the effectiveness on medical male circumcision (MMC) in preventing HIV. Earlier clinical trials demonstrated that MMC has the ability to revert between 40% to 60% female-to-male HIV infections[1-3]. Other documented benefits of MMC include reduction of penile cancer[4-6], reduction of the human papillomavirus[7], enhancement of sexual pleasure[8-10], among others. Recent years have seen several countries within the sub-Saharan region embarking on the roll-out of MMC among male adolescents and men. This is because of its several benefits which were demonstrated by research studies, backed by the recommendations from the World Health Organization.

On the other hand, the use of mobile phone technology has been demonstrated in several studies to be an effective medium to influence health-seeking behaviour[11]. Mobile phone technology has successfully been used to improve medication adherence among patients on antiretroviral therapy and tuberculosis medication[12, 13] and to spread health awareness campaigns within communities [14, 15].
Less data however exists regarding the experiences and effectiveness of using mobile phone technology to influence uptake and delivery of MMC scale-out. The only available data regarding this subject is yet to be published [16]. Our aim in the current study was to explain the experiences of using mobile phone technology to influence uptake and delivery of MMC among male adolescents and men in Northern Tanzania.

2. METHODS AND MATERIALS

We designed this analysis as an evaluation of the on-going MMC campaign within three districts of Northern Tanzania. In 2009, the Government of Tanzania adopted MMC as an important component of its national HIV prevention strategy and is scaling up MMC in eight regions nationwide, with the goal of reaching 2.8 million uncircumcised men. To compliment this strategy, MMC services for HIV prevention were officially established at the Iringa Regional Hospital in September 2009. Since then, the Iringa Regional Authority has continued circumcising male youths and adult men within five established circumcision sites. This is being done with the assistance of the Maternal and Child Health Integrated Program (MCHIP) Tanzania.

During the months of November and December 2010, Text to Change (TTC) and MCHIP Tanzania partnered to introduce the use of mobile phone messaging technology to increase information exchange regarding the circumcision campaign. The targets were males of age 10-34 years living in 8 priority regions of the Iringa region, located in the Northern part of Tanzania. Our aim was to enhance and improve the delivery and uptake of the MMC campaign. Eleven static sites and eleven outreach sites were established. Three medical circumcision campaigns were held: June/July 2010, Nov/Dec 2010, June/July/August 2011. Individuals’ mobile phone numbers were obtained through radio and community outreaches.

We sent out three categories of MMC information to the mobile phones of the individuals who opted to be included in the campaign. These were in form of a short message - one with the keyword “TOHARA”, meaning “Text to learn advantages of MMC”; second with the keyword “WAPI” meaning “Text to learn where to access MMC” and third with the keyword “BAADA” which delivered Post-operation text messages to individuals who had undergone MMC. These short messages were delivered in Swahili and English. Figure 1 shows the English version of the contents of each of the three keywords sent to the individuals’ mobile phones.

The TTC interactive platform was used to capture the responses from the designed key words. Messages from “BAADA” were manually scheduled in the platform to enable the patient receive a set of eight follow up messages till the final healing process. Data from the TTC database used in these descriptive analyses was extracted in Jun 2011. We present summaries of the total number of users who requested and thus received MMC messages,
the number of requests made per keyword, as well as those who were sent MMC messages after being circumcised. In comparative analyses, we ascertain the extent to which the requested MMC information led to the actual uptake of MMC.

### Table 1

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Information Response Triggered by Keyword</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOHARA:</strong> Text to Learn Advantages of MMC</td>
<td>Male circumcision can reduce your chances of HIV infection by up to 60%. It should be combined with other HIV prevention measures. Male circumcision is also known to reduce the risk of getting STI infection, and reduces risk of getting penile cancer and also makes it easier for a circumcised man to maintain personal hygiene.</td>
</tr>
<tr>
<td><strong>WAPI:</strong> Text to Learn where to Access MMC</td>
<td>Male circumcision services are currently offered free of charge at IRH and Ngome Health centre in Iringa town, Tosamaganga Hospital, Malinga district Hospital and Lugoda Hospital in Mufindi.</td>
</tr>
<tr>
<td><strong>BAADA</strong> Post-Operative Text Messages</td>
<td><strong>Day One:</strong> If you notice severe pain, soaking blood of the bandage, inability to pass urine or severe swelling of the penis please go back to the Male Circumcision service centre. <strong>Day Two:</strong> Keep you wound at hygiene condition at all times and remember to go back to your MC Service centre for post operative follow up and removal of dressing. <strong>Day Six:</strong> Remember to go back tomorrow for a 7 day post operative visit <strong>Day 14:</strong> Avoid having sex, masturbating or watching / reading sexually explicit material as doing so may cause you discomfort, increase you risk of getting infections and delay wound healing. <strong>Day 20:</strong> Despite of your wound seem healed, you are not fully healed. You are still at high risk of disrupting your wound and also of getting infected with HIV. You should continue with abstinence while waiting for your wound healing. <strong>Day 42:</strong> Now you can resume sexual activities, for safety and comfort you must use condom for every sexual act within 6 month of circumcision. Now that you are circumcised remember you need to use the combination of all HIV prevention strategies, abstinence, be faithful and use of condom for maximum HIV prevention</td>
</tr>
</tbody>
</table>

### 3. RESULTS

A total of 14639 unique individuals requested for MMC information at least once, which was immediately sent to their mobile phones. They generally made multiple requests. Using the set keywords, individuals had the liberty to request for same information more than once, and/or for more than one set of information. Table 1 presents the total information requests made, and the number of individuals requesting for that information. On average, each individual made an average of 2.5 information requests.

Table 2 presents the unique individuals who requested for a particular set of MMC information. Mostly, individuals requested to know the advantages of MMC (TOHARA, 40.6%), and a combination of the advantages of MMC and where to access MMC services (TOHARA and WAPI, 34.4%). After four months of the SMS campaign, when this dataset was extracted for analysis, 417 of the 11401 (3.7%) unique individuals who requested to know the advantages of MMC (TOHARA) had also requested for post-circumcision
information. Also, 507/13757 (3.7%) of the individuals who requested to know the advantages of MMC and/or where to access MMC also requested for post-circumcision information.

Table 2: Number of Individuals Requesting for Medical Male Circumcision (MMC) Information Using Each of the Three Keywords

<table>
<thead>
<tr>
<th>Keyword used in the Request</th>
<th>TOHARA</th>
<th>WAPI</th>
<th>BAADA</th>
<th>At Least One of the Three Keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total requests made</td>
<td>20063</td>
<td>14434</td>
<td>2625</td>
<td>37122</td>
</tr>
<tr>
<td>Number of unique individuals</td>
<td>11401</td>
<td>7606</td>
<td>1389</td>
<td>14639</td>
</tr>
<tr>
<td>Average number of requests per individual</td>
<td>1.76</td>
<td>1.90</td>
<td>1.89</td>
<td>2.54</td>
</tr>
</tbody>
</table>

Table 2: Number (%) of Unique Individuals who Made any Particular Medical Male Circumcision (MMC) Request Pattern

<table>
<thead>
<tr>
<th>MMC Pattern of request</th>
<th>Summary of the MMC request pattern</th>
<th>Number (%) of Unique individuals who made the request pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOHARA</td>
<td>WAPI</td>
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4. Discussion

Results from this analysis demonstrated that it is possible to use mobile telephone short messaging as a measure to increase uptake of MMC. This technology has successfully been used elsewhere [11, 13, 15]. In this program, 14639 individuals requested for information regarding MMC. Of these, 1389 (9.5%) requested for post-operation circumcision information, an indication that they had undergone MMC. It is also possible that more individuals who requested for MMC information undertook circumcision after the date data was extracted for this analysis.

We also found out that, of the 11401 unique individuals who requested to know the advantages of MMC, 417 (3.7%) requested for post-circumcision information, an indication that they actually underwent MMC. It is most likely that more individuals underwent MMC after Jun 2011, when this data was extracted from the TTC database for analysis.

All costs of sending the text messages were paid for by the MCHIP project, not the individuals. The challenges we experienced while sending the MMC awareness messages to the individuals were minimal. Some individuals who opted to receive the MMC awareness information had their mobile phones turned off by the time messages were sent. This may be because their phone batteries had ran off, or they had changed their phone
contacts to more competitive service providers. Among the major limitations of this analysis is the short duration between sending out the text messages and the evaluation of its impact on MMC uptake. We recommend that the analysis be done longer periods have elapsed, since peoples’ behaviour patterns are not apt to change in the short-term. Another limitation is the lack of a baseline comparative data, to assess the impact of the text messages campaign on the uptake of MMC.

5. CONCLUSION AND RECOMMENDATIONS

Mobile phone short messaging technology approach is very effective to MMC information service delivery, and can be used to perform quality MMC services at high volume without compromising individual safety. This information sharing model is a good and affordable example that can be replicated for matching supply and demand for MMC services in Tanzania and other parts of the sub-Saharan Africa. It is undeniable that with mass sensitization a individual is armed with information that will help them to seek MMC services. We thus recommend that this technology is used in treatment and/or prevention programs scale-out programs, including MMC.

REFERENCES


Mobile Health in India

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Abstract: mHealth can be defined as the application of emerging mobile communications and network technologies for health care systems. It involves the use of mobile computing, medical sensors, and communications technologies for health care. The health benefits are not only limited to active phone users, such as patients and doctors who carry a mobile phone; non-mobile phone users can also be benefited passively from improved public health information and community awareness programmes. mHealth mobilizes health care and health responsibilities by allowing the consumers more control, direct interaction, and interconnectedness with the health system. In many countries mobile health technology is running successfully, but in India there are many challenges in implementation like illiteracy, dead zones, technology advancement and standard issues etc. Countries that want to use mobile health to extend health care, need to develop strong partnerships with expert service providers. Two main elements are at play. First, mobile health has to make commercial sense for the mobile network operator, social sense for the health care provider, and strategic sense for the Ministry of Health. Second, the end users will determine the success or failure of an initiative. In the present study, the need of mHealth, scenario of mHealth in India and related challenges are discussed.

1. Introduction

mHealth is a general term for the use of mobile phones and other wireless technology in medical care. It includes the use of mobile devices in collecting community and clinical health data, delivery of healthcare information to beneficiaries, real-time monitoring of patient vital signs, and direct provision of care. mHealth aims to exploit the potential of mobile phones and more dedicated devices connected using mobile phone (cellular network) technology (e.g. fall detectors) to encourage healthy lifestyles, enhance chronic care and Self-management (e.g. diabetes), support informal care networks and increase the potential for independent living in the frail and elderly[1].

2. Need of mHealth

2.1 Information/ Awareness

In health care, it is very important to be able to inform the vast majority of the population about a medical campaign. The Polio awareness campaign in India which has been supported by mobile operators is a very good example that how awareness can help to eradicate the dreaded disease. SMS messages can be sent out to millions of people as part of awareness program.
SMS can be beneficial in case of medicine reminder service also, because some patients especially seniors forget to take their medicines on time. It is not practical to set alarms on the phone as it would require multiple alarms. In my opinion, service providers should send alert messages or calls to remind people to take their medicines that would be extremely successful. There are a few services like medication-reminder, ePill, OnTimeRx etc.

2.2 Emergency Services

Communication and alerts are the best tools to fight any disaster or emergency. Mobile phones have proved to be handy in disasters such as Tsunami, flood, fire and earthquake etc. Mobiles are playing the most crucial role in sending information/warning before, during and after the occurrence of disaster. The availability of mobile connectivity for 24 hours during the crisis period greatly helps the rescue teams to locate and save the affected people even from remote areas. In absence of any other mode of communication, particularly the land line telephones, which gets damaged during the disaster, mobile phone network keeps the hope of lakhs of people alive.

2.3 Real time Monitoring of Patients Vital Signs

Patient at a disaster scene can greatly be benefited from technologies that continuously monitor their vital status and track their locations until they are admitted to the hospital. One of the technologies used in this case is wearable sensors that are used to sense and record vital signs into an electronic patient record database. This dramatically improves the current time consuming process of manually recording vital signs onto hardcopy, pre-hospital care reports and then converting the reports into electronic format [2].

2.4 Collecting Community and Health Data

Mobile device also helps in collecting health data. The integration of point-of-care diagnostics with mobile phones will provide the user with a telemedicine capability that is truly mobile with real time data monitoring and transfer with instant diagnosis. Data from the users mobile phone based diagnostics would be immediately transferred by using mobile networks to the healthcare provider and integrated with their medical records. After review, the healthcare specialists can provide rapid diagnosis and send feedback to the user via their mobile phones to ensure efficient treatment and optimum patient outcomes. Sensor array technology has the potential to be incorporated into mobile phone handsets or used in mobile phone accessories. Array could also be used in a portable hand-held device and this would be more suitable for specific patient requirements.

Another example is blood sugar monitoring service by the name of MyGlucoHealth which has an app that enables users to transmit blood glucose testing results from a MyGlucoHealth Wireless meter through the user’s mobile phone (using Bluetooth) to a personal health record. Patients can also review their most recent blood sugar test results. Most of the downloads of this application are from US, India, Saudi Arabia and Latin America.
3. Scenario of mHealth

The mHealth project case studies in India are organized by primary application area from least specialized (education and awareness) to most specialized (diagnostic and treatment support). Following are the case studies:

- In Ballabghar, India Media Lab Asia community health workers used an open source software application on PDAs called the “Community Accessible and Sustainable Health system” to collect medical and demographic data [3].
- For remote data collection project “Mobile-Based Primary Healthcare Management System” organized by Center for Development of Advanced Computing (CDAC). this project aimed to improve maternal and child health, and used Compaq iPAQs, which could run a MySQL database capable of storing up to 7,000 records [4].
- mHealth project for remote monitoring is “Mobile Care, Support and Treatment Manager (MCST)”, Sponsored by ZMQ Software Systems which informs HIV/AIDS patients about their health status [5].
- Project for Diagnostic and Treatment Support is “TeleDoc – Jiva Healthcare Project”, Sponsored by The Soros Foundation and Jiva Institute which informs mobile phones to connect village-based healthcare workers with doctors in urban areas.

4. Challenges in Implementation of mHealth

4.1 Interoperability and Standard Issues

Interoperability and standards issues are especially relevant, as they often impede or make a tough job to integrate mobile solutions into the framework of existing systems currently in healthcare institutions for information storage and management purposes. To help overcome this difficulty, the adoption of open standards and cross-platform technology is advised wherever possible. Where this is not possible it is recommended that a layer be constructed on the legacy system with a standards compliant interface to the external world[6].

4.2 Technology Advancement

The biggest challenge in bringing mobile technology to healthcare is the rapid pace of technology advancement compared with the plodding nature of medical trials to test the technology. It’s standard for such trials to take five years, during which technology can leapfrog ahead. To put the timeframe in perspective, five years ago, the smart phone didn’t exist. Medical trials started just a few years ago are not addressing the appearance of the iPhone and Android, two major factors in the evolution of smart phone technology. Researchers must speed up medical trials involving rapidly evolving technology, without compromising the objectives of such trials.
4.3 Illiteracy in India

The States where number of illiterates has increased are Rajasthan (3.18 percent), Chhattisgarh (0.81 per cent) and Madhya Pradesh (0.80 per cent). Illiterate people are not able to access functions and health services implemented on mobile devices. So the illiteracy is main challenge in implementation of mobile health in some areas of India [7].

4.4 Dead Zones

Mobile Phone Signal is the strength of the connection to the mobile phone with its network. Depending on various factors such as proximity to a tower, obstructions such as buildings or trees etc. Most mobile devices use a set of bars of varying heights to display the strength of the signal where the device is located. A stronger mobile phone signal is easier to obtain in an urban area though urban areas do have some “dead zones” where a reception cannot be obtained. On the contrary, many rural or minimally inhabited areas lack a signal or have a very weak reception like Khag, Budan, Dalwash, Gund Dalwash, Hamchipora, Drung in Kashmir and Chitkul in HP, but many mobile phone providers are attempting to set up towers in parts of these areas most likely to be occupied by users, such as along major highways. Even some national parks and other popular tourist destinations away from urban areas now have cell phone receptions. In an area where the signal would normally be strong, certain other factors may have an effect on the reception, thereby making it either stronger or weaker, or may cause complete interference. For example, a building with thick walls, many underground areas such as tunnels and subway stations [8].

5. Conclusion

The benefits of mHealth technology are unlimited and it can truly help the public up to great extent. In a country like India where Doctor-Patient ratio is not satisfactory, the importance of mHealth technology can play significant role. But there are various limitations in implementation of this technology because of non availability, non adaptability of mobile phones due to large number of illiterates, dead zones and lesser use of ICT by health service providers in India.

References


CycleTel™: Expanding Access to Family Planning through Mobile Phones

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Abstract—The Institute for Reproductive Health, Georgetown University, developed a unique mobile health service that offers a family planning method directly to user’s mobile phones via SMS. CycleTel™ is based on the Standard Days Method®, a fertility awareness-based method of family planning that helps women identify the days they are most likely to become pregnant. Couples wishing to avoid pregnancy use barrier methods or abstain from sexual intercourse on those days. In many settings, the Standard Days Method is used with CycleBeads®, a color-coded string of beads that help a woman identify her fertile days. The CycleTel service offers another approach to increase access to the method. Results from a proof-of-concept study of CycleTel are encouraging, showing that CycleTel is easy to use, is acceptable to Indian couples, and has the potential to benefit many couples wanting to avoid pregnancy; pilot testing of automated software for the service is underway.

1. Background

This paper describes the testing of a unique, innovative mobile health (mHealth) application, designed to expand the availability of a family planning method through the use of mobile phones. CycleTel™ offers the Standard Days Method®, a knowledge-based fertility awareness method of family planning, directly to a user’s mobile phone via Short Message Service (SMS).

The Standard Days Method was developed and tested by the Institute for Reproductive Health, Georgetown University (IRH), to address the demand of many couples for a simple, effective fertility awareness-based approach to family planning. The method identifies days 8-19 of the menstrual cycle as fertile. Couples who wish to prevent pregnancy use a barrier method or abstain from sexual intercourse on these days [1]. The method works best for women whose cycles usually range 26-32 days [2]. The method is effective—the failure rate with correct use is <5 per 100 women-years, with a typical use failure rate <12 [3]. It is recognized as an evidence-based practice by the World Health Organization (WHO) [4]. Similarly, the U.S. Agency for International Development (USAID) includes the Standard Days Method among High Impact Practices in family planning [5]. The method is now offered in more than 30 countries around the world. In most settings, women use the method with CycleBeads®, a color-coded string of beads that helps a woman identify her fertile days and track her cycle length.
The Standard Days Method is an important addition to the method mix that helps many couples prevent unplanned pregnancy [6]. It is easy for providers to teach and for users to learn and use, and it often appeals to couples who currently are not using any method, are relying on the rhythm method or withdrawal, or are not satisfied with other methods. Results of studies of the introduction of the Standard Days Method into family planning programs around the world show that introducing the method attracts new family planning users, improves access to family planning methods, improves condom counselling, empowers women, and involves men in family planning [6].

The Standard Days Method has been offered in various locations in India since 2002 with great success. In 2003, pilot studies in Delhi and Uttar Pradesh tested the feasibility of introducing the method in India. Results showed that there was significant demand, that users were satisfied with it, that it appealed to women because it has no side effects or health risks, that it could easily be taught by providers of all levels, including community-based workers, and that women could use it correctly [7]. Subsequently, the Government of Jharkhand tested the integration of the Standard Days Method into reproductive and child health services provided by the Ministry of Health and Family Welfare and the Department of Social Welfare (Integrated Child Development Services program). The results of this study were positive, demonstrating that it was feasible to offer the Standard Days Method in the public sector by all levels of providers, and that it was appealing to women who wished to space births, particularly women who had never before used a family planning method. As a result of the Jharkhand integration study, in 2007 the Government of Jharkhand expressed the desire to scale up Standard Days Method services throughout the state. The method is now offered in all public health facilities in 12 districts in Jharkhand, which accounts for half the state.

In addition, IRH-India has worked with a variety of other local partners in Jharkhand, Rajasthan, Orissa, and Uttar Pradesh to integrate the Standard Days Method into family planning programs. Various policy successes were achieved during this time, including naming the Standard Days Method as a method that can expand choice in the Government of India’s Reproductive and Child Health Phase II [8].

There is a significant need for family planning in India, where the family planning program has long been dominated by sterilization. Access to spacing methods such as pills, condoms, and IUDs is limited [9]. CycleTel was developed as a means to make the Standard Days Method available to any woman who owns a mobile phone, even in settings where the method is not offered through family planning programs.

Unlike many other family planning methods, the Standard Days Method is knowledge based. CycleTel was designed to provide this knowledge directly to women on their mobile phones. To use CycleTel, the user both
sends and receives text messages. First, she responds to screening questions to determine if the method is appropriate for her. Specifically, she needs to affirm that her periods come about a month apart (as the method is most effective for women with cycles that usually range 26-32 days), and that she and her partner will be able to avoid unprotected intercourse during the days the method identifies as fertile. If she meets the screening criteria, she then sends an SMS to CycleTel with the date that her menstrual period started. CycleTel sends her text messages throughout her cycle, informing her when she is in her fertile (“unsafe”) phase. Additional messages help her monitor her cycle lengths to ensure her cycles continue to meet the cycle regularity criterion, and remind her to send in the date when her next menstrual period starts.

This paper describes CycleTel proof-of-concept research and results, which was completed in July 2011, and ongoing technology platform testing that is being undertaken as CycleTel moves along the research-to-practice continuum, on its way to becoming a widely-available family planning option in India.

2. Methodology
IRH completed proof-of-concept testing of CycleTel in Lucknow and New Delhi, consisting of three elements:

- Focus group discussion with 54 women and men to determine potential interest in CycleTel, to understand if this intervention would be appropriate given the way mobile phones are used, and to explore appropriate messaging.
- Cognitive interviews with 18 women and men, to test understanding of message content and fine-tune the messages.
- Manual testing of the CycleTel application with actual users, designed to answer questions pertaining to acceptability, feasibility, correct use, satisfaction, and partner involvement in the use of CycleTel. Manual testing was conducted in two phases, in two locations.

2.1 Manual Testing, Lucknow
In the first phase, conducted in Lucknow, Uttar Pradesh, 32 women were recruited to use CycleTel for two cycles. They were age 18-27, married, had a mobile phone and were accustomed to sending and receiving SMS messages. These women and their husbands wished to avoid pregnancy, but were either not using any method, were using a traditional family planning method (rhythm or withdrawal), or were using condoms inconsistently.

In addition to these criteria, women also had to be eligible to use the Standard Days Method. Therefore, each woman was screened before being invited into the study to ensure that her menstrual cycles usually ranged between 26-32 days (that is, that her menstrual periods were about a month
apart) and that she and her husband would be able to avoid unprotected sex on the fertile days. Recruitment was particularly rigorous to ensure that participants testing the service aligned with the appropriate target audience for CycleTel. Note that in actual use, the screening process is simplified as a series of three questions asked to each new user via SMS, and a help line is provided for those users who need additional support.

After recruitment, participants were administered an admission interview to collect background information. They then started using CycleTel, which was offered manually (project staff sent the messages to users) via FrontlineSMS, a free open source software enabling group SMS messaging via computer or mobile phone [10]. Participants answered the screening questions, texted the date their period started and then started to receive messages from CycleTel to facilitate use of the Standard Days Method. Participants were interviewed three more times, after completing one and two cycles of method use, and at exit. The first follow-up interview was via phone, and the second in person, which was followed by the exit interview. The study protocol and all study instruments were approved by the Georgetown University Institutional Review Board. A help line was established for the study period, to allow participants to ask questions about CycleTel use as needed.

2.2 Manual Testing, New Delhi

Given the positive results of the proof-of-concept testing, IRH initiated steps to automate CycleTel. Simultaneously, the second phase of manual testing began in Delhi to test the service with a larger sample size and more urban population. The software required to automate CycleTel was developed using an iterative process in partnership with Thoughtworks, Inc., a global IT solutions company with offices in India.

In the second phase of manual testing, 88 women from Delhi were enrolled, using the same criteria as the Lucknow phase, but with a wider age range. Women in the Delhi phase were age 24-33, had completed a bachelor’s degree or higher, and 97% were employed at least part time.

The messages sent to each study participant in the Delhi phase were from a message algorithm that IRH developed and continuously adapted based on participant feedback throughout the proof-of-concept process. Study participants could sign up to receive the messages in English or “Hinglish” (Hindi words spelled with the Roman alphabet). Messages included screening questions, enrolment instructions, reminders, enrolment confirmation, unsafe day alerts, and additional informational messages about how to use CycleTel correctly and how to access additional service features. For example, if a woman successfully sends in the date of her period as 26 October, she will receive a confirmation message that says, “CycleTel will send you SMS alerts on your unsafe days 2 NOV-13 NOV. You can get pregnant if you have unprotected sex on any of these unsafe days.”
Following, she will receive an SMS on alert on each of the days specified that says, “Unsafe day. You do not need to reply to this message.”

The Delhi testing began using FrontlineSMS. Prior to the end of the study, the automated software was completed, and all users were migrated to the automated software for at least one cycle. Most interviews were conducted via phone in this phase.

2.3 Automated Testing of Software, New Delhi

This software is currently being tested further. Some 700 women have been enrolled to participate in the study to use the automated version of CycleTel. Admission criteria are the same as those for the manual testing: ages 18-35, married, own and use mobile phone, interested in avoiding pregnancy but are not using any method, using a traditional family planning method, or using condoms inconsistently.

As in the manual testing, after women are enrolled in the study they begin to receive text messages as specified in the CycleTel message algorithm, but these messages are now automated. Participation requires the users to both send and receive text messages. The woman is required to pass the screening questions and send in the start date of her last period to begin using CycleTel. Based on that information, according to the message algorithm, the service sends automated text messages to each participant throughout the cycle, informing her which days she is fertile. The messages the woman receives on different days are automatically determined by the system based on her current cycle day. At the end of each cycle, any woman whose cycle was shorter than 26 or longer than 32 days will be advised of this. If her cycle is shorter than 26 or longer than 32 days more than once in a 12-month period, she is advised to no longer use CycleTel, because the method may not be sufficiently effective for her.

The software records each study participant’s interactions with the system, including the first day of menstruation, the fertile and infertile days of her menstrual cycle, cycle length over time, and messages received by and sent to each participant. This record of the data, collected in real time, helps monitor whether the technology is working properly and whether users are interacting with the service correctly.

Participants will use the automated CycleTel service for up to two months. A random sample of approximately 150 users (from the 700 study participants) will be selected for a phone interview after the first cycle of method use, to determine whether they are using the method correctly and identify any problem they may be having. All participants will be interviewed after they complete two months of method use. A sample of their husbands will also be interviewed. This study is ongoing. Preliminary results will be presented at the conference.
3. Results

3.1 Proof-of-concept: Focus Groups

Four focus groups with women, two with men and one with couples (n=54) established mobile phone usage trends and interest in CycleTel. Women and men reported being receptive to and having a positive attitude towards sending and receiving SMS messages. Among all participants there was a strong interest in using natural methods to prevent pregnancy, but most lacked correct knowledge of fertile days. After the interviewer explained the Standard Days Method, both women and men in all the groups expressed interest and enthusiasm for the method. Women liked the method because it is natural with no side effects, and is low cost. Men appreciated the method as a natural way to achieve family planning goals while avoiding side effects for the woman, saving money, reducing fear of getting pregnant and increasing sexual satisfaction compared with using condoms all the time.

Both women and men expressed an interest in CycleTel as a way to know when the woman could get pregnant. Women and men did not necessarily share their phones with others, but said there was a possibility for others to view messages or calls on their phone. Therefore, they expressed a preference for CycleTel messages to be discrete. For example, participants in all the focus groups preferred the Hindi versions of the phrases “safe/unsafe days” rather than “you can/cannot get pregnant today”, to protect privacy and confidentiality. Generally, they preferred to send/receive messages in Hindi with English letters (Roman alphabet), sometimes referred to as “Hinglish”, as this is the way in which they usually use SMS. Also, they expressed a preference for text rather than voice messages. Most women preferred to receive CycleTel messages directly on their own mobile phone and not on their husband’s phone, although the option for the husband to also receive messages was thought to be possible for some.

3.2 Cognitive Interviews

In-depth interviews with 14 women and four men allowed us to hone in on the optimal language and phrasing for each of the text messages to be sent through the CycleTel service. In general, we learned the importance of keeping messages as short as possible; to replace long words with short, simple ones for easy comprehension; and to eliminate all unnecessary words. In addition, as each SMS is limited to 160 characters, participants indicated that it is best to ensure the message is sent in one SMS as opposed to two “broken” messages.

Including numbers in the messages was not well understood. For example, results show that it is better to ask women if their cycles come about once a month, than to ask them if their cycles were generally 26-32 days long. Additionally, women could better respond to prompts like “SMS yes if you agree” rather than “SMS 1 if you agree”.

3.2.1 Manual Testing, Lucknow

Following cognitive interviews, the message content and patterns were finalized for the manual testing phases. Some 32 women from Lucknow were admitted to the study, 26 of whom started using CycleTel. Of these, 19 completed two cycles of use, which represents a 73% reply rate from individuals who started the study. All the women were home makers, and 85% of them had at least one child. They were relatively well educated (73% had graduated high school), and represented a variety of religions (65% Hindu, 23% Muslim, and 12% Sikh). The six women who were recruited but did not start using CycleTel did not return messages, so it was impossible to find out why they chose not to use it. Similarly, women who started using the method but did not complete the first cycle, or completed the first cycle but did not continue to the second, did not respond to messages.

During this manual testing phase, participants received a message on all 12 fertile days, plus at least one message toward the end of their cycle to remind them to text the date their next period starts. All users agreed that the number of messages was appropriate.

Some 21% of CycleTel users contacted the help line, because they did not receive the message on the expected day, because they had sent a wrong date to CycleTel and wished to correct the mistake, or because they forgot to send the date of their period. This confirms the importance of having a help line in place when the service is automated.

Most participants (95%) reported that CycleTel made it easy for them to know the days when pregnancy was likely. Some 85% said it was very easy for them to explain to their husbands about the fertile days, and a similar proportion said that it was either very easy (69%) or easy (26%) to avoid unprotected sex on fertile days. Some 95% of women reported that CycleTel helped to improve their relationship with their husbands, by encouraging husbands and wives to be more supportive of each other (47%), improving sexual relations (47%), improving communication (42%), increasing mutual respect (42%) and increasing the husband’s knowledge and understanding of female menstrual cycle (32%). Some 94% were satisfied with the service, and 78% were very confident that using CycleTel would help them prevent pregnancy. All 19 participants who completed two cycles of method use were interested in continuing to use CycleTel, and would recommend the service to their friends. All CycleTel users would be willing to pay for the service; all stated that between 25-30 Rupees per month would be appropriate.

3.2.2 Manual Testing, New Delhi

Following the testing in Lucknow, testing in Delhi began. Of the 88 women who enrolled in the study, 84 completed two full cycles of use with CycleTel (indicative of a 95.5% reply rate), and exit interviews were conducted with 80 users. As mentioned previously, all women had at least a bachelor’s degree,
and 97% of the enrollees were employed at least part-time. Some 97% of the participants had children, 52% had one child and 48% had two children. Some 56% of women who chose CycleTel did not want to have any more children, and 44% were using the method for spacing births. Some 77% of the participants had been using condoms inconsistently, while the remainder were using traditional methods or nothing at all for family planning; 11% reported ever having used emergency contraception (EC).

During the testing phase, message comprehension was high, and few problems were reported with sending and receiving messages. Some 15% of participants contacted the help line, mainly to clarify messages received. Other questions were due to technical issues with phone use, such as sending messages to the wrong number and not receiving a response, or concerns around using a new mobile phone to which they were not accustomed. Calls to the helpline were more frequent in the first cycle of use, suggesting that women quickly learn to interact with the service.

Some 95% reported that the timing of messages was suitable, and 95% reported that the number of SMS messages received was appropriate. Few of these women had problems sending or receiving messages (2%). The majority of women, 91%, reported that CycleTel made it easy to understand which days they were at risk for pregnancy. Some 71% of women reported that their husbands also viewed the messages sent to them, and 76% reported sharing information about their fertile days with their husbands. Some 95% reported that it was not difficult to avoid unprotected sex during the fertile window, though 22% reported engaging in unprotected sex during the fertile period in the first exit interview, and 13% reported doing so in the second interview. The vast majority of users were satisfied with CycleTel (92%) and most were confident that the service would help them avoid pregnancy (83%).

All users were migrated to the automated software before the end of the study; 94% stated they were interested in continuing use of CycleTel, 60% elected to continue the service, and 100% stated that they would recommend the service to their friends and relatives. Some 83% of women reported that they would be willing to pay for the service; the average price women would pay was 33 Rupees (ranging from 15 to 400 Rupees).

The husbands of eleven users were also interviewed after the second cycle of CycleTel use. All men had been made aware of their wives’ fertile window, 82% were shown the CycleTel SMS message and the remaining 18% were told about the message by their wives. Most of the men reported that they were satisfied with the service, 64% very satisfied, 27% were somewhat satisfied. Some 55% of men were confident that the method was an effective method of family planning, and 36% were somewhat confident in the service. Men reported that the features that they liked the most about the service were ease of use (37%), convenience (21%), and that the method has no side effects (16%). Some 64% were interested in having their wives
continue use of CycleTel; 55% said they would recommend the service to their friends and family, and the remainder stated that the topic was personal and they would not feel comfortable discussing it with others.

3.2.3 Testing the Automated CycleTel Service
As of November 2011, about 713 users had been recruited into the pilot study and were using the automated CycleTel service. Approximately 300 exit interviews were complete as of November 2011. Results of the pilot testing of the technology platform will be shared during the presentation.

4. Conclusion
Proof-of-concept research and a thorough test of the automated service are essential steps in the development of any mHealth application. They are particularly important to the development of CycleTel, given that CycleTel will actually facilitate use of a woman’s family planning method. This innovative mHealth approach will interact with the end-user regularly over time for as long as a woman chooses to use the service. Our results show demand for the product. Cycle Tel has the potential to address a significant family planning need among Indian couples.

References
[8] For more information about the introduction of the Standard Days Method in India see http://www.irh.org/?p=content/fam_india
[10] For more information about FrontlineSMS see http://www.frontlinesms.com/
Information on Drug Interactions on Mobile Phone—A Pilot Study to Deploy Information through Mobile Phone and Promote Patient Safety

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Abstract—Using health information technology to manage personal health information is an important part of our changing healthcare system. Health can be better managed if both doctor and patient improve communication between themselves. Using information technology makes it easier to store, share and access health related information. This is known as Health Information Technology (HIT) or Health IT. Health IT and some of its advantages are discussed in this paper—reduction in paper work, reduction in medical errors by transmitting accurate information electronically and eliminating mistakes due to misreading of doctor’s handwriting. Also from various findings it is revealed that cases of drug-drug interactions have grown. Therefore, with the aim to introduce to the doctors the mobile phone application for ‘Information on Drug Interactions’, the pilot run was carried out at Indraprastha Apollo Hospitals, with Senior Consultants from different specialities. The ‘Drug-Drug Interactions’ application was developed on J2ME (Java to Micro Edition) platform and was introduced to the consultants who were then made to use it. This facility can be used both by medical practitioners as well as patients. A web-portal is also provided to the subscribers, if they wish to access the information on the computers. The doctors liked the idea of having such a service which can search for interactions for Indian brands and generics. This paper discusses that this application is doable and useful to all

Keywords: Health IT, Drug-drug Interactions, m-Health

1. Introduction

A drug interaction is a situation in which the activity of a drug is affected by a substance, i.e. the effects are increased or decreased, and therefore interactions can exist between drug-drug and food-drug also. Interactions mainly occur due to accidental misuse or lack of knowledge about the active ingredients involved in drugs. [1] The topic of drug–drug interactions has received a great deal of recent attention from the regulatory, scientific, and health care communities worldwide. Non-steroidal anti-inflammatory drugs, antibiotics and, in particular, rifampicin are common precipitant drugs prescribed in primary care practice. Drugs with a narrow therapeutic range or low therapeutic index are more likely to be the objects for serious drug interactions. The pharmacist and the prescriber have the duty to ensure that patients are aware of the risk of interactions and a suitable course of
action, whenever interactions should occur. With their detailed knowledge of medicine, pharmacists have the ability to relate unexpected symptoms experienced by patients to possible drug interactions therapy. As new drugs are being introduced, new and increased interactions are being reported. It is not possible or even practical for any doctor to memorize every interaction about all the drugs which are being prescribed. Therefore, a mechanism is needed which will help the doctors to promote patient safety by educating themselves and the patient about the possible drug-drug interactions. Many tools are available (especially on the internet) which provide information on drug interactions; for example – [2] drug interaction checkers are available on websites like drugs.com, epocrates.com, etc. In our pilot it was found that not many doctors were aware of such websites/services available.

Our aim therefore is to get doctors to update themselves and be aware about new drugs and the drug-drug interactions, and at the same time promote Patient Safety.

2. Formation of Drug Interactions Database

For the purpose of preparing the database to be fed into the application on Drug-Drug Interactions, an ‘Authentication Committee’ consisting of eminent pharmacologists was constituted. The main idea of forming this committee was to refine this database, to provide authenticity, and to generate common interactions which would be useful to the doctors prescribing the drugs, and to the patient taking the drugs.

This database consisted of approximately 3000+ generic names which were then mapped to approximately 14000+ Indian brand names. The database was thus made as extensive as possible for this service. The Authentication Committee met about thrice in 6 months and worked on refining the database.

For the purpose of understanding the interactions were labeled as - Severe, Moderate, Mild and No interaction. Table1 below shows what this means-

<table>
<thead>
<tr>
<th>Rating</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe</td>
<td>The effects are potentially life threatening or capable of causing permanent damage.</td>
</tr>
<tr>
<td>Moderate</td>
<td>The effects may cause deterioration in a patient’s clinical status.</td>
</tr>
<tr>
<td>Mild</td>
<td>Consequences may be bothersome or unnoticeable but should not significantly affect the therapeutic outcome.</td>
</tr>
<tr>
<td>No Interaction</td>
<td></td>
</tr>
</tbody>
</table>

2.1 Features of the Application

This software supports the following features-

- Upto 10 drugs can be fed in at one time to check for drug-drug interactions.
Software will support conversion of brand names to generic names.
The drugs would be listed alphabetically in a drop down menu.

3. Technology

The Drug-Drug Interaction portal is developed on the J2ME (Java to Micro Edition) platform. This technology supports consumer wireless device platform. J2ME is a Java Platform designed for embedded systems (Mobile Devices). Java ME files implement a Profile. Most common of these are Mobile Information Device Profile aimed at mobile devices such as cell phones. There are currently more than 2.1 billion JAVA ME enabled mobile phones and PDAs. [3]

A technology company had developed such software which would work as a drug interactions checker. Based on our requirement and idea of providing a drug-drug interactions service to the doctors and patients, the software was modified the application.

3.1 Solution Architecture

The proposed platform is Java based. The platform has a mobile solutions delivery model employing a J2ME based rich user interface. The middle tier is enterprise Java deployed over the Jboss application server. The middle tier houses the Data access and authentication layer in addition to the payment interface, reporting and audit logging components. The application works with all major databases.

3.2 Steps for using the Application

The application can be used by loading the application on the phone by using the GPRS service, or the application can be run on the web. The steps for using the application on the mobile phone are-

1. Open the web browser and enter the link provided by the technology partner.
2. After opening the link, follow a series of steps which are simple and self explanatory for loading the application on the handset.
3. Once the service is successfully installed, click on the icon in the MENU. This will ask to register the mobile number on which the service is loaded.
4. Enter your mobile number and click “CONTINUE”.
5. Then, follow few simple screens by clicking “CONTINUE”.
6. This will confirm the registration of the mobile phone number.
7. Then the user can begin to use the application for checking drug-drug interactions.
8. The application has an option to enter upto 10 drugs. Click on “Continue”.
9. The result will be shown with the Severity Level, Details of Interactions, and a Disclaimer.
Information on Drug Interactions on Mobile Phone—A Pilot Study to Deploy

4. The Pilot Run

30 senior consultants from Indraprastha Apollo Hospitals belonging to different medical specialties were selected. Doctors used the application (the web version and the mobile phone application) for a period of 15 days. Some expected outcomes were listed in a tabular form and the doctors were asked to give their ranking based on their reactions on the application and its use. The ranking was to be given from 1-5; with 5 being the highest rank Excellent. The feedback was received from 15 doctors. It is represented in table 2.

Table 2: Results of Feedback from the Pilot

<table>
<thead>
<tr>
<th>S. No</th>
<th>Heads Description</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Satisfactory</th>
<th>Needs Attention</th>
<th>No. of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Information provided on drug interactions</td>
<td>0</td>
<td>11</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Ease of downloading application on the mobile phone using Wifi/ gprs</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Ease of using the application on mobile phones - reference to the number of key presses needed to get the interactions.</td>
<td>10</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>Ease of using the application on the web-the number of clicks needed to get the interactions.</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Clarity of Messages Displayed- how well the user can understand the language</td>
<td>12</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>Speed of downloading the software on mobile.</td>
<td>11</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Speed of downloading the software on the web</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>S. No</td>
<td>Expected Output</td>
<td>Heads</td>
<td>Rankings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------------</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Excellent</td>
<td>Very Good</td>
<td>Good</td>
<td>Satisfactory</td>
<td>Needs Attention</td>
</tr>
<tr>
<td>8</td>
<td>Can the software be used easily on your mobile handset after being installed</td>
<td></td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Response time for the result to appear</td>
<td></td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Convenience in Activation of the service on the mobile phone</td>
<td></td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Does it require too many key presses to get the information</td>
<td></td>
<td>0</td>
<td>1</td>
<td>11</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>Will you use this product and recommend others this service</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

5. Discussion

The doctors used the service with much interest and were supportive of the idea of having such an application handy. The observations received from 15 out of 30 doctors. The rest were not able to respond in time. Out of the total 30 doctors who were approached 5 used only the web version, as they did not want to get WEB/GPRS service activated on their phones due to the threat of virus, or due to the gprs service not supported on their handsets.

11 out of 15 doctors felt that the database is informative, while the rest felt that the database needs to be updated as many interactions were not found. There was mixed reaction relating to the process of downloading the application on the mobile phones; many times the phone service did not have gprs activated; or the server could not be connected. Once the application was installed on their respective phones, 10 out of 15 doctors felt that the application was convenient to use, while 2-3 doctors were not able to easily use the application mainly due to not being technologically savvy. At the same time, all doctors found it easier to use the web version.

All doctors were of the opinion that information display is quick once the service is connected. The connection speed is what plays an important role in this case.

Regarding the ease of downloading, 8 out of 15 doctors felt that downloading the application is fairly easy, as sometimes the service is not able to connect to the server. While, 11 out of 15 doctors felt that the number of key presses to get the required information is also only fairly ok, while this can be made better in order to make the application more user friendly.
Information on Drug Interactions on Mobile Phone—A Pilot Study to Deploy

One important analysis from the doctors has been that, all the doctors involved in the pilot run of the Drug Interactions service wanted to use this service as they feel that this is a useful service to have irrespective of whether it is available on the mobile phone or web version. The service will be useful for consultants and other medical fraternity and non medical population of the country.

6. Conclusion

From the pilot run we have the following conclusions regarding the Drug-Drug Interaction Application-

1. It is a possible application to have on the mobile phones.
2. The data needs to be updated every 3months, through a validation committee.
3. Minimum 4 persons required to manage this software once it’s ready to use. This includes- a full time Pharmacists in order to update the drug interactions database at regular intervals, three people from Biotechnology Background in order to train doctors to use the application and help them to load this on the mobile phones, and an Authentication Committee (part time) to validate the database.

Acknowledgment

I hereby extend my acknowledgements to AHERF’s Chairperson, Prof. Ranjit Roy Chaudhury who is the guiding force behind all research activities and developed the Research Roadmap for AHERF and organized the team to work on this area of ‘Mobile phone Technology and Healthcare’, under the broad area of ‘Cross Industry Research’. I also extend thanks to the AHERF team members who have supported the visits to the site and to Dr. Sangeeta Sharma who has been the consultant for this program and the brain behind preparing the database for interactions. Great support has been extended by the Authentication Committee- Prof. Ranjit Roy Chaudhury, Chairman, Apollo Hospitals Educational and Research Foundation; Prof. Jawahar S. Bapna, Consultant, Pharmacology; Dr. J.P Wali, Consultant, Pharmacology; Prof. Sangeeta Sharma, Head, Department of Nueropsycho Pharmacology, Institute of Human Behaviour and Allied Sciences, Delhi; Ms. Ambika Goel, Senior Research Associate, Apollo Hospitals Educational and Research Foundation, New Delhi; Ms. Soma, Senior Resident, Institute of Human Behaviour and Allied Sciences, Delhi; Dr. Naveen, Associate Professor, Institute of Human Behaviour and Allied Sciences, Delhi. The conceptualization and preparation of this project and the pilot run would not have been possible without the support of these people.

References

Edutainment Based Mobile Phone Games for Health Communication in India

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Abstract—Tuberculosis and HIV have become serious health concerns in India. Youth comprise the larger share of the patients afflicted by them. Two mobile phone games on HIV and Tuberculosis were selected to study their efficacy in creating awareness about these diseases amongst youth in Delhi. Semi structured interview schedules and objective type awareness tests based on the information contained in the games was prepared and administered to the youth before and after playing the games to assess any change in their awareness about the diseases.

Keywords: Mobile Phone Games, AIDS, Tuberculosis, Edutainment, mHealth Communication

1. INTRODUCTION

1.1 ICTs in Health Communication

ICTs are “general purpose technologies and permeate production and consumption activities” (Sciadis, 2003) and ICTs cover a broad range of services, applications and technologies using various types of contemporary equipments and software. Modern ICT services include cellular and mobile telephone, email transfer of files from one computer to another computer and the use of the internet. These services are called ‘readiness’ indicator (OECD 2001).

The use of ICTs in the health sector also improves the collection, storage, retrieval and transmission of individual patient information including the application of tele-medicine. Thus, ICTs have the potential to contribute to more effective delivery of health services and to increase the efficiency of health systems.

1.2 Edutainment

According to Singhal and Dearing (2006) quoting (Singhal and Rogers, 1999; 2002) Entertainment-Education (E-E: Edutainment) is the process of purposely designing and implementing a media to both entertain and educate, in order to increase audience knowledge about an educational issue, create favorable attitudes, shift social norms, and change overt behavior. Edutainment is not a theory of communication. Rather, it is a communication strategy to bring about behavioral and social change. Edutainment
approaches have tackled a wide variety of social issues, prevention, small family size, maternal and child health and gender inequality.

1.3 Games
Games are an exciting way to communicate and connect with a larger community of likeminded people. Rich mobile games, combined with connected near distance multiplayer gaming over Bluetooth opens the door for totally new gaming concepts. Mobility will add a whole new dimension to innovative and creative games concepts and will provide opportunities for the games and telecom industry alike (Goggin, 2010).

The technology in the pockets of billions of the world’s population provides a new platform for reconvening, designing and selling games for cell phones. In addition, cell phones are a new ‘arena of innovation’ (Sawhney and Lee 2005).

1.4 Mobile Learning
Any activity that allows individuals to be more productive when consuming, interacting with, or creating information, mediated through a compact digital portable device that the individual carries on a regular basis, has reliable connectivity, and fits in a pocket or purse. Mobile Learning is an ideal solution today as it facilitates learning anytime-anywhere. Mobile Learning is highly effective for social learning solutions like healthcare programs, awareness programs and literacy programs like basic numeracy and basic alphabetization for the communities with lesser literacy level (ZMQ, 2010).

1.5 HIV and AIDS: The Scenario
India has seen an increase in the number of its people living with Human Immuno Deficiency Virus (HIV) which causes AIDS. According to a WHO report, the estimated number of persons living with HIV worldwide in 2010 was 34 million and estimated number of deaths due to AIDS in 2010 was 1.8 million worldwide. Approximately 2.4 million people in India were living with HIV in 2010.

1.6 Tuberculosis: The Scenario
India is home to over 3.4 million tuberculosis (TB) patients—about one-fifth of the global figure—making it the most TB prevalent country. Of these, 17% have developed multi drug resistance MDR TB (RNTCP, 2010). HIV-AIDS and TB are becoming growing concerns in India. It is the youth that comprise the larger share of their victims. Several edutainment strategies using a variety of media are being tried by national and international organizations to run awareness campaigns on these diseases.

One such strategy is use of mobile learning through games.

To explore into the domain of edutainment based mobile phone games, following two studies were conducted:


**Study I:** Mobile Phone Games for Edutainment: An Exploratory Study (2008-9)

**Study II:** Efficacy of Stop TB Cricket: a Mobile Phone Game for Edutainment (2010-11)

The present paper is based on the findings of both these studies.

### 1.7 Objective of the Present Paper

To explore the range of mobile phone based edutainment games available in India and field test some games with youth.

Specific objectives:

1. To identify edutainment based mobile phone games available in India.
2. To prepare a catalogue of the mobile phone edutainment games available.
3. To study the perceptions of youth regarding the ease of playing and appeal of AIDS Fighter Pilot and Stop TB Cricket (edutainment based mobile phone games).
4. To assess the efficacy of the selected games in changing the awareness of youth about HIV/AIDS and Tuberculosis.
5. To do a content analysis of the messages appearing in Stop TB Cricket.

### 2. METHODOLOGY

As stated earlier the present paper is based on the findings of two studies:

**Study I:** Mobile Phone Games for Edutainment: An Exploratory Study (2008-9)

**Study II:** Efficacy of Stop TB Cricket: a Mobile Phone Game for Edutainment (2010-11)

This section describes the methodology used to conduct the studies. It may be noted that while the methodology used for seeking feedback from the youth is quite similar in both the studies, it differs in the sample size and the socio-economic background of the youth.

#### 2.1 Study I

Mobile Phone Games for Edutainment: An Exploratory Study (2008-9)

Mobile phone edutainment games were collected after consulting agencies engaged in the development sector and mobile phone game developers. ZMQ Software Systems (India) was found to be the only
organization developing mobile phone edutainment games on health concerns as part of its Corporate Social Responsibility initiative. All the mobile phone games developed by ZMQ Software Systems were analyzed in terms of edutainment issue, phone specifications required, source, process of installing, method of playing, delivery of messages, entertainment value and gaming experience were analyzed. A catalogue was prepared and printed after reviewing the games. It contained the following information about the games: Title, edutainment issue, year of launch, genre, developer, web link, connectivity, operating system, handset required, language and visuals.

The game AIDS Fighter Pilot was selected for field testing as it did not have any male or female characters, its visuals could be easily identified and was easy to play. This game was available in English therefore it was selected for field testing with 80 youth (15-30 years) who could read English and belonged to middle income group families living in Delhi. Since this was an exploratory study, the sample was further stratified to include an equal number of youth (16 each) engaged in five different occupation groups—school going, college going, non working, in-service and self employed. This enabled the control of variables like age, education, geographical location and nature of occupation of the sample. All the respondents played the game on the same Motorola mobile phone to control the variables of screen size, color resolution, keyboard controls and battery life.

The study required a long period of interaction with the respondents as it involved an interview as well as before and after awareness test. Hence, purposive sampling was used to identify the sample.

2.2 Study II

2.2.1 Efficacy of Stop TB Cricket: a Mobile Phone Game for Edutainment (2010-11)

The game Stop TB Cricket could be downloaded in Hindi (locally spoken language) and was field tested with 80 youth (15-25 years, equal number of male and female) resettlement colony, living in a South-East Delhi. All the respondents played the game on the same Nokia handset to control the variables of screen size, color resolution, keyboard controls.

To do a further content analysis of the messages appearing in Stop TB Cricket a list of all the messages was prepared and presented to 20 experts in development communication, education and health communication. They were asked to give their opinion about the relevance, accuracy and ease of understanding of each message. They were asked to re write the messages that they did not assess very high on the three selected parameters.

Semi-structured interview schedules were designed to seek the opinion and perceptions of youth in both the studies. Based on the messages appearing in the two games awareness tests were prepared. These were
administered to the respondents before and after playing the games to assess any change in their awareness about the diseases. The findings of the two studies are described below.

3. FINDINGS AND DISCUSSIONS

3.1 Review of Mobile Phone Edutainment Games for Creating Health Awareness

Seven mobile phone edutainment games disseminating messages on health were identified. These are listed in Table 1. All the games had been developed by ZMQ Software Solutions India Ltd. A detailed description of the games was included in a catalogue which can be used as an off line reference material by development practitioners engaged in the field of edutainment.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the Game</th>
<th>Issue</th>
<th>Year of Launch</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Safety Cricket</td>
<td>HIV and AIDS</td>
<td>December 2005</td>
</tr>
<tr>
<td>2.</td>
<td>Ribbon Chase</td>
<td>HIV and AIDS</td>
<td>December 2005</td>
</tr>
<tr>
<td>3.</td>
<td>The Messenger</td>
<td>HIV and AIDS</td>
<td>December 2005</td>
</tr>
<tr>
<td>4.</td>
<td>Quiz with Babu</td>
<td>HIV and AIDS</td>
<td>December 2005</td>
</tr>
<tr>
<td>5.</td>
<td>AIDS Fighter Pilot</td>
<td>HIV and AIDS</td>
<td>December 2006</td>
</tr>
<tr>
<td>6.</td>
<td>AIDS Penalty Shootout</td>
<td>HIV and AIDS</td>
<td>December 2006</td>
</tr>
<tr>
<td>7.</td>
<td>Stop TB Cricket</td>
<td>Tuberculosis</td>
<td>March 2009</td>
</tr>
</tbody>
</table>

The catalogue contained information about each game in terms of edutainment issue, genre, year of launch, developer, web link for downloading connectivity, operating system, language(s) game available in and brief description of the game. The catalogue titled Mobile Phone Edutainment Games. Figure 1 shows the cover of the catalogue. Figure 2 shows an inside paper of the describing information about two games.
3.2 Description of the Mobile Phone Games on Health

3.2.1 Game: AIDS Fighter Pilot

**Genre:** Adventure Game

**Available in:** English, Kiswahili and Shen

In this game Juma the village boy flies a glider plane and he is used as a messenger of HIV and AIDS awareness. The player is supposed to make the glider fly in the sky to catch red ribbons and boxing gloves, and deliver them to the villagers below on their demands. Red Ribbon is the symbol of HIV and AIDS awareness and Boxing Gloves symbolizes safety and protection. There are 15 messages on HIV and AIDS in the game. The messages appear every time the player scores or loses a point or clears a level. The game contains messages on the causes, signs, symptoms, treatment and myths and misconception. Figure 3 shows the game AIDS Fighter Pilot.
3.2.2 Game: AIDS Penalty Shootout  
*Genre:* Adventure game: Sports  
*Available in:* English, Kiswahili, and Shen

This is a football based game to create HIV and AIDS awareness. The player selects a team and plays a football match against an opponent team. Both teams are given penalty shoots to score goals. Initially 5 penalty shoots are given to each team. A player has to select appropriate direction and power to score a goal. The team scoring more goals wins. Players move to the next level if they win. If they lose, they are out of the tournament. The game has 3 levels- quarter finals, semi-finals and finals. The team winning the final is the winner of the Africa Cup.

3.2.3 Game: Safety Cricket  
*Genre:* Educational game: Sports  
*Available in:* English, Telugu, Marathi, Kannada and Hindi

This game is based on a cricket match between Demons XI and Safety XI. Demons XI have played their innings and have set up a target score. Safety XI has to chase those runs in 10 overs (60 balls) and 300 seconds with 11 players in hand. Balls appear regularly on the air in three different rows in the form of 4 Safety symbols: Condom, Faithful Partner, HIV Information and AIDS Red Ribbon. A player scores runs for collecting these items. At the same time, when a player is out messages on unsafe sex, infected blood transfusion, HIV virus, infected syringe and impact of the company of bad friends are displayed on the screen. Different HIV and AIDS awareness and safety messages are displayed on scoring runs. On striking negative objects, messages are displayed on how HIV is transmitted. The players need to time their strike to hit the right ball.

3.2.4 Game: Ribbon Chase  
*Genre:* Educational game  
*Available in:* English, Telugu, Marathi, Kannada and Hindi

Ribbon Chase is for more focused people who are highly engaged in game play. The player needs to spread the message and awareness of HIV and AIDS all over the world. The player is an AIDS Red Ribbon and HIV Virus chases him/her. Different cities in the world ask for information on HIV and AIDS. The player needs to deliver the messages. The HIV Virus chases the player and wants to catch him/her and does not let the player deliver the message. The player needs to run smartly to deliver the required message. This is a multi-level game with five Lives.
3.2.5 Game: The Messenger

Genre: Adventure game

Available in: English, Telugu, Marathi, Kannada and Hindi

The player is a HIV and AIDS awareness messenger in form of a Pigeon. He/she flies from village to village. In the sky the player can collect Condoms and Red Ribbons, which need to be distributed to the villagers below. People living in the villages need Condoms and Red Ribbon to prevent HIV and AIDS. The Pigeon needs to drop the safety objects on specific demand of the villagers. On every correct demand, the villager gets an additional safety and awareness message. The Pigeon can lose a life if it hits a HIV Virus in the sky. At this point different messages are displayed how HIV is transmitted.

3.2.6 Game: Quiz with Babu

Genre: Interactive game

Available in: English, Telugu, Marathi, Kannada and Hindi

Quiz with Babu involves players whose bent of mind is more towards quizzing, questioning and reasoning. In this game Babu, the village boy is fond of going to his school library. He reads a lot about HIV and AIDS in the library and newspapers. He is always busy searching information on HIV and AIDS from different sources. He has made a resolution to spread the HIV and AIDS awareness not only in is village but in the surrounding villages as well. Babu sits under a tree in the village and questions people on HIV and AIDS. A gamer plays quiz with Babu and tests his/her knowledge on HIV and AIDS. Players have 10 questions and three lifelines to answer all the questions.

3.2.7 Game: Stop TB Cricket

Genre: Interactive game

Available in: English and Hindi

Stop TB Cricket is a game which uses cricket as a sport to deliver messages on Tuberculosis (TB). There are two teams- Safety XI and TB Germs XI. A player has to bat and chase a set score after choosing his or her team. After every shot, a dialogue box containing a fact, common myth or misconception associated with Tuberculosis is displayed on the screen. When a player scores runs information on how TB can be prevented scrolls on the screen. When a player loses a wicket, information on how TB is transmitted and cured is displayed. Figure 4 shows a screen image of Stop TB Cricket.
3.3 Findings from Study I

Mobile Phone Games for Edutainment: An Exploratory Study

3.3.1 Time Taken to Gain Proficiency in Playing AIDS Fighter Pilot

Average time taken by respondents to reach proficiency in playing the game was 5 minutes. The minimum time taken was 1 minute and the maximum time taken was 10 minutes.

Majority of the respondents (67.5%) learnt to play AIDS Fighter Pilot in a single turn and even reached the score of 300. Thus, AIDS Fighter Pilot was found to be a very simple game, easy to learn and play.

3.3.2 Appeal of AIDS Fighter Pilot

Majority of the respondents (56%) found the game AIDS Fighter Pilot ‘somewhat’ interesting and engaging. About one-fourth of the respondents found the game ‘very’ interesting and engaging, 20% found the game ‘moderately engaging’ and the remaining reported that they did not find the game interesting or engaging at all.

Pearson Chi Square Test was performed to see any association between age, sex, education and occupation of the youth with their finding the game interesting and engaging. It was found that there was no association between variables like age, sex, education and occupation of the respondents and their opinion about the appeal of the game.

3.3.3 Quality of Graphics of AIDS Fighter Pilot

About 75% of the respondents found the quality of graphics in the game ‘very good’. The graphics were simple, clear and colorful.

3.3.4 Clarity of Instructions for Playing AIDS Fighter Pilot

Majority of the respondents (60%) stated that the instructions for playing were ‘very clear’. Only one respondent was not able to understand the instructions. Half the youth took less than one minute in understanding the instructions of the game, 42.5% took 2-5 minutes and the remaining few respondents took 6-10 minutes in understanding the instructions. Thus a majority of the respondents did not take more than 5 minutes to learn Aids Fighter Pilot.
3.3.5 Clarity of Messages Appearing in AIDS Fighter Pilot

60% of the respondents found the language of the messages in the game very easy and clear. Terms like, ‘antiretroviral drugs’ and ‘safer sex’ were not clear to many respondents. More than half of the respondents mentioned that the same message should not be repeated 3 to 4 times in quick succession as it made the game monotonous.

3.3.6 Ease of Playing the Game

Nearly 70% of the respondents found the game to be very easy to play. Only one respondent found the game difficult to play as he was not comfortable with the key board. All the respondents were made to play the game on the same Motorazer mobile phone. More than half of the respondents (62.5%) found the control of keys ‘very easy’. The others faced some difficulty in controlling the keys.

3.3.7 Time Taken in Understanding Instructions for Playing the Game

Half the youth took less than one minute in understanding the instructions of the game, 42.5% took 2-5 minutes and the remaining few respondents took 6-10 minutes in understanding the instructions. Thus a majority of the respondents did not take more than 5 minutes to learn AIDS Fighter Pilot.

3.3.8 Efficacy of AIDS Fighter Pilot in Enhancing Awareness about HIV and AIDS

Awareness Score- Before playing the game: Respondents were given an Awareness Test of 20 questions based on messages appearing in the game. Each question carried one mark. It was found that the minimum score was 10 (for 2 respondents) and the maximum score 20 (for 15 respondents). The average score of the sample before playing the game AIDS Fighter Pilot was 17.48.

Awareness Score-After Playing the Game: The average awareness score of the youth after playing AIDS Fighter Pilot was 19.21. The minimum score obtained was 16 (for 1 respondent). The maximum score was 20 (for 44 respondents). More than three-fourth of the respondents scored between 19-20 points after playing AIDS Fighter Pilot. The average gain in score after playing the game was 2 and the range of gain in score was 9.

Awareness about HIV and AIDS was found to be significantly higher after playing AIDS Fighter Pilot. This was also confirmed statistically by applying the t test.

Awareness about HIV and AIDS before playing AIDS Fighter Pilot was significantly related to the education of the respondents. No such relationship was found between age, sex and occupation of the respondents and their awareness about HIV and AIDS before playing AIDS Fighter Pilot.
Awareness about HIV and AIDS after playing AIDS Fighter Pilot was found to be significantly related to the age, sex, education and occupation of the respondents.

Thus it can be concluded that although all the respondents liked the game but they perceived HIV and AIDS to be associated with sex. They felt very shy in discussing sex and its association with HIV and AIDS.

3.3.9 Suggestions for Improving AIDS Fighter Pilot
About 25% youth suggested improvement in the content and language of the messages. Respondents mentioned that the content delivered in the game was quite heavy. For instance messages like HIV and AIDS screening should be required for employment’ and ‘Learn to say no to peer pressure’ were found to be difficult. Instead of these messages some messages on signs and symptoms could be included in the game. They wanted the language to be simpler as words like ‘contagious’, ‘stigma’, ‘peer’ and ‘antiretroviral’ were found difficult to understand.

A few youth wanted greater ease of playing and better key pad design as the respondents did not find it easy to play the game on Motorazer phone as it was new to them and they were use to handling their own mobile phones.

3.3.10 Issues Suggested for New Mobile Phone Edutainment Games
Youth suggested that such games should be made on topics like gender, environment, and nutrition and for providing academic support to students on topics from their syllabus in a fun format.

3.3.11 Willingness to have Mobile Phone Edutainment Games
All the youth were willing to have edutainment games in their mobile phones as they found them very informative and entertaining. Some youth who were homemakers wanted to use the game AIDS Fighter Pilot to initiate a dialogue with their spouse and children on HIV, AIDS and Safe Sex.

3.4 Findings from Study II
Efficacy of Stop TB Cricket- a Mobile Phone Game for Edutainment

3.4.1 Objective of the Game Stop TB Cricket
Although a majority of the youth (80%) stated that the game they played was about TB. However, the remaining 20% youth mentioned that the game was on cricket- of these a large number (75%) were girls.

3.4.2 Time Taken to Gain Proficiency in Playing Stop TB Cricket
A majority of the youth (90%) took only 1-2 times to play the game and develop proficiency in it. A similar trend was observed in both boys and girls. Thus, it can be concluded that the game Stop TB Cricket was easy to understand and play.
3.4.3 Ease of Playing the Game

The game was found easy to play by a majority of the youth. About 20% of the youth found the game ‘very easy’ to play and 53.7% reported that it was ‘easy’ to play. About one-fourth of the youth (26.3%) found the game ‘difficult’ to play.

3.4.4 Ease of Understanding the Instructions for Playing the Game

Half of the youth (50%) reported that they found the instructions for playing the game ‘clear’ where as 23.7% reported that they were ‘very clear’. Nearly one-fourth of the youth (26.3%) reported that the instructions were ‘unclear’-of these girls were found to be more in number as compared to boys.

3.4.5 Problems Encountered While Playing Stop TB Cricket

A large number of the youth (65%) did not report any problem in playing the game. However, the others reported problems related to size of buttons on handset, difficulty in understanding some instructions and some messages. It was observed that more girls than boys reported problems while playing the game.

3.4.6 Appeal of the Game

Almost all the youth (95%) found the game quite appealing in general. A large number of the youth (70%) found the game very appealing. The TB game was based on cricket which is a very popular sport in India. This was cited as the main reason for liking the game.

3.4.7 Language of the Messages

It was found that only about one-third (36.2%) of the respondents found the messages in the game ‘very clear’, (57.5%) stated that they found the messages ‘clear’ and the few remaining found them ‘unclear’. Although the game was in Hindi, the words used in some messages were found to be difficult to understand. For example, words like ‘sankraman, DOTS pranalee, etc. were found difficult to understand.

3.4.8 Efficacy of Stop TB Cricket in Enhancing Awareness about Tuberculosis

To assess the effectiveness of Stop TB Cricket in enhancing the youth’s awareness about Tuberculosis an Awareness Test comprising of 16 objective type questions was administered to the respondents before and after playing the game. Each question was given 1 mark. The average score on the Awareness Test before playing the game was found to be 10.7 and increased to 12.5 after playing the game. Hence, the average gain in score was 1.7. The gain in average awareness score was found to be more in female respondents (2.08) as compared to male respondents (1.8).

The lowest score before playing the game was 6 and the highest score before playing the game was 15 amongst all the youth. The lowest score after
playing the game was 9 and the highest score was 16. The minimum gain in score after playing the game was 1 and maximum was 7. A few respondents (5%) did not show any change in awareness score after playing the game.

Increase in the awareness scores clearly indicated that the game Stop TB Cricket was quite effective in increasing awareness of the youth about Tuberculosis. This was also confirmed by statistical analysis. The T-test and Chi-square test were done to measure the association between variables age, sex, occupation and increase in awareness scores before and after playing the game. The game Stop TB Cricket increases the awareness of youth about TB.

The paired samples T test value was 11.147 df= 79 at 0.000 level of significance. The expected level of significance was 0.05. It was concluded that awareness about TB after playing the game Stop TB Cricket was significantly higher amongst the youth. It was concluded that the game Stop TB Cricket is successful in increasing the awareness of youth about TB.

It was also concluded that increase in awareness of youth about TB was significantly correlated to the education of the youth. Variables like age group, sex and occupation were not found to have any correlation with the performance of the youth on the awareness test. The figure no. 3 depicts the bar graph showing the Awareness Test Scores of youth- Before and After playing Stop TB Cricket and difference in Before and After Scores.

3.4.9 Willingness to Acquire Edutainment Based Mobile Phone Games
Nearly all the youth (93.7%) expressed willingness to acquire edutainment based mobile phone games in their phones as they found these games to be very informative and entertaining.

3.4.10 Issues Suggested for Making Edutainment Based Mobile Phone Games
Most of the youth had a lot of suggestions to give about the kind of new mobile phone games they wanted to be developed. The youth suggested that new mobile phone games should be prepared on health (83.7%), social issues (12.5%) and environment (7.5%). They were found willing to participate in the game development process.

3.4.11 Suggestions for Improving Stop TB Cricket
A lot of suggestions were offered to improve the game: 17.5% suggested that the game should have different types and levels, 16.2% wanted the content and language to be simpler, 13.7% wanted both male and female players in the game, 12.5% wanted better graphics and 10% wanted better readability in terms of larger font size and slower speed of scrolling of text. Figure 4 shows the youth playing the Stop TB Cricket.
3.4.12 Feedback from Experts- Analysis of Messages Appearing in the Game

The experts from the field of Medicine, Natural Language Processing, Behavior Change Communication, Media and Communication and Development communication and Extension were contacted and explained the purpose of the study. They were given the Schedule as a print copy or on email. They were required to enter their responses in Yes or No and write suggestions for improving messages that they did not approve of. The schedule was designed in a manner that it was easy and quick to fill up. It took about 10-15 minutes to fill up this schedule.

Experts were asked to give their opinion about each message of the game in terms of accuracy, relevance and easy to understand. They were requested to suggest improvement in the structure of the messages. There were the total 16 messages in the game. It was found that the game contained no message on signs and symptoms of TB. A lay person identifies a disease by seeing certain signs and symptoms. Hence it was very important to have messages creating awareness about signs and symptoms of a disease. There were 3 messages on Causes, 4 messages on Diagnosis and Treatment, 4 messages on Prevention and 4 messages on Myths and Misconceptions on Tuberculosis.

Based on feedback from experts it was concluded that out of 16 messages in the game 1 message were rated as Excellent, 9 messages were rated Good, 6 messages were rated Average, none of the messages were graded as Poor and Very Poor. The suggestions given by the experts were used to revise the messages in the game. The revised messages can be incorporated in the next edition of the game by the game developer. Content analysis of the game gave valuable insights about the choice of language and nature of messages to be included in a game on Tuberculosis for mass distribution in Hindi language.

4. CONCLUSION AND RECOMMENDATIONS

The games AIDS Fighter Pilot and Stop TB Cricket were liked by all the youth. The concept of edutainment based games was appreciated by all the youth. Mobile Phone Gaming was found to be an innovative media for presenting serious information by using the challenge and excitement offered by games and the advantages offered by mobile learning technology. Both the games were found to be effective in creating awareness and increasing the knowledge of youth about HIV-AIDS and Tuberculosis. Suggestions for improving the games included better graphics, more levels, sound effects, easier language and better battery life in hand sets to enhance the gaming experience. Introduction of female players was suggested in Stop TB Cricket. This will help in attracting the young and technology savvy generation.

New mobile phone edutainment games were suggested to be developed on issues like gender, environment, health, nutrition and on topics from the
Edutainment Based Mobile Phone Games for Health Communication in India

school syllabus of the youth. Such initiatives can be supported by the local government, NGOs, corporates, especially mobile phone manufacturers and network service providers, and other institutions concerned with community development.

These games can be used as tools in behavior change communication, creating awareness and giving information on sensitive issues.

Game developers and other organizations involved in the development of such edutainment games should have thorough knowledge of grassroots realities and issues to ensure accuracy, adequacy and relevance of content and language. Mobile phone edutainment games should be available on all mobile network service providers. They should allow free download of edutainment games to encourage widespread dissemination of development messages to the masses.

AIDS Fighter Pilot should be available in Hindi to reach a larger target population. Some sound effects should be added to this game to give a true rich multimedia experience to the players.

REFERENCES

Is mHealth Viable to Ethiopia?—
An Empirical Study

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Abstract—The expansion of Internet and the availability of mobile devices in affordable price to all type of people in the world expand the opportunity to use mobile technology in the health sector. In this paper we address the applicability, feasibility and usability of mobile technology to the under-served population of rural Ethiopia (particularly Amhara region). As the magnitude, disease prevalence and the shortage of healthcare workers increases from time to time, the health service delivery becomes inefficient and ineffective. To alleviate these grounded problems an additional technology is required. The result of the study shows that assisting healthcare service delivery through ICT is very urgent and demanding. In addition, the mHealth is the main channel to address the aforementioned problem. To this end we proposed a mobile based health service discovery framework.

1. Introduction
The use of information and communication technology (ICT) is one of a range of potential solutions to the health care challenge. ICT encompasses a range of technologies which enable the exchange of data through the telephone or Internet, home based health service delivery, remote consultation and treatment, and remote capacity building and on-job training.

ICT has the potential to modify the way in which people use health services both by increasing access to information and by remotely providing other forms of support. Expectations are changing with people wanting to determine their own health needs through advice on the Internet or other technological interfaces and faster more person-centered (personalized) services from health care providers including patients and health professionals. Indeed, we may be witnessing a move from the “face to face age of health care” to the “information age of health care”.

The explosive growth of mobile communications over the past decade offers a new hope for the promotion of quality healthcare, especially for developing countries. There is a growing body of evidence that demonstrates the potential of mobile communications to radically improve healthcare services even in some of the most remote and resource-poor environments [3, 4].

Healthcare is a fundamental, but under-serviced need of citizens in developing countries. In addition to having the highest maternal mortality, child-under-five mortality and neonatal mortality ratios, these regions have the largest unmet need for health service provision in the world. Given the shortage of healthcare professionals: doctors and nurses, and the low number of medical schools in Ethiopia, the government trained health extension workers (HEW) were women chosen from their own communities trained in basic health service provision for one year, and sent back to provide health service in their community specially in prevention, consulting and awareness creation.
Some of the benefits of mHealth are (1) increased access to healthcare and knowledge transfer, (2) increased efficiency and cost reduction, (3) improved ability of diagnosis, treatment and track of diseases, (3) timely dissemination of health information, and (5) provision and expansion of training and medical education.

1.1 Potential of Mobile Phones to Improve Health in Ethiopia

In the previous years the government of Ethiopia makes tremendous strides its efforts to improve the lives of their citizens, yet formidable obstacles remain. Disease and the lack of adequate preventative care take a significant barrier to sustainable development.

1.1.1 Defining mHealth

In recent years, mHealth has emerged as an important subsegment of the field of eHealth. While there is no widely agreed-to definition for these fields, as a result [3] proposes a working definitions:

eHealth: Using information and communication technology (ICT) - such as computers, mobile phones, and satellite communications - for health service and information.

mHealth: Using mobile communications - such as PDAs and mobiles - for health services and information.

1.1.2 The Promise of Mobile Technologies for Health

mHealth and eHealth are inextricably linked. Both are used to improve health outcomes and their technologies work in conjunction. mHealth programs can serve as the access point for entering patient data into national health information systems, and as remote information tools that provide information to healthcare clinics, home providers, and health workers in the field. While there are many stand-alone mHealth programs, it is important to note the opportunity mHealth presents for strengthening broader eHealth initiatives [3].

Mobile communication offers an effective means of bringing healthcare services to developing-country citizens. With low-cost handsets and the penetration of mobile phone networks globally, tens of millions of citizens that never had regular access to a fixed-line telephone or computer now use mobile devices as daily tools for communication and data transfer [3]. Mobile technologies enable eHealth systems to decentralize and thus extend their reach to remote settings, as well as to individual members of the health sector and the general public. Meachael [5] stated the effect of mHealth in developing countries, “it is worthwhile to consider how mobile phones are being used organically, and then to look at some examples of formalized mHealth initiatives”. In case of Ethiopia there is an emerging mHealth project which is PDA based data collection.
Despite of the huge expansion of mobile communication in Ethiopia, mobile technology is not being used yet to assist the healthcare sector. There are some operational projects in the country, for example the remote data collection using PDAs (which is in a pilot phase) and there is a project called Smart Care (hospital information systems). Thus, the utilization of mobile technology to improve the health of the citizen is very minimal.

Technology has now evolved to a point that delivering telemedicine services is economically feasible, the graphics quality of the mobile media is acceptable, and the data transfer is reliable and at an acceptable speed. The cost of technology, once a critical barrier, is now providing e-Health opportunities for new services because the costs of hardware, software and telecommunications technology continue to decrease, meanwhile, the capabilities continue to increase [4].

Frühling [4] says telemedicine offers many opportunities for rural e-health consumers for example, patient consultations from and referral services to medical providers, and training for health care professionals via distance education.

1.2 Objectives

The last few years witnessed a rapid development and deployment in both wireless technologies and mobile Internet based mHealth system with pervasive computing technologies. The increasing data traffic and demands from different medical applications will be compatible with the data rates of 3G and 4G systems [4]. In this paper we investigate the feasibility and applicability of mHealth for remote areas of Ethiopia. The objectives of this study are:

- To assess the viability of mobile phones to facilitate healthcare services in the rural areas
- To understand the exposure of healthcare workers to ICT equipments and technologies
- To assess the availability of minimal infrastructure in order to deploy eHealth services specially in the rural areas
- To investigate the interaction of healthcare institutions towards using ICT in healthcare to reach the unreached and to widen the coverage of healthcare services in the country.

The paper is structured as follows: in section 2 we discuss the application of mHealth. Section 3 addresses Ethiopia’s health services and the methodology used to gather data and the tools to analyze the collected data is presented in section 4. Section 5 we present the mHealth framework. Finally, we conclude the paper and pinpoint future work in section 6.2

2. Application of mHealth

mHealth applications are numerous and diverse. They range across remote diagnostics and monitoring, diagnosis and treatment, collecting medical data remotely, ease communication and reduce hospitalization and self-diagnostics. Figure 1 shows mHealth intervention areas.
Is mHealth Viable to Ethiopia? An Empirical Study

**Fig. 1: mHealth Intervention Areas in eHealth**

2.1 Education and Awareness

A short messaging service (SMS) is the most cost effective, efficient and scalable method of providing outreach services for a wide array of health issues [3, 1]. In education and awareness applications, in most developed countries SMS messages are sent directly to users’ phone to offer information about testing and treatment methods, availability of health services, and disease outbreaks [2]. SMS alerts have proven particularly effective in targeting hard-to-reach populations and people in rural areas, where absence of clinics, lack of healthcare workers, and limited access to health-related information all too often prevent people from making informed decisions about their health. For example Uganda’s ‘Text to changes’ and South Africa’s ‘Masiluekis’ send SMS message to create HIV/AIDS awareness. Philippines’s ‘Phoned Pill Reminder projects’ sends SMS for tuberculosis treatment.

However, SMS alerts cannot be used for citizens with illiteracy and low level education. Besides the SMS need to be localized. Hence, to educate and create awareness to the majority of rural population, an automatic voice alert system is required to be designed.

2.2 Remote Data Collection

Data collection is one of the most important areas of mHealth. Policy makers and health providers at the national, district, and community level need accurate data in order to gauge the effectiveness of existing policies and programs, and in order to shape new ones [3]. Currently there is a data collection program (using PDAs) in Ethiopia as a pilot project (‘RapidSMS’1) for data collection and outbreak tracking. This project is first used in 2008 for food distribution program to supply a high protein plumpy’nut to under-nourished children in different feeding centers of the country. It has been reported that in five weeks of pilot study 939 unique reports and 10-15 reports everyday were received [8]. Later on this project has been used for healthcare data collection and outbreak reporting. Recently ‘SMS

Tech for Health\(^2\), a new pilot project is launched in Amhara, Oromia, Tigray and Southern. This pilot project is designed for health professionals and expectant mothers; its aim is to improve healthy babies by reducing complications during the birth process and improving maternal health. Besides, the projects provide an opportunity for healthcare workers to consult the knowledge database for additional information regarding complications. ‘txt4Enat’ is another component of the project which will provide opportunities for about 100,000 women to send SMS messages when they encounter a complication during their pregnancy.

When this mobile based data collection is implemented full-fledged, it will solve the current problem of lacking patient data, enabling the governmental officials to gauge the effectiveness of healthcare programs, to allocate resources more efficiently, and to adjust programs and policies accordingly.

### 2.3 Remote Monitoring

One of the area’s most uniquely suited for mobile technology application is remote monitoring of patients. As much as 85 percent of the people of Ethiopia live in rural area. The limited number of hospitals in the country may urge to use remote monitoring of patients in outpatient settings. It is impossible to provide mobile phones for the total population but patients with a chronic disease (AIDS, diabetes, TB, etc) who own a mobile phone can use the monitoring services such as health condition monitoring, maintaining healthcare workers appointments, and receiving SMS reminders to take the daily medication or to take a test (such as measuring the blood sugar level). Accordingly, the United Nations Foundation and Mishra and Singh \([3, 6]\) assert that monitoring patients at home for chronic conditions dramatically improves their survival rate.

### 2.4 Communication and Training for Healthcare Workers

mHealth education for health workers is introduced about 4 years ago, that can enable health workers to learn new treatment procedures, test their knowledge after training course, take certification exams and look on information from medical references and to decide on diagnosis. Some research reports disclosed mHealth education applications improves provision of care and levels of knowledge \([2]\).

An acute shortage of healthcare workers is a major challenge facing Ethiopia. To alleviate such a devastating problem, Ethiopia has trained about 32,000 front line health community workers (called Heath extension workers, HEW). They took a one year preventive healthcare training. The majority of the HEWs want to upgrade to the next level. However, there is no such opportunity yet. Training HEW using mobile technology can close this gap and will help to empower, motivate and reduce attrition. The

\(^2\)http://www.healthunbound.org/content/new-sms-project-ethiopia-improve-maternal-health
training enables health extension workers to perform many of the simpler medical tasks currently done by doctors and nurses.

Our assumption is that mobile technology improves the communication mainly between health posts and health centers for the purpose of performance reporting and providing and asking guidance and assistance.

2.5 Diagnostic and Treatment Support

“Diagnostics and treatment support are vitally important in healthcare—misdiagnosis or the inability to diagnose a condition could have serious, even fatal, ramifications” [3]. mHealth applications in this area are designed to provide diagnosis and treatment advice to remote healthcare workers through wireless access to medical information databases or medical staff. There are two possibilities to provide remote diagnostics and treatment, first the remote medical professionals can diagnose the illness and prescribe a treatment (eliminating patients travel), and second the local medical professionals can access the remote medical database through the mobile technology.

Furthermore, Bill Gates in his keynote speech in mHealth Alliances conference said “Diagnosis of malaria and TB will likely be the first ones you can assign a number to and say without this mobile phone app these people would have died,” Gate said, “In the diagnostics areas we are seeing some very good stuff come through.”

Deployment of mobile devices, with their ability to quickly capture and transmit data on disease incidence, can be decisive in the prevention and containment of outbreaks. For instance, Peru, Rwanda, and India use mHealth applications to track disease and epidemic outbreaks [3].

3. Health Services of Ethiopia

In this section we address the available health services in Ethiopia, especially in one of the biggest and most highly populated region, Amhara.

The Amhara National Region State covers an area of 170,752 sq. kilometers and encompasses a population of about 17 million3. Almost 90% of Amhara’s population is rural, living in heavily populated (111 persons/sq. kilometre) farming communities. It has about 105 districts. The health coverage is not sufficient compared to urban administration regions of Addis Ababa and Dire Dawa.

3.1 Health Institutions

The region consists of 23 hospitals, 632 health centers, 1235 health clinics and 2941 health posts. The number of available health institutions is very limited compared to the size of the population. It has only three referral hospital, among them only one is a teaching hospital. According to health experts, the Bahir Dar Felege Hiwot hospital serves about 9 million people. It is estimated that the region has approximately 2209 hospital beds.

32007 national census (www.csa.gov.et)
3.2 Health Professionals

One of the acute problems is a shortage of healthcare workers. The number of health professionals is very small compared to the size of the population which accounts 25% of the country’s population. The health facilities are equally distributed over the districts based on their population. The number of health workers in the state is displayed in Figure 2.

Malaria, TB and HIV/AIDS are among the common diseases in the region besides other causes for morbidity. Figure 3 displays the number of patients diagnosed in year 2010.

4. METHODOLOGY

In this case study observation and interview is employed. To select zones and woredas/or districts we use purposive sampling techniques. We choose 5 districts in the region for the assessment purpose. In each district we select two health centers to assess the available infrastructure as a benchmark for the implementation eHealth (particularly mHealth) projects. The main purpose of the study is:

- To study the existing gap of the health center especially on the availability of ICT facilities and devise a mechanism how to implement IT services with the available infrastructure in the health centers;
- To assess the perception of healthcare workers in utilizing eHealth specially mHealth;
- To identify barriers preventing e-health services from reaching their potential in rural communities and to study the feasibility of mHealth in tackling the protruded health problem;
• To observe and assesses the healthcare workers readiness in using the available ICT services and facilities and how much do they acquainted with IT devices in their day to day life;

• To understand the intention of healthcare workers towards using ICT in diagnosis and treatment, in prevention, in patient monitoring and in awareness creation;

4.1 Sampling Technique

We use purposive sampling techniques to choose the health centers in each district. Each districts health office provides the number of health services available in the district, the overall coverage, and the common diseases affected the population, and the total number of healthcare workers. We select two health centers in each district. Based on the recommendation of district health office, we choose one health center with very poor infrastructure: (no electricity, no roads, and no telecommunication service and far from the district town) and the second health center is relatively with better infrastructure and close to the district town in distance or near to the highway.

According to the country policy, a health center coordinates and manages 5 health posts. A health center and a health post are supposed to serve 25000 and 5000 people respectively.

4.2 Data Gathering Tools

We employ interview and observation to gather data for the study. In each health center we interviewed the health center head and three health extension workers. Among the thirteen interviewees, nine are nurses and, one health officer and three HEWs. The average work experience of the interviewee is 3 years and the average age is 24. Five females and eight males were participated in the interview. Each interview took from one hour up to one and half hours. The interviewees are presented with both open-ended and close-ended questions.

In the subsequent subsections we present the population size, number of health facilities (Table 1 summarizes the health facilities of the woredas/districts) and the number of health professionals in the respective districts.
4.2.1 Fogera Woreda/ District

The district consists of 28 kebeles/villages with a total population of 220,926. The district has 11 health centers, 41 health post but there is no any hospital. The nearest hospital is about 55 kilometres. Malaria is the common disease which affects the rural population. We manage to visit two health centers: Kidist Hana Health Center and Kuahar Abo Health center which is 23 kilometres and 8 kilometres far from the district town (Woreta). The furthest health center is 49 Kilometres far from the district capital.

<table>
<thead>
<tr>
<th>Woreda</th>
<th>Health Centres</th>
<th>Health Posts</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fogera</td>
<td>11</td>
<td>41</td>
<td>220,926</td>
</tr>
<tr>
<td>Farta</td>
<td>10</td>
<td>41</td>
<td>271,951</td>
</tr>
<tr>
<td>Dera</td>
<td>10</td>
<td>36</td>
<td>248,464</td>
</tr>
<tr>
<td>Mecha</td>
<td>11</td>
<td>33</td>
<td>313,068</td>
</tr>
<tr>
<td>Yilmana-Densa</td>
<td>12</td>
<td>33</td>
<td>230,546</td>
</tr>
</tbody>
</table>

One of the unique features of this district is, it assigns IT professional in all health centers to facilitate health service delivery through information technology; however, most of the clinics we visited do not have IT equipments and electricity (see Table 2). Nonetheless, there is mobile network coverage in the clinics. Therefore all the healthcare workers use their mobile phone for communication purposes.

Infrastructure is one of the problems of the district for example only two health centers has all weather roads but others have only seasonal roads as a result transportation is a grand problem. Except two urban health centers none of the health centers have access to electricity which makes the available medical equipments unutilized and malfunctioning. On the contrary in most of the health centers mobile network is accessible though the healthcare workers used for reporting and for communication purpose only.

4.2.2 Farta Woreda/ District

Farta is one of the 105 woredas in the Amhara Region of Ethiopia. Part of the Debub Gondar Zone, Farta is bordered on the south by Este, on the west by Fogera, on the north by Ebenat, and on the east by Lay Gayint. Towns in Farta include Gasay and Kimir Dingay.

According to the woreda health office, this woreda has a total population of 271,951, of whom 140,878 men and 131,073 women; about 2.97% are urban inhabitants. With an area of 1099.25 square kilometers, Farta has a population density of 212.22 per square kilometre. Farta consist of 39 kebeles/villages among these two are urban kebeles which has an electricity access. The woreda has 10 health centers (from which two are urban health centers), 2 health clinics, and 41 health posts. Four of the health centers have an access to all weather roads. The remote heath center is 65 km far from the district city. Alike other districts, scarcity of infrastructures are one of the pressing problems of the district.
4.2.3 Dera Woreda/ District
This district is found in South Gondar zone. The district has a total population of 248,464, of whom 126,961 men and 121,503 women. It has about 36 kebeles/villages. The district consists of 10 health centers, 31 health posts and about 10 private clinics. The distribution of the healthcare workers is as follows: 72 nurses, 5 health officers, 7 lab technicians, 9 pharmacists, 3 sanitarian and 3 midwifery and 81 health extension workers. Some of the health centers lack physical infrastructure like road, electricity, and telephone infrastructure. For example Sana one of the sample health centers in our study has no electricity, only a seasonal road, and even mobile networking is not yet reached.

4.2.4 Mecha Woreda/ District
Mecha is one of the districts/woredas found in West Gojjam zone. The woreda/district has a total population of 313,068, of whom 158,218 men and 154,858 women. Among the total population 26,824 lives in urban and 286,244 in rural. It has 44 kebeles/villages 4 of them are urban kebeles/villages. The district consists of 11 health centers, 30 health posts, 20 private clinics, 11 private own pharmacies and 5 diagnostic laboratories. The number of healthcare workers incorporates 78 nurses, 3 health officers, 9 lab technicians, 10 pharmacists, 4 sanitarian, 5 midwifery and 89 health extension workers.

4.2.5 Yilmana-Densa Woreda/ District
Yilmana-Densa is one of the districts/woredas found in West Gojjam zone. The woreda/district has a total population of 230,546, of whom 115,734 men and 114,812 women. Among the total population 26824 live in urban and 286,244 in rural. It has 44 kebeles/villages 4 of them are urban kebeles/villages. The district consists of 12 health centers, 33 health posts, 20 clinics and 1 hospital under construction. Acute shortage of healthcare workers is one of the astounding problems of the district; the distribution of the healthcare workers is as follows: 78 nurses, 3 health officers, 9 lab technicians, 10 pharmacists, 4 sanitarian, 5 midwifery and 89 health extension workers.

Table 3 shows the ICT facilities available in the health centers. All the health centers neither have any ICT facilities nor equipments. Each health center except one gets mobile network coverage; therefore there is a possibility of accessing Internet through mobile phones. However, only one healthcare worker, a head of the Dremo health center, uses his mobile phone to access Internet, on the other hand most of the healthcare workers even do not know the availability of the services. Among 13 interviewees none of them have email account. The interview result reveals that the healthcare workers has very limited IT training, some of them took basic computer training in the university or college others have never taken IT training at all. This depicts that healthcare workers working in rural are as require basic IT training.
Table 2: Infrastructure of the Health Centers

<table>
<thead>
<tr>
<th>Health Center</th>
<th>Electricity</th>
<th>Transportation</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixed</td>
<td>Mobile</td>
<td></td>
</tr>
<tr>
<td>Wanzaye</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Korata</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sana</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Kidist Hana</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kuahar Abo</td>
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<td>0</td>
<td>1</td>
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<tr>
<td>Maynet</td>
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<td>Dremo</td>
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<td>Ageta</td>
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<td>Ambo mesk</td>
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</tr>
</tbody>
</table>

Table 3: Availability of ICT Services and Equipments

<table>
<thead>
<tr>
<th>Health Center</th>
<th>Computer</th>
<th>Internet Service (broadband/ dial up)</th>
<th>Email Service</th>
<th>Mobile Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wanzaye</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Korata</td>
<td>No</td>
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<td>Sana</td>
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<td>Dremo</td>
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</table>

4.3 Result and Discussion

4.3.1 Availability of Infrastructure

The finding shows that 30% of the health centers have electricity and 30% power transmission line is already installed, 60% have all weather roads, 40% seasonal roads, no health centers have fixed telephone and all of the health centers get mobile network coverage. For details see table 2.

4.3.2 Tawareness of Healthcare Workers for Diagnosis and Treatment

The interview result shows that the majority of the healthcare workers do not have awareness that IT can be applied as an enabler to facilitate health service delivery. However, some of them use mobile phones to consult doctors and friends whenever they come across complicated or unusual patients’ cases. Besides, mobile phone is used for reporting and data collection purposes to the district health office and to communicate with cluster health posts. Even if they did not know the impact of ICT in healthcare, they suggest that if a mobile based healthcare is developed that will contribute in prevention and diagnosis of health problems. Hence, from the interview and informal discussion made, we learned that mHealth is an option to assist the healthcare sector. One of the woreda/district recognizing the implication of ICT in improving the healthcare system assigns IT professionals in every health centers.
4.3.3 Utilizing mHealth

In all the visited health centers all the healthcare workers own mobile phones, so if any mHealth application is offered, they can use the system easily without longer term training.

4.3.4 Internet Service

The expansion of Internet services such as (broadband and dial up) in the country is still at its infancy. However, the proliferation of mobile network and the provision of Internet service through mobile phone by the telecom company make the mobile based healthcare service delivery viable for tackling the burden of healthcare in the country. The result of the study shows that all the health centers included in study has no broadband or dial up Internet services. On the other hand, all health centers have almost 100% mobile based Internet services.

4.3.5 Internet Usage

As shown in Table 3 all the health centers do not have any Internet services, however, the telecom company provides mobile based Internet access to the users with the price of air time. Except the IT professionals in the two health centers and one nurse, other health workers have never used Internet services. In the interview they were asked why not they use Internet as it is free and costs only the air time rate; they replied that they expect that Internet may incur much cost and others did not know whether the service is provided. Some also do not know the use of Internet due to lack of training. After the discussion with the interviewers, they show a certain enthusiasm to use Internet. In fact, mobile phone is used as a daily communication tools in the health centers and health posts.

As we mentioned in the above, the majority of the population live in rural areas but the health coverage is very insignificant. As we can see from figure 6, one health post serves about 5000 population and one HP has a maximum of two HEW, this increases the magnitude of the problem and one health center is designated to 25000 people.

The study also solicited comments from the participants regarding their opinion of e-Health services and the likelihood of using such services.

Fig. 5: Ethiopian Health Institution Organogram
Based on the results of this study, three of the major challenges of expanding e-health service to rural healthcare concern the availability of the broadband Internet, access to computers and education on how to use computers. Regardless, if the technology is robust enough for telemedicine and physicians are willing to participate, the digital divide overpowers the drivers mentioned earlier [4].

The findings in the study have valuable implications for practitioners of e-Health services and will help them better understand the characteristics and challenges to extending the reach of e-healthcare services to rural citizens [4].

5. mHealth Framework

Based on the result of the study we propose a mobile based service discovery. As mentioned in our previous work [7], the framework consists of: service consumers, service providers, dialogue system and service discovery engine and service repository.

The components of the framework are described as follows: 1) Service consumer requests a health services using a mobile phone. 2) Service providers: publishes services to the service repository. 3) Dialogue system: it mainly accomplishes two tasks. First it converts voices into text using speech recognition and vices versa. The main benefit of using dialogue system is to enable a user to request services using voices. Similarly when requested services found the response is converted form text to voice. 4) Service discovery engine finds services from the services repository. As shown from figure 7, service discovery engine consists of different components: query interpreter (interprets user query), user profile and context (stores user profile and context data), matchmaking (matches requested services with offered services), ranking and selecting. 5) Service repository stores services advertised by the service provider.

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![mHealth Framework](image_url)
6. Conclusion

The proliferation of mobile technology in the world makes the healthcare service easily addressable. In this study we assessed the readiness of implementing electronic healthcare in Ethiopia. The study shows that mobile based healthcare service delivery is feasible, since the affordability of mobile phone by low income citizen and the expansion of mobile network in the rural areas help to utilize mobile based health services to consult, create awareness, diagnosis and treat the patients in the country. Thus we propose mHealth service discovery and delivery framework.

References

ICT Based Health Services for BPL Communities in India: A Case Study of Haryana State

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Abstract – Risk due to low level of health security is endemic for informal sector workers. The vulnerability of these poor people increases, when they have to pay fully for their medical care with no subsidy or support. A large number of people, especially those below the poverty line (BPL), borrow money or sell assets to pay for the treatment in private hospitals. “Rastriya Swasthya Bima Yojna” announced by the Central Government of India attempts to address this sensitive issue. Government of Haryana has already launched this scheme in all the 21 districts of the State to provide health services to the BPL Families. Smart Card based access is provided to the poor people to take health services from private hospital. The present study discusses the challenges in implementation of the scheme and proposes the measures for its effective outcomes. The obstacles can be overcome by creative thinking and effective use of mobile telephony.

1. INTRODUCTION

The South Asian region contains the largest number of people living in the poverty among developing regions, and this region faces a high burden of disease and under-nutrition associated with poverty. India is the largest country of this region and certainly the health concerns are also high with the huge population. India, received negligible external assistance, unlike other countries, where external assistance proved to be effective in health spendings. India is classified as a “low income” country by the World Bank with a GNI (gross national income) of $450. However, there is a great inequality in the distribution of the wealth in India. with the nation estimated to have a third of the world’s poor. According to a 2005 World Bank estimate, 41.6% of the total Indian population falls below the international poverty line of US$ 1.25 a day (PPP, in nominal terms 21.6 a day in urban areas and 14.3 in rural areas) [1]. Report by the Oxford Poverty and Human Development Initiative (OPHI) states that 8 Indian states have more poor than 26 poorest African nations combined which totals to more than 410 million poor in the poorest African countries [2]-[3]. There is a great inequality in the distribution of the wealth in India and a huge population is below poverty Line (BPL).

In India the workers in the unorganized sector constitute about 93% of the total work force [4]. On one hand, such workers do not have the financial resources to bear the cost of medical treatment. On the other; the public owned health infrastructure leaves a lot to be desired. India stands
compared unfavorably with world levels, even with low income countries, in the capacities of human resources. The number of physicians per 10,000 populations for the world is 10.5, for India it is 7 which is at par with low income countries. For public sector, the figure is nearly 2. Similarly, number of nurses per 10,000 population in India is 8, while it is 33 for the world and 16 for low income countries [5]. There are over 250 medical colleges in the modern system of medicine and over 400 in Indian system of medicine and Homeopathy (ISM&H). The country produces over 25000 doctors annually in modern system of medicine and a similar number of ISM&H practitioners, nurses as well as para professionals [6]. However, the health services for common man are still in a bad shape.

There is a huge gap in the critical health manpower in the government led health services. The gap is much higher in the rural areas, where healthcare services to the poorer segments of population are dependent. A large number of vacant posts of both nurses as well as doctors are generally reported at the primary level in government hospitals. Most of the specialist positions in government hospitals in rural areas are lying vacant as the doctors prefer to work in the Urban area with high career opportunities. The situation at the secondary and tertiary level is somewhat better, as doctors generally reside in urban areas. Health facilities provided by the Government for both poor and rich, but the largest gainers are the wealthier people and the patient satisfaction related to these schemes improved only at lower level facilities, not hospitals.

2. **Rastriya Swasthya Bima Yojna**

Considering the income levels and the Govt aided health facilities, the health insurance is one of the important tools in providing health protection to millions of poor people in India. However, the poor people are unable or unwilling to take up health insurance because of its cost, or lack of perceived benefits. Organizing and administering health insurance, especially in rural area, is also difficult. The “Rastriya Swasthya Bima Yojna (RSBY)” project of Govt of India is a step to tackle this problem and is working on collaborative mode between the central and state governments.

2.1 **Funding Pattern of the Scheme**

1. Contribution by the Government of India: 75% of the estimated annual premium, subject to a maximum of Rs.565 per family per annum. The cost is borne by the Central Government.
2. Contribution by respective state Government: 25% of the annual premium, as well as any additional premium.
3. The beneficiaries pay Rs.30 per annum as registration/renewal fee.
4. The administrative and other related cost of administering the scheme is borne by the respective State Government.
2.2 Implementing Agency
The state Government while formulating the pilot project determine the implementing agency on behalf of the State Government.

2.3 Eligibility
1. Unorganized sector workers belonging to BPL category and their family members (a family unit of five) shall be the beneficiaries under the scheme.
2. It is the responsibility of the implementing agencies to verify the eligibility of the unorganized sector workers and his family members who are proposed to be benefited under the scheme.
3. The beneficiaries are issued smart cards for the purpose of identification.

2.4 Benefits
The beneficiary is eligible for such in patient health care insurance benefits as designed by the respective State Governments based on the requirement of the people/geographical area. However, state Governments are advised to incorporate at least the following minimum benefits in the package/scheme:

(i) The unorganized sector worker and his family (unit of 5) are covered. A family comprise the household head, spouse, and up to three dependent children. Total sum insured is Rs.30,000/- per family per annum on a family floater basis.
(ii) Cashless coverage to all covered ailments.
(iii) Hospitalization expenses, taking care of most common illness with as few exclusions as possible.
(iv) All pre-existing diseases to be covered.
(v) Transportation costs (actual with maximum limit of Rs.100 per visit) with in an overall limit of Rs. 1000/-.

2.5 Formulation of Project
The state Government formulates the projects for providing health insurance benefits, for the workers and their families in the unorganized sectors for a defined geographical area, preferably a district. Following aspects are considered while formulating the project:

(i) There must be a clear defined institution capable of organizing a health insurance programme. It can be an autonomous body, State Government department, a co-operative society or even an NGO. The organization should have the technical skills to understand the concept of health insurance, should be able to design a programme that is technically sound, should have skills to discuss with the community and should have the administrative capacity to organize the programme.
There must be a network of health care providers (public or private). The project should incorporate use of private and all public healthcare providers, including ESI hospitals.

There should be some basic data available regarding the demographic profile of the district.

The cost of the scheme i.e., total premium per year, along with the procedure adopted to arrive at the premium.

The procedure for collecting the registration/renewal fee from the beneficiary should be outlined.

3. Implementation in Haryana State

In Haryana state, the condition of health services are little better through a network of 57 Hospitals (including Hospital of Medical College Rohtak), 90 Community Health Centers, 460 Primary Health Centers, 2438 Sub-Centers, 24 District T.B. Centres, 41 Dispensaries and 3 Trauma Centres. Haryana hosts the Post Graduate Institute of Medical Education and Research at Rohtak as well to two medical colleges at Agroha (Hisar) and Mullana (Ambala). The state Health Department, Haryana is providing health services and trying to raise the health status of its people. The schemes of Health department of Haryana include Telemedicine Programme, School Health Programme, Blindness Control Programme, Janani Surksha Yojana and few more to reach the poorest [7]. The government has been implementing some social security measures for certain occupational groups, but the coverage is at mini scale. Majority of the workers are still not having any social security coverage. Most important insecurity for these workers in unorganized sector is the frequent illness and need for medical care and hospitalization of such workers and their family members. For these low-income people, insurance was never considered to be an option in the past. They were assumed to be too poor to save and pay premium. Hence, the government assumed the responsibility of meeting health care needs of the poor. The implementation of the RSBY is a big step to reach these people, with a strong focus on health services. The network of this project consists of both the Govt and private hospitals at cities and small towns.

4. Implementation Problems

The RSBY is really a big project to reach the poor people. However, there are a number of implementation issues, which are the major show stoppers in the full scale advantages of the scheme. The major problems are outlined below

1. Majority of the hospitals accepting the RSBY cards are in the cities and big towns. There are very few options at the village level.
2. Village people prefer to visit the nearby doctor instead of going to the city for full scale advantage of the facility.
3. Majority of the beneficiaries are not fully aware about the facilities under the RSBY scheme.
4. There is a lack of coordination for the scheme at local level.
5. The insurance coverage is not sufficient to cover the big scale diseases and their effective treatment.
6. Number of patients complain that they are not being treated well under the scheme by respective hospitals.

5. **Proposed Improvements**

Rapid growth of mobile telephony, together with low acceptability of other information and communication technologies (ICTs), have encouraged developing countries to apply mobile telephony in solving certain problems in the health sector which has long established the need for appropriate ICT interventions. A number of projects in developing countries have demonstrated the applications and effectiveness of mHealth in various health areas in resource-poor settings. These projects are related to both the delivery and monitoring of the health services through the mobile networks. The integration of the RSBY to the mobile communication network can prove to be an effective tool in large scale implementation of the scheme. The major improvements, which are proposed through the integration are:

1. Beneficiaries are able to find the available hospitals in the area (offering RSBY services) through the SMS or through a local language call centre.
2. The proposed system can also supports the reporting of health cases and the request for medical professionals’ assistance at remote locations. SMS-based applications for data collection can be used to find the cases of particular epidemic e.g. the case of Flu in the rainy season. As a result, medical data collection can be done easily, within seconds and with minimum data loss directly from the site of the incidence to a central location where data interpretation, analysis or decisions can be made. This kind of data can be specifically used in organizing the special medical camps for these locations.
3. SMS based facility to use the ambulance facilities in the emergency situations with proper records to have effective implementation.
4. SMS / automatic call based alerts for vaccination.
5. SMS / Toll free number based complaint management system to take care of the scheme implementation.
6. SMS/ automatic call based alerts for the follow-up visits of the patients.

6. **Conclusion**

Health Services are the basic need for any nation and highly important in the development. The Rastriya Swasthya Bima Yojna is a big step in providing health services to BPL people. However, there are a number of issues in the practical implementation of the scheme to the masses. The proposed method of integration of the scheme with the mobile phones can be more effective in providing timely information to the beneficiaries and improve the success of the scheme. The model can leverage the benefits of mobile proliferation and contribute maximum to the health services in India.
REFERENCES


Jiah: Healthcare Goes Mobile

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Abstract—One of the primary challenges in providing quality healthcare in developing countries, like India, is the lack of trained medical professionals. This can be compensated by appropriate screening of patients by partially trained health workers. We developed Jiah, a Java based mobile phone application, that can be used to assist and connect health workers and trained medical professionals through a backend Medical Record System (we use OpenMRS [1] at the backend). Jiah is an extension of Sana, a similar application currently available for android phones [2], and is developed to cater to the majority of Java based phones currently available in developing countries. Using XForms [3] for creating our mobile application provides the system users with the flexibility to create a wide variety of forms with ease. We also performed a pilot study using Jiah and present our results from the study.

1. INTRODUCTION

One of the largest challenges that continue to cripple the developing world is lack of trained physicians. Even though there is no scarcity of semi-trained labor force, many health workers in many developing countries are not able to provide satisfactory care because of not having enough proficiency. Developing countries like India also are also weighed down with the load of infectious and chronic diseases that usually have a quite expensive treatment. It is crucial that focus of the solution to the aforementioned problem is shifted towards prevention. Massachusetts Institute of Technology (MIT), USA developed Sana (in Android) to revolutionize healthcare delivery in remote areas through innovative mobile information services that improve patient access to medical specialists for faster, high quality, and more cost effective diagnosis and intervention. However, in Indian context, most of the programmable phones support Symbian OS instead of Android OS, hence the need for developing Jiah in Java. The Android based applications support a different architecture and hence are incompatible with the Symbian system dominant in the Indian mobile market; making it a necessity to make a Symbian based client if we intended to deploy something like Sana into action on a large scale.

2. WHY JIAH—APPLICATION OF THE MOBILE HEALTHCARE CLIENT

One of the primary challenges in providing quality healthcare in developing countries, like India, is the lack of trained medical professionals. A study done by Fortis Escorts Hospital, India shows that lack of physicians has led to poor medical care in rural India [4]. The National Rural Health Mission (NRHM) conducted a study in the rural parts of 4 states of India on the
primary evaluation of service delivery of health facilities which depicts that the implementation of the solutions proposed are far from what they ought to be, however slowly moving in the right direction [5]. Jiah can be effectively put to use in such a system in the screening phase.

For Example, the android counterpart of Jiah- Sana has partnered with Narayana Hrudayalaya, Bangalore, India to use Sana to screen and manage chronic diseases focusing on oral/cervical cancer and cardiovascular diseases. As of July 2011, 6000 people have been screened for oral cancer [6]. However android phones are costlier than Symbian phones and by using Jiah available for a Java phone, a wider deployment can be done at a quicker rate.

The latest World Health Organization (WHO) data claims that every six out of ten deaths in rural India are caused by non-communicable diseases such as cardiovascular diseases and cancer. Also, the data shows that such diseases are on a rise in the developing countries [7]. We believe that Jiah can be best suited to detect such diseases early (by using Jiah in the screening phase) and hence providing better quality healthcare in rural areas.

3. Architecture

The system architecture is divided into the following broad categories:

![Architecture of the Whole System](image)

3.1 OpenMRS

OpenMRS is a community-developed, open source, enterprise electronic medical record system platform. This is the backend database system that would maintain the electronic records for the patients which can be viewed by a doctor using a computer for remote diagnosis. After the installation, we just need to configure OpenMRS for Jiah by installing the Sana Module. The patient data collected by the health worker gets stored on OpenMRS for review by on-duty doctor. Also, the diagnosis and the prescription given by the doctor get stored on this database system.
3.2 SDS Layer

SDS is a middle-layer which helps collect the data the phones uploads piece by piece and then for a given case and submits it to OpenMRS. SDS is also responsible for all SMS interactions which are used for sending back notifications/diagnosis to the phone for a given case. Using the SDS layer, Jiah can download XForms. The completed XForms are again sent to the SDS layer which in turn forwards it to OpenMRS for validation. Also, the diagnosis sent by the doctor gets delivered to the Jiah client using this layer.

![Figure 2: Open MRS Record Visible to Doctor at Remote Location](image)

3.3 Jiah-Mobile Client

Jiah, the client application in the hands of a health worker, offers a mobile tele-health platform for resource poor settings. Jiah in its core is based on JavaRosa [8], an open source platform for mobile devices. Jiah is used for collecting the patient information and then uploading it to OpenMRS. The diagnosis sent by the doctor is also received at the client end for performing the prescribed treatment.

4. Use Case

When the application runs for the first time the user will have to do some changes in the settings according to the server in order to customize the application.

- Select the type of view you want for the form filling.
- Select the language of the forms you are going to use (currently provided are English, Kiswahili, Afrikaans, Espanol, Portuguese), the standard languages available with JavaRosa.
Change the address in the “Form Fetch Server” field to the server’s address from which you want to download the forms.

Change the address in the “Form Submit URL” field to the server’s address to which you want to submit the form data.

1. On the main screen of Jiah, the health worker clicks the download forms button. The form list is grabbed from the server one of which is Malaria form (a form to collect information for potential Malaria patients).
2. The health worker downloads the Malaria form.
3. He then proceeds on to fill the form as follows

   Name                                     Ram Kishore
   Age                                       42 yrs
   Gender                                    Male
   Fever (yes, no) radio button              Yes
   Fever (range)                             101
   Fever (continuous, intermittent)          intermittent

Associated features <check box>

1. Chills (checked)
2. Arthralgia
3. Sweating (checked)
4. Vomiting (checked)
5. Haemoglobinuria (checked)

6. The form is submitted to the server for the doctor to examine. Based on the following captured data, certain decisions can be made:

   Fever continuous: Not Malaria, but probably Typhoid
   Fever intermittent: Probably Malaria
   More associated features: More chances of being Malaria

The doctor examines the form and sends back the result as “Probably Malaria”. The health worker receives notification through the mobile frontend or SMS. He collects blood sample of the patient for further examination.

5. Result and Conclusion

Although Jiah has been tested locally for errors, it is still in beta phase and would require more rounds of testing especially in the field.

Jiah currently provides functionality almost similar to that of its Android counterpart, and can prove to be an effective tool in providing remote diagnosis.
6. Future Work

We are currently working on adding following features to the current application.

1. Implementing image capture and upload feature. Image capture is an essential feature because without image it’s very difficult to make diagnosis and provide treatment.
2. Implementing audio capture and upload feature. Along with image and other information that is captured via forms, audio by the healthcare worker can provide additional information about the patient that is not captured by the images or the form fields.
3. Uploading data via SMS- This feature will prove helpful for providing health support in extremely rural places that still lack GPRS support.

References

Health Sector Reform: The Case for mHealth

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Abstract—Rapid adoption of mobile telephony in rural India has prompted the social sector to exploit mobile communication as a dependable and effective ICT media. Intervention studies and projects in low resource settings of developing countries have underlined multiple roles and effectiveness of mobile communications in the health sector. In particular, the delivery function of public health programs can be improved by using prompts and reminders through SMS and voice calls for the health workers. In the state of Orissa in India, for example, mobile videos were instrumental in improving the quality of counselling among the community health workers. Improvement in quality and timeliness of data can help the health system dynamically manage the delivery and promotion functions. Despite these promises, certain technological and programmatic challenges impede the adoption of mHealth across the health system.

1. Introduction

This paper provides an overview of the key application areas for mobile telephony in health programs, popularly termed as mHealth, especially in primary healthcare in rural India. It also highlights the critical areas that require further research and development in areas where technological and operational challenges systematically impede the health sector taking advantages of mHealth.

Rapid growth of mobile telephony, together with low acceptability of other information and communication technologies (ICTs), have encouraged developing countries to apply mobile telephony in solving certain problems in the health sector which has long established the need for appropriate ICT interventions. In India, Telecom Regulatory Authority of India (TRAI) maintains and publishes data on telephone subscriptions. According to TRAI, India has some 858 million mobile subscribers by the end of July this year, compared to 652 million the previous year. In a country of 1.21 billion people, this annual growth of 32 per cent means 35 per cent teledensity in rural India. Even though this coverage appears to be low, mobile telephony has covered a substantially higher number of rural households. The mobile phone coverage is already comparable to that of popular media like radio and television which have been used for spreading health awareness for many decades now. For many years to come, mobile telephony will remain perhaps the most accessible ICT media in rural India.

2. Application Areas

Most health programs consist of three generic functions – i) delivery that involves the medical practitioners and health workers to conduct diagnosis and provide care, ii) promotion to create awareness among the target audience and help them adopt target healthy behaviours and iii) monitoring and evaluation to improve the delivery and promotion functions.
2.1 Delivery

Delivery quality can be improved by maintaining timeliness, improved coverage and quality of diagnosis and care. Using a computerized database of beneficiaries and services provided to them, the Foundation for Research in Health System (FRHS), a non-governmental organization, was able to generate a list of beneficiaries who did not receive key services in family planning, maternal health and child health. This list helped the health workers and their supervisors to reach out the excluded beneficiaries in an entire district of Patan in Gujarat state in India [1]. This method of tracking individual beneficiaries was subsequently adopted by the state of Tamil Nadu which implemented Pregnancy and Infant Cohort Monitoring System (PICMS), a web-based application to present social, maternity benefit and health data for the pregnant mothers and infants in the state. During 2009, this data was being used to provide the eligible families cash for maternity benefit scheme, though health workers were not using the database for follow-up. The PICMS and FRHS projects encouraged India’s national health ministry to adopt the beneficiary tracking system across the country. An effective beneficiary tracking system generates actionable information for the health workers and supervisors on the due dates for delivery. Besides, mobile data collection and reporting tools can enable the health workers to capture and report beneficiary health data during care giving and confirm the same using an authentication mechanism. This process can allow the health system to ensure maximum coverage by the health programs.

2.2 Promotion

In health promotion, behaviour change communication (BCC) makes the beneficiaries aware of appropriate healthy practices and assists them to steer towards the target behavioural goals. Such communication initiatives have been undertaken for many decades to help smokers quit, increase fruit and vegetable intake, and promote breastfeeding, among others. For a long time, television, radio and print media have dominated the BCC landscape. In developing countries, folk media, songs, drama and theatre (termed as ‘mid-media’) are also used to promote health awareness. The essence of the message promoted by these media channels remains ‘it is good to follow a particular healthy practice’. For example, a television advertisement on polio vaccination conveys ‘it is a must to give your child polio vaccine’. Population Council, a Delhi-based research institute, in a recent study found that among those who did not receive the immunization in the state of Uttar Pradesh, some 12 per cent of beneficiaries were unaware of the place and 10 per cent of the time of immunization [2]. This implies that awareness is necessary but not sufficient to enable the target audience adopt a particular healthy behaviour. In particular, some health practices like breastfeeding and chronic healthcare require an improved level of self-efficacy, defined as ‘the perception about an individual’s ability to perform a promoted behaviour effectively’. A number of experimental
studies have shown that text messaging through SMS, telephonic calls, and other mobile content are effective in providing the target audience with appropriate behavioural facilitators - self-efficacy, social support, availability, quality of care, intention and outcome expectation, among several other important factors. In a sense, mHealth can be used along with interpersonal communication that has been an effective method to impart these traits among the beneficiaries.

There are few examples of field-level implementation of mobile communication in behaviour change in India and other developing countries. During 2008, a team of researchers from the University of California Berkeley developed several short mobile videos to assist the community health workers (CHWs) during advice to the pregnant women in rural communities in the state of Orissa in India. These videos conveyed messages that could potentially persuade the pregnant women to adopt better health practices and to motivate the ASHAs, a CHW engaged to provide counselling and facilitate access to health services, to improve their performance. The four-minute videos had animated actors expressing persuasive dialogue or just giving lectures. The spoken message was in Oriya or Kui languages, locally spoken in the study area. Messages focused on various dangers that pregnant women face such as the dangers of anaemia preventive actions. This video was prepared using multimedia software available in the market before converting the video to a format suitable to play in an easily available phone in rural India (Nokia 3110c). The experiment with seven health workers and their 52 clients resulted into improvement in quality of counselling and client engagement as seen by response by client to the video, health worker and attention level [3]. The mobile video project in Orissa demonstrates the uses of mobile communication both in BCC and delivery.

2.3 Monitoring and evaluation
In the area of program monitoring, the traditional way of using ICT is the data collection and analyses using management information system, known as the Health Management Information System (HMIS). In India, the national rural health program – National Rural Health Mission – has employed the country-wide HMIS, NRHM-HMIS. In NRHM-HMIS, like many other developing countries, data from the rural health facilities is collected and maintained in paper-based formats. In 2007, researchers have found 14 per cent paper-based data in Malawi was discarded because of illegible handwriting, missing decimals, or outliers in the forms [4]. On the other hand, Patnaik, Brunskill and Thies reported error rates of four per cent for electronic forms, five per cent for SMS and less than one per cent for telephonic helpline [5]. It is likely that mobile devices will be gradually used in data collection and reporting for HMIS data. Besides improvement in data quality, data collection using mobile devices allows faster reporting of services delivery to facilitate supervisor checking. This method is similar
to the implementation of PICMS in Tamil Nadu and BTS in Gujarat, except that these projects do not communicate the relevant information directly to the relevant providers through their mobile phones.

3. Achievements and Challenges

Mobile communications like SMS and calls are being used in many public service delivery projects across India by various government departments, as part of their e-Government initiatives. In particular, the states of Gujarat and Chhattisgarh have successfully used SMS to intimate the beneficiaries of the lifting of food supplies by the fair price shops, operating under the Public Distribution System (PDS) [6]. In 2009, Bihar implemented the SMS Based Monitoring System to facilitate government officers to send daily reports through SMS on the key achievements in ten most important government schemes [7]. These initiatives underline that the public officers and beneficiaries at the community level can adopt mobile communications.

Despite these achievements in various social and public sectors, progress in mHealth in India is rather limited. Most mHealth projects in India started their journey around 2008. Despite the promises with data collection using mobile devices, the experiments are yet to conclusively establish the acceptance and feasibility of this method for large scale deployment. In particular, a sizeable number of ASHAs in northern India have shown their limited acceptance of data collection using SMS and mobile forms. This process needs further research and development. Few projects in India have contributed to the development of a fuller understanding of behaviour change processes facilitated by mobile communication.

Challenges in the adoption of mHealth are multiple. There are technological challenges in input, display, transfer and processing of data in English and Indic languages (especially for people with different levels of literacy), security and integration with medical devices. Traditional health research institutions lack capacity to develop mHealth interventions that require multidisciplinary approaches of behavioural, medical, business and computer sciences. The public health departments in central and state governments also lack capacity to design and implement mHealth on the ground.

4. Opportunities

- Technological research and development are required in multiple areas, especially in medical devices, network, security, data, language, among other areas. Both open and commercial innovations can add value to the advancement of mHealth. Rural areas will require low cost, rugged and portable medical devices, some of which were successfully tested by the students, professionals,
application developers and R&D firms in the developed countries. For example, students in a number of American and European universities have developed mobile phone-based applications to detect malaria [8]. Such devices are highly advantageous for health workers in developing countries to rapidly test the suspected cases of malaria and take preventive action.

- Studies using social science methods are necessary, especially in the areas of health behavior communication, cost-effectiveness of intervention and usability studies. Technologists have expressed the reservations in undertaking pilots. In mHealth areas, however, a pilot can be a method to design the intervention for the target audience.
- Experimentation with business models in various health areas and providers can provide further insights into the sustainability of mHealth initiatives.

5. Conclusion

Intervention studies and projects in developing countries have demonstrated the applications and effectiveness of mHealth in various health areas in resource-poor settings. In India, more such interventions are necessary to design better mHealth programs for the concerned communities. Indigenous research and development in key technology areas, as well as technology transfer from other countries, will help in solving technological shortcomings. Investments in the form of aid, grant and capital can spur research and innovation in this area. mHealth in its current form is exploiting the second generation mobile telephony which will continue to dominate rural health for several years to come. Third generation of mobile telecommunication has been witnessing lukewarm response both in rural and urban areas. As mobile broadband makes its inroad in rural areas, mHealth can add more value to the health sector.

References


mHealth in Botswana: Driven by Partnerships, Customization and Local Empowerment—Lessons Learned on Implementation, Stakeholders, and Sustainability in Resource-limited Settings

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Botswana’s public health care system is burdened with the second highest HIV prevalence and the fourth highest tuberculosis prevalence in the world. It suffers from a lack of resources, both human and technological. The system is reliant on hard-copy records, and the flow of information can be slow and unreliable. These factors create a barrier to patients’ access to treatment, especially specialized care. Over the past three years, the Botswana-UPenn Partnership (BUP) has implemented and developed several mHealth initiatives to address these issues, including mobile telemedicine and point-of-care information and decision support systems using smartphones with the University of Botswana School of Medicine (UBSOM) residency programs. Observed benefits of BUP’s mHealth program include improved quality of care, empowerment of clinicians, and a reduction of referrals and associated costs.

This abstract assesses the non-technological factors, both positive and negative, that have brought the BUP mHealth program to its current state. Quantitative and qualitative data will be drawn from the following projects: Mobile Oral Telemedicine, Mobile Teleradiology, Mobile Cervical Cancer Screening, Mobile Teledermatology, and Mobile Telementoring with UBSOM residents. Challenges include unreliable external equipment and information technology infrastructure, theft or accidental damage of mobile devices, unexpected software update needs for mobile phones in the field, and initial local negative perceptions of the technology. Lessons learned relate to short and long term solutions to these challenges, customizing mHealth strategies for existing relationships and workflows, establishing local ownership, and facilitating communication between public and private partners. Mobile technology has proven to be effective for obtaining
remote specialist consultations and providing medical reference material to resident physicians. The technology must be paired with motivated users and integrated within diverse practice settings if it is to be scalable and sustainable. These lessons learned can assist in development of similar mHealth programs in other countries.
Demo of CycleTel™: Expanding Access to Family Planning through Mobile Phones

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Abstract — Significance/Background: The Standard Days Method® (SDM) of family planning has been introduced in public and private health facilities in select states in India. SDM identifies a fixed fertile window in a woman’s cycle, and has typically been used with CycleBeads®, a color-coded set of beads women use to track their cycles. As a knowledge-based family planning method, SDM does not require clinical visits and can be offered directly to consumers. CycleTel™ is a means of offering SDM to women via mobile phones. The interactive service goes beyond unidirectional provision of health information, and requires two-way communication between software and user to track menstrual cycles and inform users of their fertile window.

Main Question: Is it appropriate and feasible to offer SDM via SMS? What steps are necessary to test, develop and deploy an interactive mHealth service in India?

Methodology: IRH is following a research-to-practice approach to develop and implement CycleTel: conducting proof of concept testing, undergoing technology development, identifying deployment partnerships, testing the technology and preparing for systematic scale-up in India and elsewhere.

Results: Proof-of-concept testing, technology and partner development, a phased launch approach, and rigorous M&E, have proven CycleTel to be a feasible, effective innovation for offering SDM to consumers. Users understand how to operate the service and use the service successfully. Key findings from the study thus far include: (a) mHealth interventions require significant formative research prior to technology development; (b) strong technology partnerships facilitate rapid development/deployment; (c) bulk of time/effort is spent coordinating deployment of infrastructure, and developing/implementing plans for evaluation, scale up and sustainability. CycleTel is a well-researched case study of an mHealth service that has documented the “mHealth development process” from concept to deployment.
mAgriculture
Kenyan Farmer’s Use of Cell Phones: 
Calling Preferred over SMS

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Abstract — The increasing penetration of mobile phones in Kenya has led to a rise in SMS-based information dissemination services. Such services have potential to reduce information asymmetry and empower farmers with weather, market, and other relevant information. However, a number of factors other than the sheer existence of the phone need to be in place for such potential to be realized. Data was gathered using 117 questionnaires administered in 6 Kenyan provinces, as well as 12 focus groups conducted in 4 locations around Kenya. Findings revealed that Kenyan cell phone users still prefer to call rather than SMS (short message service) due to the ease of calling and little practice using SMS. SMS-based information providers should, therefore, consider adding a voice-based product to their services in order to expand their market reach.

Keywords: mobiles; SMS; agriculture; trust; information and communication technology; Kenya

1. INTRODUCTION

The successful uptake of the mobile phone throughout the developing world has significantly impacted economic development initiatives. Governments, private corporations, and non-profit organizations are all examining the possibilities for using this new means of communicating with citizens.

From 1999 to 2009, mobile phone penetration rose from 12 per cent of the global population to nearly 76 per cent (ITU 2011). By allowing communication at distance, mobile phones allow users to overcome limits of time and space. The first SMS (Short Message Service) was sent on 3 December 1992 (The Times of India 2002). By 2008, over 4 trillion SMS text messages were being sent around the globe (ITU Internet Report 2006). Today, SMS has become a huge commercial industry worth over $81 billion globally as of 2006 (ITU Internet Report 2006). SMS is widely used to spread information from individual to individual. However, especially in the developing world, organizations and governments are increasingly using SMS to reach out to rural populations that could not previously be contacted. But the SMS habit is not yet deep-seated in East Africa as compared to other regions and countries (Hellstrom 2010). One possible reason for this, given by Hellstrom (2010), is the per-second pricing scheme in East Africa. The calling price system can give more value for money than using SMS, assuming that the call is very brief. Literacy, although high in Kenya at 85.1 per cent (IndexMundi 2011), is also another potential barrier to SMS use.

The penetration of mobile service in Kenya has reached 64.2 per 100 inhabitants (Communication Commission of Kenya 2011). At the end of June 2011, Kenya had 25.27 million mobile subscribers (CCK 2011). Kenya’s high mobile penetration rate and subscription number indicates that mobile technology is a promising business opportunity, and an indispensible tool for empowering the country’s citizens, especially its rural poor.
The majority of Kenyans (78.4 per cent) live in rural areas (CountrySTAT Kenya 2009). These rural communities rely largely on agriculture as their main means of sustenance. There is a growing and enthusiastic discussion between policymakers, development practitioners, and researchers about the role of mobile phones and SMS in economic and agricultural development. By reducing communication costs, mobile phones may assist farmers in identifying potential buyers or facilitating the purchase of inputs in rural areas (Aker 2011).

Mobile phones may also help with agricultural extension outreach. Lawal-Adebowale and Akeredolu-Ale (2010) collected data in southwest Nigeria to understand perceptions of ICT usage for agricultural development by three stakeholder groups – agricultural researchers, extension agents, and rural farmers. One finding was that the farmers had a high perception that the “linkages with the researchers and extension agents can be effectively achieved through the mobile phone if the device is owned by all” (Lawal-Adebowale & Akeredolu-Ale 2010). However, this study did not specify whether farmers thought they could link to researchers and extension agents through voice calls, SMS, or another mobile-based service.

A working paper by Mittal et al. (2010) found that the quality of information, its timeliness, and trustworthiness are the three important features that can enable farmers to use mobile-enabled agricultural information effectively. The Indian study found that while mobiles are currently being used in ways that contribute to farm productivity, they are not being used to their full potential. Infrastructure and farmers’ capacity to use the information need to be improved in order to realize the full information dissemination potential of the mobile phone. This study sought to see if findings like Mittal et al. (2010) also hold true in the Kenyan context. A flood of new development initiatives using SMS to send information to rural farmers has emerged in Kenya. This study hopes to better understand the use of SMS by Kenyan farmers in order to enhance such new emerging initiatives.

Some of the new agricultural SMS-based service providers include MFarm Ltd., which provides access to localized, current data on markets and weather as well as a network for buying and selling farming goods through SMS (MFarm Kenya 2011). The Kenya Agricultural Commodity Exchange (KACE) has an SMS-based information service, SokoniSMS, for farmers to receive market prices in Kenya (KACE Kenya 2011). GSMA recently announced its MFarmer Initiative Fund, supported by a grant from the Bill & Melinda Gates Foundation. The purpose of the Fund is to “encourage mobile communications service providers (in partnership with other public and private sector agriculture organisations) to use mobile communications to provide information and advisory services to smallholder farmers in developing countries who are living on under US$2 per day” (GSM 2011). WMO/Sony Ericsson/Airtel have partnered to start “Weather Info For All,” an initiative that will send weather forecasts to farmers via SMS (World News Inc. 2011).
It is important to understand how farmers are using their phones to ensure that new development initiatives are properly addressing farmer’s concerns and have utility for farmers. The findings of this study will allow development organizations, mobile application developers, and those in the M4D sector to have a more accurate understanding of Kenyan farmers’ current use of mobile phones, especially related to SMS.

1.1 Study Objectives
In order to fulfil the purpose indicated above, the evaluation sought to answer the following core questions:

- What are typical usage patterns of mobile phones in general, that may influence the use of SMS as a channel for agricultural information?
- How do farmers use SMS? (Basic demographic profile of users)
- Do farmers trust SMS?
- What are barriers to the use of SMS?

2. Data and Survey Methodology
This article is based on fieldwork carried out in Kenya from January 2011 to July 2011. The evaluation was comprised of two parts. First, twelve semi-structured focus groups were conducted in 4 locations in Kenya by a moderator and observed by an objective researcher. Three of the groups were in Kiambu, Central Province, three in Chavakali, Kakamega, Western Province, three in Murungaru, Kinangop, Rift Valley Province, and three in Engineer, Kinangop, Rift Valley Province with the following composition:

<table>
<thead>
<tr>
<th>Women 30-55 years</th>
<th>Men 30-55 years</th>
<th>Youth, mixed gender 20-29 years</th>
</tr>
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<tr>
<td>3-10 participants</td>
<td>3-10 participants</td>
<td>3-10 participants</td>
</tr>
</tbody>
</table>

Focus group participants were selected for the focus groups using a two-page recruitment survey, conducted in households in the regions specified above. The 90-minute focus group discussions, conducted in Swahili, were based on the discussion guide. The focus groups allowed for engaging dialogue and produced data and insights that would be less accessible without the interactions found in a group setting.

Second, 117 questionnaires were administered in six different provinces (approximately 20 from each province: Rift Valley, Coast, Nyanza, Western, Eastern, and Central). The three-page questionnaire was comprised of yes-or-no, multiple-choice, short-answer, and prioritization questions. Use of the questionnaire allowed for more geographically diverse data to be collected.

The questionnaire data was coded and analysed using SPSS software. The focus group discussions were video-recorded, translated, and
transcribed. Interview transcripts were then analysed and manually coded for any recurring patterns and themes that emerged.

3. FINDINGS

This study found that voice is more used and understood than text messaging. Rural households use phones for personal, community, and work/farm-related activities.

3.1 Voice Versus SMS

Most farmers, regardless of age, sex, or location, tend to prefer making calls to using SMS. Farmers cited that they often prefer calling to SMS because calls consume less money to get a final response (there is much back and forth with SMS). “SMS is cumbersome and takes a lot of time and energy so it is easier to call” (Kakamega man). Reasons for using the different services as stated by farmers in both locations are listed in Figure 1 below.

Rural households use phones for personal, community, and work/farm-related communications (Figure 2). Most discussions centred on family/friends and work on the farm, with weather being the third topic most often discussed on the phone. James Goodman (2005) found that in South Africa and Tanzania, mobile phones are used mostly in strong links (family and friends), but also in weak links with others outside the community, including businessmen. Larger multi-country studies by Miller et al. (2005) and Souter et al. (2005) also show that the telephone is used extensively
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to maintain social networks (Molony 2008). This data from Kenya further strengthens these findings, showing that already established relationships (friends and family) are both the primary content of phone calls/SMS and also the primary recipients of such calls/SMSs. Farm work (talking to middle men, farm help, produce buyers) is the second most common topic of phone calls/SMSs.

Figure 3 (below) shows the frequency that farmers called others versus the frequency that they send SMS. It appears that a large number of farmers (n=23) call between 11-50 times a week while only sending 0 – 5 SMS a week. The farmers (n=4) that communicated the most through phone calls (called others over 50 times a week) also communicated the most through SMS (over 50 times a week).

Fig. 3: Comparison of the Frequency of Calls Made to the Frequency of SMS sent
Of those that participated in the study, most farmers (n=33) send and receive between 6 – 10 SMS messages a week (Figure 4). There is a higher frequency of farmers who do not send or receive many SMS (between 0 – 5 SMS/week) compared to those who send over 50 SMS/week.
Of those that participated in the study, most call and are called between 11 - 50 times a week (n=37) (Figure 5). There is a higher frequency of people who call and receive calls over 50 times/week than there are who do not call or receive more than 5 calls a week.

This data shows that more farmers use phone calls to relay information on their mobile rather than SMS. There are several reasons for such use of phone calling rather than SMS that are discussed in sections 3.2 through 3.4 below.

3.2 Trust
Trust is an important factor to take into account when discussing the electronic exchange of information communicated between two people, especially two strangers. In a study on the determinants of IT adoption and use, Khodamoradi and Abedi (2011) found that an important factor influencing the adaptation of any new technology is an individual’s perception of the trust-worthiness of the technology. While trust is a difficult variable to measure, it is an important factor to keep in mind when trying to understand technology use and uptake. Information dissemination through abstract communication channels like SMS is dependent upon the trust relations that are established between the actors involved in these exchanges. For example, during our focus groups, farmers displayed doubt and wariness when receiving SMS from strangers.

Moderator: What do you often do when you receive messages from strangers?

“I often ignore them.”
“I won’t do anything.”

Moderator: Why?
“Because I don’t know the sender.”
“I have to make sure that it is safe before I send the message.”
“I have to take my time before replying.”
“I often prefer for people to call me especially if they don’t know me because I don’t know who you are and I can’t understand why you are sending it to me.”

It therefore appears, that if farmers are to use any information that is disseminated through the phone, they must be aware of the source, and secure in the integrity of the sender and information. If the farmer is unsure of the content’s validity or sender’s motives, many farmers stated that they would either delete the SMS or ignore it. Additional considerations for farmers when deciding how to use information contained in an SMS were whether or not the SMS requires action, and the nature of the information contained in the SMS. Further investigation should be done to better understand precisely how these different factors affect the farmers’ reactions.

3.3 Information Desired and Used
Most farmers who participated in the study use the predicted amount of rain to determine how much to grow and when to grow their crops (Figure 6).
The second most important determinant for how much to grow and when to grow was the price of seeds. The other variables (price the crop will sell for, difficulty to grow the crop, other) did not appear to be as important in the farmers’ decisions. This seems to indicate that an accurate rainfall forecast is the most important information to convey to farmers as they decide how much to grown and when to grow their crops.

![Fig. 6: Comparison of Information Used by Farmers to Determine when to Grow Crops and how Much to Grow](image)

The method in which this information is disseminated should be considered carefully. Although farmers expressed an interest in a wide range of agricultural topics, some individuals stated they would not believe a message with advice about farming, e.g. about medicine to administer to sick cows.

“I would not take them seriously because with farming I should be practically showed what to do… For example, Christopher who keeps livestock, how do you expect that you send him a message to go and buy medicine and just give it to his cattle just like that. Who would trust that?”

Others stated that usage of any information relayed via SMS would depend on the content of the message. And still others said that if the agricultural information were true, it would not be relayed through SMS, but rather other, more public channels such as radio.

“As far as I am concerned when it comes to climate change we don’t use SMS because we are so many farmers or people in the country who do cultivation. So if these people are genuine, they would not send SMS they would just put it on air [radio, newspapers, TV, etc.].
So while it does appear that farmers are eager for information related to farming, SMS may not be the ideal medium through which to convey the agricultural information. Farmers seem more likely to use the information if it is disseminated through radio, newspaper, TV, or in-person.

### 3.4 Users’ Cell Phone Skill Level

An interesting observation was made during a number of the focus groups (Youth Kakamega, Youth Murungaru, Women Engineer) that also warrants further study. Some of the farmers were observed copying down the phone number of an SMS sender on a slip of paper. It can be imagined that copying down a phone number then entering it in order to send an SMS reply leaves much greater room for human error than simply using the “reply to sender” option within the phone. When queried as to why they did not use the reply option, it became known that the farmers did not know about the reply option. This reveals a lack of full understanding about basic SMS use and may also indicate why farmers believe SMS to be so cumbersome to use.

### 4. Recommendations

At 1 Kenyan Shilling per SMS (as of Nov. 15, 2011), sending SMS is still the cheapest option to communicate with farmers. SMS allows details to be recorded and referred to later and can be helpful to remind farmers about meetings and products. Nevertheless, SMS is no panacea for farmers’ information problems. There can be many obstacles to overcome when attempting to communicate with farmers via SMS. When using SMS, Agricultural Information Service Providers should keep the following points in mind:

- Keep messages simple and to the point. Farmers will be more likely to respond when the message is straightforward.
- Allow SMS recipients the option of opting out of the bulk SMS services.
- Include organizational contact details within the SMS.
- Farmers will be wary about any advice given via SMS unless the sender is known and/or well-established (like government or large NGOs).
- It may be helpful to initially call or visit the farmer to introduce and explain how their number was received and what future SMS content will be about.
- State whether or not the response SMS farmers send will be free or cost money and if the response SMS will cost, how much.

There are not yet many mobile applications or services that build on voice in Kenya. The current SMS-based agricultural services being provided in Kenya can be further enhanced by ensuring that there is also at least one voice-based aspect or product offered. By accommodating for clients who are not as proficient or comfortable using SMS, a larger target market
will be reached and slower acceptors of the technology may become more familiar with SMS over time.

One example that might be borrowed for Kenya is an Interactive Voice Response (IVR) system, Avaaj Otalo, which provides three avenues for Indian farmers to engage with agricultural information (MobileActive 2011). When farmers call the hotline number, they can either listen to archived information, announcements, or participate in the question-answer forum. Another example is IFFCO Kisan Sanchar Limited (IKSL), a voice-based agricultural information service to empower rural farmers in India (GSMA 2011). After purchasing a special SIM card, users receive free, recorded voice messages each day covering local and national agricultural topics.

Regular tech workshops in the communities should also be part of the organizational activity plan. Continuously teaching and training the rural communities will help contribute to faster uptake and use of SMS technology.

Finally, it is important to remember that SMS may not be the ideal medium through which to convey information. Farmers seem more likely to use information if it is disseminated through radio, newspaper, TV, or in-person. Carefully assess the reasons for using SMS and consider other media/ICT options or a combination of ICTs, to make the dissemination more effective.

5. Acknowledgement

This research project was sponsored by the Fulbright Commission (IEE). The author would like to thank MFarm Ltd. (K), especially Linda Kwamboka for support and assistance during the field study in Kinangop. I am grateful to Dr. Sevilla and the faculty and students at Strathmore University for helping with the questionnaire survey across the country, and to Irene Njoroge and Leonida Mutuku for their assistance with the focus group data. I appreciate the help of the Voice of the Farmer (Synovate - Kenya) staff for their assistance with the Kakamega and Kiambu field studies. Finally, thank you to the “iHub”, Daraja Mbili Primary School, and Kiarie for allowing use of their facilities throughout the project.

References


Kenyan Farmer’s Use of Cell Phones: Calling Preferred over SMS


[7] initiative_fund.htm


Effectiveness of Mobile Phones as Communication Media to the Poultry Farm Owners in Bangladesh

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Abstract—The study was undertaken to ascertain the effectiveness of mobile phones to the poultry farm owners in Bangladesh. Data were collected during 10 April to 16 June 2011 from 103 farm owners. The farmers were asked to indicate the effectiveness of 15 communication media against a five-point Likert scale on whether the effectiveness was very high, high, moderately high, little, or very little with the weightages of 5, 4, 3, 2, and 1 respectively. Communication media effectiveness index (CMEI) was computed for each of the medium, which could vary from 103 to 515. Effectiveness was the highest in case farmers’ mobile contact feed dealers followed by mobile contact to Veterinary Surgeon, mobile contact to Field Assistant, mobile contact to dispensary for medicine, and farmers’ personal contact to Field Assistants. This clearly indicates that mobile phones are now very effective communication media compared to other conventional, print and electronic media.

Keywords: Effectiveness, Mobile Phone, Communication, Media, Poultry, farm, Owners

1. INTRODUCTION

With a population of about 165 million in an area of 147,570 sq km, Bangladesh is one of the most populous developing countries (BBS, 2010). Over the last 15 years, Bangladesh has made important economic progress with a GDP growth rate averaging 5 percent per year. The incidence of poverty has steadily declined, and considerable progress has been made toward achieving the Millinium Development Goals (MDG). More than 74 million people are mobile subscribers (Mukta, Karim and Kashem, 2010). People use their mobile phones in many purposes other than agricultural purposes. Barman (2009) conducted a study on the use of mobile phone by the farmers in receiving agricultural information from the input dealers. He found that more half (54 per cent) of the farmers had medium use of mobile phone in receiving agricultural information from the input dealers. A recent study conducted by Kashem (2009) shows that among 12 communication media used by the farmers in receiving technological information mobile phone ranked 5th in position. However, no research study has been reported to determine the extent of effectiveness of the mobile phones as communication media. Hence, the present study was undertaken to ascertain the effectiveness of mobile phones as communication media to the poultry farm owners in Bangladesh.

2. METHODOLOGY

Thousands of poultry farm owners at present are producing poultry birds to help meet up country’s poultry meat requirements at the Sripur Upazila (lowest administrative unit) under Gazipur district of Bangladesh. The
The population for this study was the poultry farm owners of Sripur Upazila who frequently use the mobile phones, along with other available contact media, for collecting information from different communication sources. Data were collected during 10 April to 16 June 2011 from 103 poultry farm owners, out of 550. The sampled poultry farmers were asked to indicate the extent of effectiveness of 15 selected communication media in a five-point Likert scale. They were asked whether the effectiveness of the medium was very high, high, moderately high, little, or very little; the weights assigned to the responses were 5, 4, 3, 2, and 1 respectively. Communication media effective index (CMEI) was computed for each of the medium by multiplying by 5, 4, 3, 2, and 1 for very high, high, moderately high, little, or very little responses against each of the medium. The CMEI could thus vary from 103 to 515, 103 indicating the effectiveness of the medium as very little effective while 515 indicating the effectiveness of the medium as very high.

### 3. FINDINGS

The findings indicate that the mobile contact by the poultry farm owners to poultry feed dealers ranked 1st (CMEI=358) followed by mobile contact to Veterinary Surgeon (CMEI=330), mobile contact to Field Assistant (CMEI=324), mobile contact to dispensary for medicine (CMEI=312), and personal face to face contact of the poultry farm owners to the Field Assistants (CMEI=297). This clearly indicates that mobile phones are now very effective communication media compared to other conventional, print and electronic media. The CMEIs have been computed for all the 15 communication media. The findings have presented in Table 3. For clearer understanding the findings have been diagrammatically depicted in Figure 4.
## Table 3: Effectiveness of Communication Media as Perceived by the Poultry Farm Owners in Bang

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Communication Media</th>
<th>Extent of effectiveness</th>
<th>CMEI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Very high</td>
<td>High</td>
</tr>
<tr>
<td>1.</td>
<td>Television</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>2.</td>
<td>Radio</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Newspaper</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>4.</td>
<td>Development magazine</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Leaflets and bulletins on poultry production published by BLRI</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>Leaflets on poultry production published by DLS</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>Bulletins on poultry production published by the DLS</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>8.</td>
<td>Personal face to face contact to Field Assistant</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>9.</td>
<td>Mobile contact to Field Assistant</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>10.</td>
<td>Mobile contact to ULO</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>11.</td>
<td>Mobile contact to VS</td>
<td>14</td>
<td>34</td>
</tr>
<tr>
<td>12.</td>
<td>Mobile contact to poultry feed dealers</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>13.</td>
<td>Mobile contact to BLRI for technical information</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>14.</td>
<td>Mobile contact to doctor for health problem</td>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td>15.</td>
<td>Mobile contact to dispensary for medicine</td>
<td>10</td>
<td>27</td>
</tr>
</tbody>
</table>
4. Conclusion

The findings demonstrate that the effectiveness of communication media as perceived by the poultry farm owners of Sripur Upazila was the highest in respect of mobile contact to poultry feed dealers followed by mobile contact to Veterinary Surgeon, mobile contact to Field Assistants, mobile contact to dispensary for medicine, and personal face to face contact to Field Assistants. These findings clearly indicate the importance mobile phones to the poultry farm owners regarding their effective contact with the available communication media. The policy makers and administrators may, therefore, give proper importance and attention the communication media where the effectiveness is relatively higher. In order to achieve higher output from the communication sources/media it would be wise to render practical need-based training to them to increase their trustworthiness, credibility and reliability so that poultry farm owners can get more benefits and subsequently produce more quality poultry birds.

References


Mobile Communication as a Viable Tool for Agriculture and Rural Development

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Abstract— A research study was undertaken at Doddaballapur taluk of Bangalore Rural District of Karnataka, India during 2010-11. The respondents were 40 farmers and 40 scientists selected using simple random technique. Findings reported that forty per cent of farmers and forty five per cent of Scientist had favourable attitude towards MMS network. Agricultural technologies like crop management (52.50%), marketing (80.00%), Horticultural technologies like tissue culture (55.00%), Veterinary technologies like dairy (70.00%), and other agricultural technologies like weather information (77.50%) were more relevant technologies disseminated through MMS network. The major constraints faced by farmers and scientists were lack of practical exposure and clarification are difficult if any doubt arises.

Keywords: Attitude, Constraints, ICT, Mobile phone, MMS Network.

1. INTRODUCTION

Mobile phone is becoming one of the basic necessities now days for all types of users irrespective of the age group. A mobile phone is an Information Communication Technology (ICT) tool used for two-way communication. Further, the mobile phone has become more relevant in the modern days and agriculture is one of the sectors benefited from it. The sector of agriculture benefits more from mobile phones in the developing countries as it saves money, time and offers accurate advantage for farmers. The mobile phone technology is being used creatively in poor countries to help to reduce poverty, particularly in remote rural areas. Mobile phones are already being used in rural areas as a tool for financial transactions by swapping airtime for goods and services. Mobile phones provide a new platform through which rural communities will be able to access government information and services, using text, data, and audio browsing techniques.

2. MATERIAL AND METHODS

The study was conducted in Doddaballapura of Bangalore Rural District, Karnataka state, India during 2010-11. Purposively Doddaballapura was selected because number of farmers using MMS network was high compare to other locations. The respondents for the study were 40 farmers from Doddaballapura using MMS network and 40 scientists involved in dissemination of technologies through MMS network from Indian Farmers Fertilizers Cooperatives Limited (IFFCO) Kissan Sanchar Limited (IKSL) and Indian Institute of Horticultural Research (IIHR). The required data were collected from respondents using structured pretested questionnaire and schedules. The data collected were analyzed and tabulated using the statistical tools like percentage, mean and standard deviation, correlation, multiple linear regressions and rank.
3. RESULTS AND DISCUSSION

3.1 Attitude of farmers and Scientists towards MMS network

The results observed from the Table 1 that both farmers (40.00%) and Scientists (45.00%) had favourable attitude about MMS network. Among farmers 32.50 per cent had most favourable attitude followed by 27.50 per cent had least favourable attitude. Among scientists 30.00 per cent had least favourable attitude followed by 25.00 per cent had most favourable attitude towards MMS network (Table 2). The reason may be the farmers are getting timely and accurate messages from MMS network based on their needs and the scientists are also sending the correct messages to the needy farmers and obtaining feed back from them about efficiency of MMS network.

Table 1: Attitude of Farmers and Scientists towards MMS Network

<table>
<thead>
<tr>
<th>Category</th>
<th>Farmers</th>
<th></th>
<th>Scientists</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Per cent</td>
<td>Frequency</td>
<td>Per cent</td>
</tr>
<tr>
<td>Least favourable</td>
<td>11</td>
<td>27.50</td>
<td>12</td>
<td>30.00</td>
</tr>
<tr>
<td>Favourable</td>
<td>16</td>
<td>40.00</td>
<td>18</td>
<td>45.00</td>
</tr>
<tr>
<td>Most favourable</td>
<td>13</td>
<td>32.50</td>
<td>10</td>
<td>25.00</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100.00</td>
<td>40</td>
<td>100.00</td>
</tr>
</tbody>
</table>

3.2 Type of Agricultural Technologies Disseminated through MMS Network

The results in Table 2 indicated the type of technologies disseminated through MMS Network. The technologies are sub divided in to four categories. (1) Agricultural technologies: The technologies like Crop production (50.00%), Crop management (52.50%) and Marketing (80.00%) were more relevant technologies disseminated through MMS Network. Whereas technologies like Input management (55.00%), Crop protection (50.00%), Soil and water management (65.00%) and Harvest and Post harvest (70.00%) are relevant technologies disseminated through MMS Network. The reason may be in agriculture now a day’s marketing of produce is very important. However, the other aspects like crop production and crop management etc. are also equally important. The results were in consonance with the results of studies conducted by (Salleh et al., 2009 and Basavaraj, 2010). (2) Horticultural technologies: The technologies like Tissue culture technique (55.00%), Floriculture (50.00) and Food processing (42.50%) were more relevant technologies disseminated through MMS Network. Whereas technologies like Nursery preparation (57.50%), Ornamental gardening (62.50%), Essential oil production (52.50%), Cold storage (47.50%) and Preservation (57.50%) were relevant technologies disseminated through MMS Network. The reason may be because of advanced technologies in recent years like tissue culture to protect germ plasm for later use. Further, food processing technology to increase the self life and get better price for the produce in the market. Other technologies like nursery preparation, gardening,
essential oil production, cold storage and preservation are also important technologies disseminated through MMS network. (3) Veterinary technologies: The technologies like Dairy (70.00%), Poultry (52.50%) and Sheep and Goat (52.50%) were more relevant technologies disseminated through MMS Network. Whereas technologies like Piggery (45.00%), Rabbit (57.50%) and Fishery (70.00%) were also disseminated through MMS Network. The reason may be in the study area most of the farmers were taken dairy, poultry, sheep and goat rearing as a subsidiary activities. (4) Other agriculture related technologies: The technology like Weather information (77.50%) was more relevant technologies disseminated through MMS Network. Whereas Government schemes and programmes (55.00%) were relevant technologies disseminated through MMS Network. Due to change in vagaries of monsoon the information about weather is more relevant. Further, Government schemes and programmes are help in improving livelihood of farmers. The results were in consonance with the result of studies conducted by (Parab et al., 2009).

Table 2: Type of Agricultural Technologies Disseminated through MMS Network

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Technologies</th>
<th>Relevancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Most relevant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Freq.</td>
</tr>
<tr>
<td>1</td>
<td>Agricultural Technologies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Input management</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Crop production</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Crop protection</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Soil and water management</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Crop management</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Harvest and Post harvest</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Marketing</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>Horticultural Technologies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nursery preparation</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Tissue culture technique</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Floriculture</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Ornamental gardening</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Essential oil production</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Cold storage</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Preservation</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Food processing</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Any other(Specify)</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Veterinary Technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dairy</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Poultry</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Sheep and Goat</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Piggery</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Rabbit</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fishery</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Any other(Specify)</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Other Agriculture Related Technologies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Government Schemes and Programmes</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Weather information</td>
<td>31</td>
</tr>
</tbody>
</table>
3.3 Constraints Faced by Farmers and Scientists to use MMS Network

The results of the table 3 indicated that among all the constraints faced by farmers to use MMS network, Clarification is difficult if any doubt arises (Rank I), Lack of practical exposure (Rank II), Lack of locally relevant information (Rank III), were the major constraints faced by farm youth to use MMS network. The reason may be because of mobile message which are reaching to farm youth have created some doubts, sometimes very difficult to understand, there is no practical experience of technologies and also the information disseminated through them were not relevant to the situation. Among all the constraints noticed by scientists while implementing MMS network, Lack of practical exposure (Rank I), Lack of locally relevant information (Rank II), clarification is difficult if any doubt arises (Rank III), were the major constraints. The reason may be that scientists think there is a need for practical exposure of farm youth, some time farm youth clarify their doubts not all the times and also there is a need for taking feedback from the farm youth for improving the system.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Farmers Score</th>
<th>Per cent</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Clarification is difficult if any doubt arises</td>
<td>101</td>
<td>84.16</td>
</tr>
<tr>
<td>2.</td>
<td>Lack of practical exposure</td>
<td>99</td>
<td>82.50</td>
</tr>
<tr>
<td>3.</td>
<td>Lack of locally relevant information</td>
<td>97</td>
<td>80.83</td>
</tr>
<tr>
<td>4.</td>
<td>Network availability</td>
<td>70</td>
<td>58.33</td>
</tr>
<tr>
<td>5.</td>
<td>Cost involvement is more</td>
<td>64</td>
<td>53.33</td>
</tr>
<tr>
<td>6.</td>
<td>Human element is missing</td>
<td>63</td>
<td>52.50</td>
</tr>
<tr>
<td>7.</td>
<td>Electricity problems</td>
<td>62</td>
<td>51.66</td>
</tr>
<tr>
<td>8.</td>
<td>Health problems</td>
<td>57</td>
<td>47.50</td>
</tr>
<tr>
<td>9.</td>
<td>Fear to adopt technology</td>
<td>54</td>
<td>45.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Scientists Score</th>
<th>Per cent</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Lack of practical exposure</td>
<td>84</td>
<td>70.00</td>
</tr>
<tr>
<td>2.</td>
<td>Lack of locally relevant information</td>
<td>83</td>
<td>69.16</td>
</tr>
<tr>
<td>3.</td>
<td>Clarification is difficult if any doubt arises</td>
<td>82</td>
<td>68.33</td>
</tr>
<tr>
<td>4.</td>
<td>Network availability</td>
<td>80</td>
<td>66.66</td>
</tr>
<tr>
<td>5.</td>
<td>Fear to adopt technology</td>
<td>63</td>
<td>52.50</td>
</tr>
<tr>
<td>6.</td>
<td>Human element is missing</td>
<td>62</td>
<td>51.66</td>
</tr>
<tr>
<td>7.</td>
<td>Cost involvement is more</td>
<td>60</td>
<td>50.00</td>
</tr>
<tr>
<td>8.</td>
<td>Health problems</td>
<td>59</td>
<td>49.16</td>
</tr>
<tr>
<td>9.</td>
<td>Electricity problems</td>
<td>54</td>
<td>45.00</td>
</tr>
</tbody>
</table>

4. Conclusion

The concept of MMS network is a new approach in transfer of technology. Therefore, the implementing agencies need to keep this in view for dissemination of technologies through MMS network. However, majority of the big (large) farmers using MMS network. Hence, there is a need for extension activities to motivate small farmers for using MMS network.
REFERENCES


From Texting Strangers to Texting the PhilRice Text Centre

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Abstract—Filipino youth exodus from agriculture has been very apparent in recent decades. Most of them are being groomed for jobs abroad such as becoming nurses and seafarers. This is indeed a sad reality for a country whose economy is largely dependent on agriculture. This paper argues the youth can still contribute to the agriculture sector by performing some infomediary roles. They can be mobilised to pass on rice farming information to farmers. In this paper, we look into how mobile phones are situated in the lives of the rural Filipino youth. From there, we analyse how the PhilRice Text Centre could effectively mobilise the Filipino youth to facilitate transfer of information on new rice farming technologies to their farmer parents. Practical recommendations on mobilising the youth as infomediaries are subsequently forwarded in this paper.

1. INTRODUCTION

The PhilRice Text Centre (PTC) serves as a platform for farmers to send in any query they might have on rice farming in the Philippines. PhilRice is the country’s lead agency for rice research and development. From 2006 to 2009, PTC responded to more than 70,000 text messages (PhilRice, 2010).

To optimise PTC, however, there remain some social issues that need to be addressed such as computer illiteracy, no money to purchase prepaid credit and unaware that PTC exists (Manalo et al 2010). Hence it was recommended that interventions should focus on mobilising infomediaries. Infomediaries are people who access new technologies, in this case mobile phones, for those who do not have or do not know how to use them. The same research noted farmers wanted their children to serve as their infomediaries.

There might be some wisdom to the recommendation owing to the rather unmatched texting behaviour of Filipinos. A survey across Southeast Asia noted young Filipinos, 15-24 years old, are heavy text users (Villamor, 2010). Interestingly, the same survey noted mobile phone users in the Philippines, the youth included, could not sleep well when their mobile phones were not within easy reach.

Another thing that should be highlighted is that in the Philippines, there is a massive number of young individuals, 15-24 years old. In 2010, the National Youth Commission pegged their number at roughly around 21 million. Not mobilising this resource can mean a big loss for the Philippine agriculture sector.
This paper will present how mobile phones are situated in the lives of some farmers’ children belonging to the youth category in the province of Aurora. Our overarching aim is to come up with recommendations in engaging the youth in the initiatives of the PhilRice Text Centre, which is a major step towards serving as infomediaries for their parents.

2. Methodology

This research was conducted in the lowland and upland communities of Aurora province in the Philippines. The province has 21,250 hectares devoted for rice farming (www.aurora.ph 2011). Hence, innovative extension modalities are needed to augment provincial production, and to contribute to the rice self-sufficiency bid of the Philippine government.

Thirty-three farmers’ children, 13-20 years old, participated in the study. Most participants in the uplands were members of ethnic minorities, particularly Igorot and Ilongot. There were 7-10 participants per barangay. All of them were in high school.

All participants were asked to sign informed consent letters prior to participating in this study. The methods used to understand their activity patterns and mobile phone usage were time transect and individual interviews. Time transect is a visual representation, usually a pie chart, of how one spends his or her time (Beazley & Ennew, 2006). This method provided useful inputs as to how much time in a week farmers’ children spend on using their mobile phones. The individual interviews were conducted to probe on mobile phone expenditures and overall attitude of the research participants towards mobile phones.

Separate schedules for data collection for every barangay were observed. Participants were at first gathered in one location for a group discussion and exercise. The process was recorded using digital recorder and camcorder except for participants in barangay Kadayacan in Aurora who refused to be filmed. In their case, the process was recorded using digital recorder alone. Notes and photos, with permission from the participants, were likewise taken during data collection. Recorded proceedings were listened to. The individual interviews took place in the respective schools of the participants. Each participant, particularly in their individual interviews, was assigned an identification code for confidentiality purposes. Likewise, careful attention was observed in writing this manuscript to avoid putting any detail that may identify a participant. Salient points were transcribed and grouped into different data categories or themes. The different categories earlier arrived at were reduced to fewer categories for a more meaningful presentation of data. Data gathered were analysed thematically.

3. Results and Discussion

Two points merit attention that reinforce the youth’s potential to serve as infomediaries for their parents. These are the readiness to spend for prepaid credits and their rather addictive behaviour to mobile phones.
Regarding the first point, on average, weekly expenditure on purchasing prepaid credits for mobile phones among participants across locations fell between USD 0.50-1.50 or roughly 10-20% of their weekly allowances. It can be said, however, that lowland dwellers spent more than those from the upland. Across sites, participants took advantage of the promos of mobile phone companies in the Philippines which gave them unlimited texting and calling values from USD 0.25.

One should note that mobile phone expenditure of the participants, USD 0.50-1.50, is already equivalent to 1-2 kg of rice in the Philippines. Additionally, it may be difficult to reconcile with the fact that many Filipinos live on less than USD 1.35 daily (ADB 2008). To make it more obvious, a significant portion of their weekly allowance was spent on purchasing prepaid credits. Given that they did not have an income, they either asked money from their parents or somebody such as their boyfriend to purchase prepaid credits for them:

“My boyfriend sometimes purchases prepaid credits for me... thrice a week...”

The youth’s willingness to purchase prepaid credits despite coming from poor families would illustrate how important interaction with people within their social circles is to them. To a great extent, this strongly relates to the second point that we would like to raise in this section: mobile phone addiction. The texting habits of the participants in Aurora would very easily explain how the Philippines has become the texting capital of the world. Sending more than 200 text messages daily was common to the point of them getting scolded by their parents. Texting was a partner to any of their activities such as eating and doing household chores.

“[I text] daily... often, up to 7 hours... ’til midnight or even until dawn until 3am”

“I text all night until I run out of prepaid credit, usually until 1am...”

For many, texting was a way to fill in gaps such as during weekends when they were already doing their household chores, and not in the mood to do anything. Texting was seen as the best way to kill time. Many of the participants enjoyed listening to their music collections in their mobile phones. Many of them sent SMS to strangers. Often they just key in random numbers, if somebody replies, then they start to text with that person. Some text the numbers written on the walls or in public toilets or those written on the seats of public utility vehicles.

“I usually text in the afternoon when I’m done with all my tasks [homework and household chores]. I have textmates. Some were referred to me by my friends. Some are total strangers... some, I just got from my friend’s phone...”

In this study, there was a group found to have used mobile phones to create and maintain a social network. This makes sense considering
that they did not have decent access to the Internet. The group was called “Clanmates”. As of the time of data collection, Clanmates had 40 members who text one another about random topics such as love and relationships. The Clan leader said under no circumstances will they let their members become “palamuti” (decoration), which, in their vernacular refers to members who just receive messages but do not participate in discussions.

“We will not let our members become “palamuti”... we will text relentlessly with them until they open up to all of us... ”

In this section, we have established how inseparable mobile phones are to the young individuals in Aurora. Mobile phones have been intricately connected to their social beings to the point that they have been addicted to using it. Hence, these circumstances led us to think of ways on how this seemingly unproductive behaviour can be transformed to something useful. The next section offers some ways by which the youth can be engaged to perform some infomediary roles for their parents or for other farmers in general.

4. Recommendations

This section aims to forward recommendations on how the participants can move from texting with strangers to texting with the PhilRice Text Centre. The recommendations are as follows:

Information campaign to promote initiatives that will directly target the Filipino youth. One way to do this is to go to schools and start promoting initiatives of PTC. Disseminate information materials popularising the PTC number, what it can do, and what can the youth do for their parents or for other farmers in general.

PTC should innovate. There are several innovations that should be explored by PTC. First, PTC might want to explore setting up a “farming buddy” initiative where the youth can feel they have someone to turn to for some advice whenever they are on field.

Second, PTC can have some sort of “Clanmates”. This is similar to how “clanmates” work, but this time PTC will serve as a platform where farmers’ children can just discuss anything about rice production and agriculture as an option when they enter the university. This can also serve as a platform for them to pass on questions from their parents. This also means that text centre agents should have some mechanisms to effectively reach out to the youth. One way to do this, is to go beyond the usual “question-answer-end” conversation method. The PTC should create a real “textmate” environment. This can even open avenues for organising some rice camps for the youth.

Third, PTC can also have some texting “promos”. It can give away new rice varieties or the rice variety suited for the location of the winner. Other
innovative promos may take off from this. Lastly, the text centre agents might want to consider looking at how to effectively deal with members of cultural minorities. It has been observed in this research that those coming from ethnic minorities were relatively more shy than those belonging to any of the majority groups. Are there any considerations that need to be taken into account in dealing with them? How could texting be more engaging?

5. Conclusion

The role of the youth in agricultural extension system is not well-pronounced, if not ignored, in the Philippines. This may be due to observations that indeed they are massively veering away from agriculture-related jobs. Mobilising the youth, through mobile phones, to serve as infomediaries for their parents might open avenues for their indirect active participation in the country’s agricultural landscape. Moreover, this will even help increase the usability of many online platforms by agencies such as PhilRice to promote new rice farming technologies. At present, PhilRice has increasingly been using social media such as Facebook and Twitter. Hence, it makes sense to explore how different platforms can complement each other to best serve the Filipino farmers.

References

SMS One: Social Networking of Rural India with Mobile SMS Newsletter Innovation

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Abstract—The economic and social mobilization of the rural people largely depends on the progress of rural sectors. Inadequate information delivery leads to knowledge poverty for which rural areas are lagging far in contrast with urban, leading to development divide. This paper discusses a case SMSOne, is one such initiative whose major objective is to provide rural household social connectivity. Its' service motto talks about “from zero to zeros” using mobile sms services for social and economic enlistment of rural people as its objectives. SMSOne by promoting social entrepreneurship is looking and collaborating social hearted individuals and NGOs to penetrate into rural fabric of society. The real empowerment to rural society contribution through rural youth was based on a sustainable business model moving towards socio economic development of people. This explorative case study shows how people’s participation contributes towards socio economic development of rural society. Rural areas development is seen without any external contribution towards it. The technology intervention is contributing towards collaboration among themselves for their own development with information dissemination.

1. BACKGROUND

The economic and social mobilization of the rural people in India depends largely on the progress of rural sectors. Their social and economic uplift is the major step for any country has to prosper since about 70 percent of population lives in those regions. Governments are struggling to improve rural infrastructure due to inaccessible terrain, lack of funds and other reasons. The solution for this is very clear: let the creative entrepreneurs come out with innovative business models and start providing the services to rural areas. The other one is the active participation by private enterprises by extending their market into rural areas. To cross the barriers of development divide, path-breaking initiatives are started coming up in different parts of rural India. But the acceptance of such services may depend on affordability, local-language, understandability, authenticity and result oriented. SMSOne provide a solution for it when rural India catching with telecom revolution. The only linkage for their social connectivity is provided by mobile phone communication based applications. The ownership lye with the rural people and the reach and contribution to affordable services based on local needs and demands are clearly going to be fulfilled.

There is something driving people of urban and rural to adopt mobiles into their personal life. Building creative initiatives should fit well into that something to provide services. SMSOne is one such initiative, which is catering to the social component under non-income poverty by building
rural youth as social entrepreneurs. The rural youth work for rural people for their socio economic development. It is an excellent idea, as local people know better about their local situations rather by others to implement such initiatives. A decent living as per Indian rural standards for entrepreneurs got achieved through SMSOne. The spread of mobile-based services depends on two major issues: one is the signal coverage and other is the adoption of services by people. First is infrastructure issue and second depends on quality, localised, affordability and other issues.

The efforts of Telecom Authority of India (TRAI) contributed to around about 584.32 million users across India by 31st March 2010 [1], out of which 190.88 million is coming from rural segment. Now about 32.67% of total wireless subscribers are now in rural areas. The overall tele-density reached to 52.74 and rural areas reached to 24.29. This high growth rate was achieved with the service providers’ ability to offer innovative and low tariff plans. This growth has led to rapid expansion of the subscriber base. On average about 12 million subscribers per month contributing to mobile diffusion.

2. REVIEWING OF LITERATURE

To help the under served people of rural India, the observation is that ICT-based solutions if designed for rural use, will significantly benefit the village economy as per Krithi Ramamritham. Getting information that is relevant to their daily needs, including social and political capitals make rural people can participate inclusively in their own socio economic development. Mobile phones can have a stark effect on economic growth in rural areas as per present academic research outcomes. The improvement of daily activities by eliminating the unwanted travel, taking major decisions is the major achievements are observed in individual as a case. But till date, there is no sufficient evidence to state that ICT technology intervention brings development. As per Page and Szuba’s definition of empowerment, a multi-dimensional social process that helps an individual and community gain control over their lives. Connectivity through mobiles is not an issue but rural consumer ready to utilise services to get connected. Nokia-Common wealth telecommunication (CTO) research study has shown that people in remote villages, to deploy and employ mobile phones for economic growth, by enhancing employment and socio economic well being [2]. The economic evidence due to mobile intervention in agriculture including fisheries was observed [3,4,5].

Especially mobile technology is making it to happen as a personal entity as it occupy in their pockets along with money and keys [6]. It provides an opportunity to participate in society and gain incites into day-to-day activities with information and knowledge. The potential to improve the quality of life can achieve with ICTs intervention by providing access to information, services and goods at ease [7]. Robert Jenson study on fisherman concluded that by addition of mobile phones reduced price
distribution and improved fisherman’s profits and consumer benefit. Fishing supply chain and farmers benefits [8,9], agriculture extension and farming studies [3,5,10] and rural livelihood studies [4] show that mobile usage brought a positive immediate change concerned, but long term impact is yet to be measured. Most of the project studies show immediate outcomes rather long term impact on rural society at large till date. Look at similar projects operating outside India such as DrumNet project in Kenya targeted farmers to enhance productivity, access to markets and increase in business. In Sri Lanka a project by Govi Gnana Seva provide accurate market prices. In Ghana a project by CSIR providing services to entrepreneurs to facilitate linkage among suppliers and consumers. These projects are similar but there is an external intervention involved but in SMSOne nothing as such shows its innovative business model.

3. SMS ONE INITIATIVE

Social capital considered has two types – bonding and bridging. Bonding connected with small group with strong ties within while bridging is associated with loose ties across communities [11]. The mobile sms connectivity contributing to bridging capital as it connects across various communities across villages and the community newsletter could contribute to the bonding capital by creating a virtual social space. It is a ‘basic service’ provider with ‘local short-message-service (sms) community newsletter’ [12] contributed by the community and for the community. This newsletter offers a platform to people come together to share useful and genuine social information as location specific medium to open communication channels between villages nearby. This small beginning moved towards an organisation tree with steps:

- An Unemployed Youth Form A ‘Mobile Sms Community’ With 1000 Mobile Users
- He/She Serves With Local News And Updates At Free Of Charge
- He/She Earns Sufficient Income Through The Commercial Sms

At present, SMSOne have more than 680 communities consisting of 680,000 subscribers across rural India, and most of which are in rural, semi-urban and backward areas. The social fabric of local area forms the stakeholders of it. The concept of sending sms message to a person, who is an earning member of a family, is the key to reach information to the family. The services are categorized into – governance, business and social services. The advertisement or commercial charges are fixed based on the importance of the service. For instance, political messages carry higher rate compared to local news such as doctor availability at a particular point of time. The ‘basic services’ such as updates about crop pricing or news of a seed or fertilizer delivery to a specific town nearby can eliminate unnecessary travel costs and time for farmers. Similarly, the piped water supply timing to village is
really good information, as people won’t miss water even released in odd hours. Such services create a real benefit even it may look simple and trivial but quite effective. The location specific newsletter initiative is happening for the first time in rural India. Most of the mobile owners are voice users till now. But, the generation next, who are under 35 years of age, are with high literacy percentage can able to read English and can operate mobiles. They form at least one member in any family to take care of these services, which become essential for such sms based initiative.

3.1 Business model of SMS One
The key of any business model is to keep users stick to it and want to expand its user base through its performance based services. The advertisement revenue growth leads to benefit entrepreneurs and in turn motivate them to serve their community. The advertisers are happy as their message reaches the target consumers in time. Success achieved through this business model is ‘rural socio information dissemination model’. Every Panchayat Samiti Ghan (basic governing unit at village level) has about 15000 populations and out of which at least 3000 mobile connections are in operation. Getting early adopters is not a big task based on the services performance at no price. Community leader of SMSOne as seen in organisational chart (Figure-1) is critical since he bind consumers, providers and advertisers.

3.2 Financial Model of SMS One
The financial model is based on advertisement sms contribution towards SMSOne sustainability and hence targeted like political, cooperatives, commercial, social and governmental sectors. Based on activities the demand been assessed. Putting together the number of ‘promotional sms’ to be despatched to consumers will arrive at 380 per annum and coming out about one per a day on average. At present the rate of advertisement sms consumption by consumers is not going to disturb them much. The total revenue from all sectors taken together comes to about Rs.1,170,000.00 (about 26,000 USD) per annum. It is enough for better life of the stakeholders. The revenue share of each entrepreneur comes out to be around Rs.6000 to
Rs.10000 per month (about 120 to 220 USD). The ratio of social to promotional sms known as ‘survival sms ratio’; SMSOne on average it is at 3/4 or 0.75 as per observed average recording.

3.3 Working Model

The steps followed to deliver information through sms newsletter with language options (English, vernacular English & vernacular) are:

- Step-1: Collection of local social information by community leader
- Step-2: Compilation of information into meaningful sms by community leader
- Step-3: Edit and transmits the sms newsletter by editor at central cell

4. Conclusion

A primary field study conducted to know the benefits have found that a good percentage of age groups below 35 who are literate are basic beneficiaries. The member is literate and owner of mobile connection will lead services reach to his family. The implications are the young entrepreneurs have better life, consumers are fed with need-based information and commercial interests of groups are fulfilled. This empowerment reduces political exploitation of youth and show positive direction towards own development without any external intervention. Mobile services become an extension tool for the benefit of rural India.

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Agriculture Information, Rural Development and Mobile Learning for Improved Livelihoods in Uganda: Lessons South Western Uganda

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Abstract—ICT is a fundamental component for access to timely and relevant agricultural information a key to improved small-scale agricultural production and increased linkage to remunerative markets, thus leading to improved food security, rural livelihoods and growth of national economies. This paper discusses the dynamics of using mobile phones one of the ICT components among smallholder farmers which links them to markets and other various stakeholders involved in agricultural development. The paper highlights strengths, weaknesses and threats while analyzing insights associated with use of phones as a mobile learning tool than other ICTs including: internet, televisions and radios. Research findings showed that use of phones was appreciated (48.1%) by rural communities as easy, timely, fast and convenient way to communicate and get prompt answers to relevant questions/information. Farmers were more eager about the use of phones compared to other ICTS. Recently, information on marketing is on higher demand (100%). However, there is generally more use of phones by male (59.3%) than female (40.7%) farmers, yet more female (27.2%) farmers request information on NRM and agriculture as compared to male farmers (18.8%). Despite some obvious challenges, the use of phone in the study area was accompanied by positive outcomes and opened opportunities such as emergence of strong collective action among social groups for joint marketing. Based on these results the increased mobile penetration rate in the country provides opportunities for actors along commodity chain to look into possibilities of using mobile applications to boost agricultural development that accounts for 29.4 % of the county’s GDP.

Keywords: Agricultural Information, Mobile Phone, Rural Information
Abstract—Food is the prime necessity of the life without which the existence of human being may be perhaps dubious. India has the complacency of reaching from food importing one to the self-sufficiency country. Kudos to the Green Revolution which has made India a proud Nation on the global stage. But the issue of burgeoning population, rapid industrialization, urbanisation has still put pressure on Indian agriculture to increase the production and productivity per se. In this context, the role of ICTs is becoming imminent in general and mobiles in particular. It is a known fact that the whole world was influenced much by the Information Technology as much as possible. As per the ITU World telecommunications (ICT indicators data base), 2011: The global internet usage has raised from 26% to 35% from 2006 to 2011 respectively, with 5.9 billion mobile subscribers, global penetration has reached 87%. Mobile broadband subscription has grown 45% annually over the last 4 years. Every aspect of the society is a common user of the Information Technology be it administration, medicine, engineering, agriculture etc.

The increasing penetration of mobile phones and mobile-enabled information services to farming community can reduce information asymmetry and complement the role of extension services. The reason being that use of mobiles saves time and effort, it cuts steps from the extension process, it offers instant international reach, continuity in availability. Various efforts are being made at all levels to maximize the utility of mobiles in agriculture viz., ICARs Kisan Call Centres, Kisan Mobile Advisory, IFFCO-Kisan Sanchar Limited, Fisher Friend program provided by Qual communication, Reuters market light, aAQUA(All Most All Questions Answered), ITCs e-Choupal, region specific initiatives of SAUs, other private initiatives, so on and so far. No doubt mobiles have reduced the distance between farmers and extension officials at various levels. India which has more than 6 Lakh villages and with nearly 1 lakh extension workers the mobiles have really been acting as the catalysts to transfer agricultural information to the needy one by SMS alerts, Toll Free Call Centres, Mobile advisory etc., but the impact of mobiles as a mode of providing information for farming purposes would depend on how effectively the mobile network links farmers to address their location specific problems, market information and policy initiatives by the Government, ICAR, SAUs, private agencies and also the extension functionaries.
mEmpowerment
Cyberspace—The New Women Frontier for Mobile Communications

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Abstract—Social networking and participatory media represent the new frontier in transcending the traditional boundaries of communications. The research is performed in context of a funded project—‘Redefining Women in IT’, which used virtual and social networks such as Facebook, LinkedIn and other Web 2.0 technologies to support and facilitate mentoring, coaching, networking and building partnerships between the University of Northampton, Partner Schools in the area and leading IT organizations to address gender imbalance in Computing and IT. The paper describes reflections on the power of social networks in connecting diverse and distributed groups into a community of shared interests, providing opportunities for forging connections with external partners, virtual mentoring, advancing career visions and development. The research, which is a work in progress, further, seeks to investigate how these communications between women could be evolved to include global partners to support mobility, learning and work opportunities and collaboration.

1. INTRODUCTION

Social networking is no longer an option. It’s part of how we live our lives. Participatory media and social networking applications such as Facebook and LinkedIn, Web 2.0 tools and cyber infrastructure provide remarkable opportunities for communication and networking for professional development, developing business partnerships and a platform for social and collaborative learning.

Worldwide many studies have shown the number of women choosing to study and work in the respective industries is low in both computing [4] and Engineering (only 9% of UK engineering professional are women (IET 2010)). Figures from Engineering UK (2010) show the UK lags behind the rest of Europe for the percentage of females students obtaining first degrees in Mathematics/Computer Science (UK [27%] compared with Europe [32%], and Engineering (UK [15%]), compared with Europe [20%]). According to a recent report [1] on lifelong learning policy in Europe, gender imbalance is especially pronounced in engineering (19% female graduates) and computing (24%). The gender specific tail-off in academics is further reflected in the decline in recruitment and retention of declining female computing workforce [1].

Research suggests that special interventions and practices, contribute to ways and means of encouraging young people, especially women in scientific and technical studies as well as ensuring the long-term recruitment in respective fields.
2. BACKGROUND TO PROJECT

The project, ‘Redefining Women in IT’, funded by the University of Northampton, addressed gender imbalance in Computing and IT using four major strands - developing partnerships with leading IT organisations, mentoring, coaching and networking. Women being the focus of the project, partnerships were sought to be developed between the undergraduate and postgraduate computing students at the University - the key stakeholders in the project, girls aged 11-13 in the local partner secondary schools and professional women in Computing and IT.

The cascade model of mentoring was used, where University students after being mentored by professional women to provide personal development and career guidance, in turn mentored school girls about subject choices and career options through planned activities. The planned activities in the project included employability and career workshops and speed mentoring with professionals for computing students, cascade mentoring and structured interactions from computing students to school girls, University students running and supporting career and widening participation events at local schools and University.

The strength of these partnerships meant participants were exposed to a wide range of professionals who lent their combined experience, contacts and networks in delivering project objectives.

3. SOCIAL VIRTUAL NETWORKS

Two major challenges were faced at the start of the project. First challenge was the diverse and distributed nature of its project participants that included female computing students at the University, female students in local partner schools and Female Computing and IT professionals and Second challenge was that the communication boundaries between the female computing students were defined by the year groups and subject pathways. It was deemed essential to find a pragmatic and effective solution to connect project stakeholders as well as to create a community of shared interests between the female computing students at the University.

The popular social networks, Face book and LinkedIn, offered the pragmatic solution to facilitate communication and disseminating outcomes from planned activities to all connected with the project. A limited Face book group – Computing Women in Northampton was created that was setup, managed, populated and administered by the computing Students at the University (Figure 1)
Tina McGarvey,

“I have finally got some date for a trip to Research Machines - the dates are as follows: 23rd May, 26th May or 30th May. Please let me know the preferred date and if you want to come as soon as possible as we need to book the date and the transport. RM will also need details of everyone coming for health and safety.”

Fig. 1

4. Community of Shared Interests

The student engagement with Facebook provided the necessary fillip, bonding and co-operation between computing students resulting in a project team with ownership and responsibility towards project deliverables. According to Lucy Hunt, System Analyst, Unison and a member of BCS Women group, “...what is also great to see on this project is how students from different stages on their courses are now talking and working together - it is a great way to develop a support network within the university. I hope that it is giving them some “real life experiences” for running projects that they learn from and can put on their CV. Also for them to start experiencing what doing these roles professionally might entail ...”

The building of virtual community also provided a forum to students to share information, post views and informal feedback on planned activities. This feedback was useful in tailoring the delivery of planned workshops, which not only improved attendance and engagement at these events but made these activities more meaningful and relevant to their career needs. It provided an easy way to get an announcement out to a number of people in a private group without building up an extensive email distribution list.

Lucy Hunt said, “...Rashmi and Catherine are open and flexible and listen to what the students want and need - while balancing the needs of project planning and reporting ..."
5. **Virtual Mentoring**

At the beginning of the project, leading IT organizations, such as Cisco Systems, Microsoft PFE Team, Dell Systems and Women Networks such as e-Skills UK, UKRC (UK Resource Center), BCS Women Group, were contacted for project sponsorship in terms of support with role models and mentors. Understanding the time and distance constraints for mentoring on the project, virtual mentoring was considered the feasible method that offered flexibility in regards to time and place independence, with primary mode of communication between mentor and mentee through the use of email and virtual collaboration tools such as Google chat and Skype.

To create a positive relationship between mentor and mentee [3], a speed mentoring event was organized to meet face-to-face with professional women, which not only gave a name to the face but also helped to establish expectations, reviewing professional and personal goals and objectives, exploring different career pathways, improving and building on their professional skills as well as building up their network of contacts and employers for when they leave university for what the communication might bring to them.

6. **Knowledge Exchange**

The Face book group was considered an extension to face to face meeting. Understanding the casual nature of social networks such as Face book, it was considered imperative to limit its membership by invitation to all including external project partners. The professional connections structured communications on the Face book group for disseminating information on planned activities and events, external to project, job and volunteering opportunities and career consultations.

Web 2.0 Tools such as blogs and other collaboration applications like Google Wave, a live and shared space on the web, were used to discuss, chat and collaborate on the project. Outcomes from all events - planned activities, external events, employability workshops, were chronicled and blogged by computing students for wider dissemination.

A website development is under progress to showcase and share project outcomes and its impact with the wider community, link in with existing women networks, nationally and internationally, project stakeholders to provide the continuity of communication and dialogues initiated within the context of the project to the associated research in the future.

7. **Evaluation**

The potential of virtual social networks has been felt in terms of a unified community of shared interests, increased communication, shared ideas and bonding between project participants. The computing students have gained in confidence in addressing their career requirements and feel supported through this virtual community.
While the use of Facebook offered a platform for information dissemination, with interactions being in context of the project, the promptness of response for postings that expected actions were sometimes delayed or missing. It is been felt that when using social networks for professional exchanges, the communication protocols should be well established and understood.

The speed mentoring was an enjoyable event for all involved, with professional women who participated the event introducing their colleagues and organizational networks to the project, student engagement with virtual mentoring was not very visible.

It is believed that a series of face-to-face structured mentoring interactions would be necessary before benefits and value of virtual networking could be realised both in the short term, but also in the longer term as their careers progress. Based on post-event feedback, the outcomes from mentoring school girls are positive, with website, developed for the project, providing the much needed continuity, communication and collaboration with schools in future planning of events.

8. INTERNATIONAL PARTNERS
The Facebook group has enabled connections to international communities, such as, YWIC (Young Women in Computing) group from New Mexico City. These connections offer motivation, sharing best practices for outreach and community engagement and mobility through funded interventions. Invitations have also been made through BCS Women group for representation from its international branches.

9. CONCLUSIONS AND FUTURE DIRECTIONS
As education becomes borderless and mobility essential for furthering personal development and career prospects, It is envisaged that the model and communications between women that are established as part of the project using virtual social networks could be extended and connected internationally to academic institutions and virtual professional networks. These could be used for enhancing inter-cultural understanding and, support structured interactions in terms of training sessions and remote learning and employability on an increasingly international labour market.

This model could be evolved for creating communities of shared interests for women in India. In urban India, professional and technically savvy women could mobilise these networks to extend representation from non-working women, i.e., ‘house wives’, engage schools and connect through NGO infrastructures to volunteer time and resources for supporting women in rural areas through education and supporting cottage industries.

Progress and growth is all about networking with like-minded individuals to create awareness and contribute to the wider community.
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Mobile Communication for Sustainable Development: Change and Challenges in South Asia

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Abstract—Developing countries and international development agencies have begun to formulate steps to incorporate telecommunications policies into their mainstream economic policies to guide sustainable development. National mobile strategies focusing on m-governance, m-business, m-education and telemedicine involve the use of mobile communications technologies to benefit communities within and across countries and regions. This paper will focus on the use of mobile communications technologies by communities, the change due to access to these technologies and the socio-economic impact of mobile media on people’s lives in South Asia. It will also look at the challenges before the governments of developing countries in tackling a series of socio-political, techno-economic and moral-ethical questions in building mobile communications policies for development and bridging the digital divide in South Asia.

1. Introduction

Information and communication technologies (ICTs) are playing a vital role in connecting communities in national, regional and global development. ICT is being applied to fight poverty, promote economic growth and support development efforts in the developing world. Most of these efforts are based on the international communication policy debates which emphasize that creating digital opportunities is not something that happens after addressing ‘core’ development challenges; it is a key component of addressing those challenges in the 21st century (G8, 2002). Nevertheless, there are roughly one billion people in about 800,000 villages in the developing countries without any kind of connection to communication technologies (United Nations, 2006). The growth of ICTs has been driven by the forces of globalization and privatization on the one hand and integration of telecommunication and information technology on the other; some of these effects have been experienced in the developing world. Meanwhile, the developing countries continue to experience the digital divide as the benefits of ICTs continue to reach only some.

Over the past decade, developing countries and international development agencies have begun to formulate steps to incorporate telecommunications policies into their mainstream economic policies to bridge the digital divide and guide development efforts. National mobile strategies focusing on m-governance, m-business, m-education and telemedicine involve the use of mobile communications technologies to benefit communities within and across countries and regions. This paper will focus on the use of mobile communications technologies by communities, the change due to access to these technologies and the socio-economic
impact of mobile media on people’s lives in South Asia. It will also look at the challenges before the governments of developing countries in tackling a series of socio-political, techno-economic and moral-ethical questions in building mobile communications policies for development and bridging the digital divide in South Asia.

2. MOBILE COMMUNICATION AND DIGITAL DIVIDE

The ITU sponsored Maitland Commission Report published in 1984 drew attention to the extreme inequalities of telephone access between rich and poor nations and argued that investment in telecommunications was not to be seen as luxury service for corporates and elites, but as an essential service that directly leads to economic growth. Telecommunication reforms were reinforced by Structural Adjustment Programmes (SAP) of the World Bank in India and in several other developing countries such as Brazil, Kenya, Ghana and Chile. While the teledensity in India was 11 percent in 2006, China had a teledensity of 29 percent. Rural teledensity in India stood at a meagre 2 percent compared with urban teledensity of 31 percent (Singh, 2006). Despite the pace of reforms, teledensity in the rural areas is still very low leading to a big divide between urban and rural areas. The fixed teledensity in 2006 in India (4.58), Pakistan (4.16) and Sri Lanka (9.50) continues to be lower than the mobile teledensity of 8.82 in India, 25.22 in Pakistan and 27.1 in Sri Lanka. Most of the growth in teledensity in these countries is due to the growth in urban mobile teledensity. Although mobile phones are diffusing rapidly, fast, data-capable third generation mobile networks are less common in low-income countries.

After two decades of policy reforms in telecommunications, the ITU in its development communication initiative acknowledged that 942 million people living in the world’s developed economies enjoy five times better access to fixed and mobile phone services, nine times better access to internet services and own 13 times more PCs than 85 percent of the world’s population living in low and lower-middle income countries. While there has been some improvement over the last decade, in bridging the gap between the information ‘haves’ and ‘have-nots’, they fail to paint a true picture for many rural communities who are still often unserved by any form of ICT (ITU Connect the World, 16 June 2005, http://www.itu.int/newsroom/press_releases/2005/07.html).

3. MOBILE COMMUNICATION FOR DEVELOPMENT (M4D)

The twenty-first century has witnessed major changes in the media landscape. Digital technologies and advances in media such as the Internet, have driven the pace of development. As the Internet audience continues to grow worldwide, along with technologies such as mobile phones and broadband, these new media will continue to impact development (Leckner and Facht, 2010). The mobile phone which is spreading at a remarkable rate across the developed and developing world is the focus of
attention many public and private development initiatives. More research that explores mobile technologies which are employed deliberately for development purposes - in a more specific, economic and social sense - is needed (Donner and Tellez, 2008). This paper highlights some social and economic benefits that have accrued from the use of mobile phones in the developing world.

Over the past 25 years, developing countries have considerably increased ICT access, especially for telephone services. Developing countries have accounted for more than 60 per cent of the world’s telephones lines (fixed and mobile) in 2005, up from less than 20 per cent in 1980. During this period, population increased by half and real GDP more than doubled in these countries- while the number of telephone subscribers rose 28-fold (World Bank, 2006: 5). Between 2000 and the end of 2005, telephone access is estimated to have tripled from 129 in 2000 reaching almost 400 subscribers per 1,000 people in 2005. Despite rapid growth in the developing countries, mobile phones are 29 times more prevalent and land lines 21 times more prevalent in high income countries than low income countries.

Most of the recent growth has involved mobile phones which now outnumber fixed ones. Mobile phones have an especially dramatic impact in developing countries - substituting for scarce fixed connections, increasing mobility, reducing transaction costs, broadening trade networks, and facilitating searches for employment and new markets. Mobile telephones provide market links for farmers and entrepreneurs and are mainly used for communication and information services. “Much of the voice traffic over the cell phones is commerce directed. Access to agricultural market prices, access to agricultural trade information, facilitation of remittances from foreign workers, information on work opportunities using the phone can reduce substantial travel costs” (Richardson, 1999).

It was hoped that national ICT policies of private sector participation, competition and effective regulation (PCR) would close the digital divide in the developing countries. While they have helped to reduce it slightly in certain areas, the digital divide persists, particularly among the least developed countries (United Nations, 2006b). To bridge the digital divide, there is a need to go beyond PCR policy by coupling it with proactive government planning, investment and procurement. India has been successful in establishing a framework of policies and regulations, which have enabled and stimulated the growth of mobile telecommunications. The government has undertaken several reforms to improve the quality of telecom services in India such as de-monopolisation of national long distance calls, basic services opened for all with no limit on number of actors, use of satellites and allowing high band data.

The government’s policies have transformed the landscape for mobile telecommunications to ensure that the benefits of mobile communications can be shared amongst all of their citizens, not just the urban elite.
The government has adopted privatization of telecommunications but continues to be a strong national player and provides the impetus for public interest in telecommunications. The independent regulatory agency, the Telecommunications Regulatory authority of India (TRAI) liberalized long distance calls and introduced mechanisms to force private operators to provide minimum rural connectivity. With prepaid services and calling cards, even poor households have been able to benefit from increased telephone access. As recognition of these efforts, the Indian Government was conferred with the ‘Government Leadership Award 2007’ for exceptional achievement in the field of mobile communications policy by GSM Association in the 3GSM summit in Barcelona in February 2007 (www.hindu.com/thehindu/holnus/001200702140311.htm).

The incorporation of telecommunications policies into economic policies and national development agendas must involve the public and private sectors as both have important roles to play in the diffusion of mobile applications. The private sector is primarily responsible for providing access and competitive private sector-led markets go a long way toward making these services widely available. The public sector’s main role is to provide a sound policy framework, regulate markets where they do not work well enough on their own, and support additional service provision where markets do not achieve economic and social objectives. The public-private partnership can be seen where mobile phones are widely shared and rented out by the call by local entrepreneurs, serving as de facto public telephones.

4. **m-Governance**

m-Governance is defined as the strategy and implementation involving the utilization of all kinds of wireless and mobile technology services, applications and devices for improving benefits for citizens, business and all Government units. The rapid diffusion of mobile ICT gadgets such as laptops, mobile phones, PDAs (Personal Digital Assistants), along with emails, instant messaging and other networking services have rapidly fuelled the mobilization of interaction. In order to take the full advantage of the mobile and wireless ICT technology as well as dealing with the fluidity of the interaction with the mobile society and booming mobile usage rates, the Kerala State Government has initiated action to set up about 20 m-Government Services offered by 8 departments identified for pilot level implementation and to deliver services though mobile phones accessible to the citizens in the field, in the street, at home or other convenient locations on a 24 x 7 basis, rather than the users having to visit Government offices or log on to the Internet portals to access services. KSITM is working on several projects to deliver various services to the public using mobile phones. KSITM’s objective is to make it possible for people of Kerala to access different kinds of information, and eventually even equip them to effect payments of bills, using their mobile phones.
The government of Andhra Pradesh has started an ambitious Short Message Service (SMS) alert system (Mathrudevobhava) for expectant mothers from July 11 2011. In order to attract rural womenfolk to government hospitals and encourage institutional deliveries and reduce mother mortality rate (MMR) and infant mortality rate (IMR), the district administration has embarked upon a series of SMSes regarding next date of visit hospital for necessary treatment, vaccinations and diagnostics tests etc. Besides these SMSes, the authorities would also send SMS messages about the diet to be taken during the respective months of pregnancy, dos and don’ts for specific individual cases etc. These mobile health messages are intended to reduce mother mortality rate and infant mortality rate in the State (The Hindu, 2011).

5. **Education**

In countries where low literacy remains a substantial barrier to development, radio is universally recognized as the most cost effective mass medium for informing and entertaining a wide population. Considering the fact that an estimated 115 million children, mostly girls remain out of school in Sub-Saharan Africa and South Asia, radio programmes aimed at women’s development are broadcast in several countries - for example India, Indonesia, Mexico, Sub-Saharan Africa and Dominican Republic. Radio can reach larger numbers of poor people because it is easily affordable and uses little electricity which is in short supply in many developing countries and barely affordable for the poor. In spite of radio’s inherent advantages radio experts and communicators working on community radio were dismayed to find that the World Congress on Communication for Development held at Rome in October 2006 overlooked the vital role of community radio in empowering people and strengthening democracy (Kumar, 2006). In the developing world, the popularity of mobile handsets has been enhanced by the integration of radio. For instance, many mobile handsets sold in India and Pakistan integrate a FM radio receiver and it is found that those with such handsets listen to radio on their phones. It is also found that content such as audio and video content can be easier to consume than text-based SMS by users with lower literacy skills.

Mobile devices - such as handsets, MP3 / MP4 devices, personal digital assistants, and smartphones-have the advantage of not being online to store, play and/or record audio and video content. Many development communication projects are integrating offline rich content to support strategic implementation. Offline delivery is effective if the content being distributed does not need frequent updates. Offline systems are being used for educational content such as an audio or video lecture by a teacher. The One Media Player per Teacher (OMPT) initiative selects appropriate portable media players, speakers, battery-powered video projectors, and mobile power generators (solar and human kinetic) for use by international educational development projects (France, 2009). In collaboration with
various non-governmental organizations, OMPT targets teachers and students in remote areas without internet access to deliver offline audio content such as recorded lessons, health information etc. which is played in classroom and community group environments. In India, OMPT is working with the Microsoft-supported project Digital Green to disseminate agricultural information to small and marginal farmers, such as video testimonials by progressive farmers, or field demonstrations by agriscientists (Gandhi, Veeraraghavan, Toyama, and Ramprasad, 2009).

6. WOMEN’S EMPOWERMENT

There are tangible examples of gender sensitive policies in telecommunications that have set the framework for achieving desirable outcomes established by national policy, particularly in the two areas of universal access and affordable services for the empowerment of women (Prasad, 2008). Such policies have suited the needs of many rural women who may be home-bound and have limited time for travel or limited income to incur travel costs. The ‘Grameen Phone’ project of the Grameen Bank in Bangladesh has enabled the borrowers, all women, to buy cellular phones in order to earn better income. Many rural women who are engaged in small scale enterprises like poultry, farming, fisheries, livestock, selling various produce can know the current market rate through cellular phone service thus eliminating the exploitation by middlemen (Amin, 1998: 8). In the villages of Bangladesh, which are among the poorest in the world, women entrepreneurs provide payphone services at a profit using mobile phones (Lawson and Meyenn, 2000).

The ‘Theli Phone’ (shoulder-bag phone) initiated by SEWA (2003) in India with tie-ups with the cellular and limited mobility service providers and the handset manufacturers of the state enabled 5,000 members to buy mobile handsets as well as subscribe for the mobile services. The main intent is to increase efficiency and business outputs of its members like the salt farmers, artisans, vegetable producers and midwives through effective communication. The SEWA experience has also been shared internationally, resulting in similar models being set up, such as the Self Employed Women’s Union (SEWU) in Durban, South Africa and the Women’s Economic Empowerment Association (WEEA) in Yemen. The Self-Employed Women’s Association (SEWA) in India has done outstanding work on this front by training rural women in the production and use of video to generate income, disseminate new skills and to advocate changes in policy.

The self-help groups of women in Andhra Pradesh, India are provided with mobile phones which have helped them to earn higher incomes by receiving more orders for their products and keeping in touch with the market demands and trends. The modest success of Bangladesh and India in improving women’s economic status through the use of cellular mobile phones can enable the development of gender-aware universal access
policies that stress public access points as an alternative to more capital-intensive choices (one line per home) and ensure that the locations of public access points are gender-sensitive.

7. **SOCIAL MOVEMENTS**

The use of mobile communications to organize popular movements against corruption, the campaign for the right to information and environmental conservation is growing in India. The campaign to create awareness about the law to fight corruption received the overwhelming support of common people who received SMSes about the venue and mode of protests being organized in the towns and cities across the country. Many supermarkets have begun to send SMSes to customers of bringing their own shopping bags in a bid to reduce the number of plastic bags in the environment. Mobile banking in India pioneered by the Corporation bank has led to a movement for branchless banking in the rural and remote areas. Various public health organizations send mobile messages on mother and child health including vaccinations in the community.

8. **CHALLENGES TO M4D**

As a tool for development communication, the functionality of a mobile handset is bounded by a variety of factors including the availability and quality of network reception, and electrical power for recharging. Neither of these factors is readily available in many rural and remote areas. However, the utility of the handset is not completely negated in these situations. Literacy is of critical importance to the uptake of mobile applications. Text-based content or SMS interfaces have limited success for users with lower literacy skills. India is experimenting with Interactive Voice Response Systems (IVRS) to overcome this challenge. Income is also a limiting factor in the uptake of mobile services. Innovative mobile services such as family and friends circle, mobile number portability, pre-paid mobile vouchers of smaller denominations are targeted at those with low incomes who would like to receive calls and only make calls if necessary. In spite of some success in drawing women in the mobile revolution, gender practices persist that prevent women from owning or having access to a mobile handset in the socially backward areas of South Asia.

9. **LEGAL AND ETHICAL CONCERNS**

A gender analysis of women and men’s differential access and use of the mobile phone has uncovered the reinforcement of gender stereotypes in several parts of South Asia. The risk to privacy is the most frequently echoed concern all over the region. India has yet to legislate against the use of ICTs to encroach on the private lives of individuals. The MMS scandals of using camera phones to photograph women has thrown up some serious ethical issues about the invasion of privacy of girls and young women. They can be caught unaware using camera phones and can be photographed without their knowledge or consent.
Film advertising is also being promoted by using MMS clips. Pritish Nandy who promoted his film *Ek Khiladi Ek Haseena* released in November 2005 by sending MMS clips of steamy sex scenes of the actors to cell phone users called it an innovative publicity platform. Although the Censor Board had slapped ‘Ek Khiladi Ek Haseena’ with a “for adults only” certificate, the film’s producers did not hesitate to use the adult content from the film in their promotional MMS clip even though it is easily accessible to people of all ages who own multimedia-enabled mobile phones. Their logic is that no censorship system exists to grade or monitor mobile phone content.

According to Pritish Nandy, “It’s a censored version; we made sure that we only circulated a censored version of the clip. It’s an adult film so there would be slightly more than you would see on TV, but TV is for universal viewing and since there is no such grading required for MMS we can send it out in normal course. These kinds of things are being aired on television as well, so I don’t think that’s a problem.” Film advertising has been carried on using posters, billboards and on television but has not been done on mobile phones. They insist that not only are MMS clips less expensive than hoardings, TV spots and other conventional promotional tools, but they also reach out directly to the consumer. There is a fear that such trends can lead to greater video voyeurism and easy access to pornographic material among the youth who are the dominant users of mobile phones and Internet in India.

10. MEASUREMENT OF EFFECTS OF MOBILE MEDIA ON DEVELOPMENT

The measurement of the impact of mobile technologies on development and evaluating the outputs of implementation of m-strategies to enable governments and planning agencies is needed to formulate effective mobile interventions, modify and continue policies and strategies for pursuing M4D. But to do so successfully, firstly, there is a need for credible systems of gathering statistics about its rate of diffusion and use of mobiles among the rural population, women and other marginalized groups. At present, within countries access to mobiles is uneven with urban /rural, gender, age and education as influencing factors. The situation is quite complex and often exact data on ICTs and the quantum of digital divide is not available in South Asia.

11. CONCLUSION

Developing countries in South Asia recognize the potential of mobile technologies for development of their economies and communities. But policies have to address a multitude of factors such as the levels of technology and supporting infrastructure, access to mobile technologies, cost of mobile applications, the legal and regulatory framework and the integration of telecommunications policies into national economic and development policies before a country can take advantage of the potential of M4D. There is also a need to measure the outcome of ongoing projects
in order to strengthen and review mobile communications strategies and policies for development. National m-strategies that are underway must be assessed to generate data for future planning and implementation of policies for development. Greater international cooperation is needed to enable the developing countries of South Asia to move from their state of digital divide to one of digital opportunities as envisioned in the international M4D policy and achieve sustainable development.

REFERENCES


MobiSAM: Mobile Social Accountability Monitoring in South Africa

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Abstract—In order to make decentralised local government democratic, both government and civic actors must ensure meaningful, informed and effective citizen participation in local governance processes. A key challenge is how to provide the mechanisms and tools to achieve this. This paper explores the use of mobile phones as a tool for facilitating participation in local governance processes. It presents MobiSAM, a polling application that is used to complement social accountability monitoring within a local municipality within South Africa. By providing real-time data and analysis, MobiSAM facilitates evidence-based engagement with local government in order to promote increased accountability, improved service delivery and meaningful participation.

1. Introduction

The South African Constitution (Act 108 of 1996) requires local government to “provide democratic and accountable government for local communities; to ensure the provision of services to communities in a sustainable manner; to promote social and economic development; to promote a safe and healthy environment; and, to encourage the involvement of communities and community organisations in the matters of local government” (Act 151(1) of 1996). Thus local government structures are mandated to facilitate service delivery and participation in order to realise the democratic dream.

While post-apartheid local government institutions “have been created with genuine intentions to positively affect democracy and to bring about social and economic delivery at local government,” (Buccus & Mathekga, 2007, p. 11) they have largely failed. The response of citizens to this failure has increasingly been one of protest; according to one study, over 900 service delivery protests were held in one calendar year. (Booysen, 2007).

Poor service delivery is often attributed (correctly) to poor capacity, limited fiscal resources, corruption and a lack of leadership. However, it has been argued that local government institutions continue to fall short of their constitutional mandate because government’s top-down technocratic approach emphasises local government as a vehicle for service delivery at the cost of (and instead of simultaneously) emphasising local government as a vehicle for participation (Buccus & Mathekga, 2007).

Despite the challenges, local government structures offer meaningful opportunities for increased citizen participation “by placing more power and resources at a closer and more easily-influenced level of government” (Mogale, 2005, p. 136). The immediacy of people’s needs and the proximity of government to those who elected them provides increased motivation for participation. The key to success, however, is to ensure meaningful, informed and effective participation of citizens in government processes,
and to provide the mechanisms and skills to hold service providers to account for their performance in managing public resources and delivering services.

One of the most rigorous and successful methodologies is Social Accountability Monitoring (SAM), developed by the Centre for Social Accountability in South Africa, and now used by civic actors in several SADC countries (Policy Forum, 2010). This paper discusses how the SAM methodology can be enhanced by the use of mobile phones. Mobile phones offer civic actors an opportunity to express their needs and engage with local governments in ways that have not yet been harnessed. Despite poor access to formal education and low literacy rates, mobile phone penetration rates in South Africa are surprisingly high, with 100.48 phones per 100 inhabitants and 11.9 mobile phone subscriptions for every fixed telephone line (International Telecommunication Union, 2011). As illustrated in Table 1, these trends are similar in other developing countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Mobile Phone Subscriptions (per 100 Inhabitants)</th>
<th>Mobile Phone Subscriptions to Fixed Telephone Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa</td>
<td>100.48</td>
<td></td>
</tr>
<tr>
<td>Namibia</td>
<td>67.21</td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>61.63</td>
<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td>55.1</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>104.1</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>61.42</td>
<td></td>
</tr>
</tbody>
</table>

This paper argues that by using mobile phones to increase participation in local government processes, accountability and service delivery will be improved and decentralised local government will be made more democratic. It describes a pilot study currently being undertaken within the Makana Municipality in Eastern Cape South Africa, to determine the viability for the use of mobile phones to facilitate evidence-based engagement with local government in order to promote increased accountability, improved service delivery and meaningful participation. The paper first presents related work on how mobile phones have been used within the public sector. It then provides some context information for the pilot study area (Makana Municipality), showing that the municipality performs similarly to a number of other local governments in developing countries world-wide. It then presents the SAM methodology, and its extension to MobiSAM. Finally it describes the design and implementation of the MobiSAM system, followed by a discussion and some concluding remarks.

2. Related Work

c SINCE the early 2000s, researchers have been investigating ways that ICTs could be used to increase the efficiency and effectiveness of the public sector (Layne & Lee, 2001). Heeks maintains that ICTs can facilitate the following reforms within the public sector: increased efficiency, more efficient and
effective decision making at decentralised offices; increased accountability information; and to form the “conduit for delivery of new forms of public service” (Heeks, 2000, p. 19). If we limit our view of ICTs to only consider mobile phones and Internet access, these technologies have been used for a number of different purposes within the public sector: to improve emergence response and assessment (Blackman, 2006); to accelerate government response to requests from citizens (Blackman, 2006); to encourage voter turnout (particularly within groups of young adults) (Dale & Strauss, 2007); and to foster political mobilisation. Out of each of these uses, the most prevalent and successful has been the use of mobile phones to foster political mobilisation.

With the rise in popularity and ease of access to the Internet, the last couple of decades have seen a broad discussion about the democratising impact of new information technologies (Norris, 2001; Parpacharissi, 2002). Numerous parties have made claims that the popularity of the Internet would encourage a new form of political participation. Suarez, quoting DiMaggio claims however, that just providing access to the Internet itself will not increase political participation (2006, p. 118):

Access to the web does not help inform a previously apathetic electorate because individuals who search the web for political news are ‘well informed to begin with, politically oriented and heavier users of other media’ (DiMaggio et al. 2001, 320)

Since then, the Internet, and in particular social media tools such as Facebook and Twitter have been used to mobilise citizens in both developed and developing countries. Within developing countries, these tools have been used to mobilise support in protests in Ethiopia for a “day of rage” (Smith, 2011), and have played pivotal roles in revolts against governments in Libya (Arab Crunch, 2011), Tunisia and Egypt (Preston, 2011). After these and related incidents, the Special Rapporteur from United Nations on the promotion and protection of the right to freedom of opinion and expression, Frank La Rue, called for Internet access to become a basic human right. He found that “given that the Internet has become an indispensable tool for realizing a range of human rights, combating inequality, and accelerating development and human progress, ensuring universal access to the Internet should be a priority for all states...” (2011).

Mobile phones have also been used successfully to increase citizen participation in a number of these uprising, giving citizens access to Internet sites from any location. Citizens have been able to use their mobile devices to participate using Web2.0 technologies such as these social media sites, as well as by supporting citizens in taking videos of photos of events and uploading them to news websites (such as Aljazeera’s ‘Your Media’ and CNN’s ‘iReport’). On a number of occasions, such as in recent demonstrations in Swaziland (news24, 2011) and in China (The Economist, 2007), mobile phones were simply used to send text messages to organise protests.
Despite being used successfully to mobilise support, the democratising impact of these technologies has not lived up to expectations. As found by Suarez, the groups of citizens who actively use the Internet to search for political information are typically politically active already (2006). By providing facilities that enable participation from a mobile platform, it is expected that due to the proliferation of these devices, a greater percentage of citizens would have access and thus be able to participate.

Also, although the use of ICTs to mobilise support has been successful in that a sizeable amount of attention has been directed at particular issues, the use of these technologies have not in themselves facilitated systematic change within political systems. Without this systematic change, the circumstances that brought the problems are not addressed or rectified.

3. Context

Makana municipality is situated in the Eastern Cape, one of South Africa’s poorest provinces. The 4,379 km² municipality is home to an estimated 70 000 people or 16 975 households. The area experiences a high unemployment rate (67.9%) and low levels of education (42.3% of Makana residents have received primary level education or none at all). The result is that 24.2% of households live below the poverty line. Efforts to alleviate poverty are hampered by a sluggish economy and there is an increasing dependency on social grants, with half of all Makana residents receiving some form of government grant in 2009 (Makana Municipality, 2011).

This places a significant burden on the municipality, particularly in delivering basic services. The municipality is responsible for (amongst other things) municipal health services; municipal roads; sanitation; electricity reticulation; potable water; refuse removal, refuse dumps and solid waste disposal; child care facilities; and, local tourism. (Municipal Systems Act, No. 32 of 2000) Despite a R266 million budget in 2009/10 (Makana Municipality, 2010, p. 4), only 21% of Makana residents have access to portable water and only 35% to sanitation (Makana Municipality, 2011).

The municipality was recently ranked as the third worst performing municipality in the Eastern Cape Province, with 2,507 instances of misspending (R19.8 million), making up 9% of the total misspending in the province (Mini, 2011a, 2011b). The supreme audit institution has repeatedly found the municipality unable to adequately account for the use of public resources. In 2009/10, the Auditor-General could not obtain sufficient appropriate audit evidence to support over R29 million (11%) of municipal expenditure. (AG report 2010)

The situation in Makana municipality is comparable to most local municipalities across South Africa, where “local government capacities are in short supply and financial sustainability is frequently in doubt. This hampers total government ability to perform traditional functions such as
service delivery and regulation, collecting rates, user charges and fees.” (Mogale, 2005, p. 137). This is not a problem that is unique to South Africa, but has been demonstrated on numerous occasions and across a number of different contexts. A recent cross-country, empirical evaluation found similar evidence across developing countries around the world (Bardhan & Mookherjee, 2000).

4. Social Accountability Monitoring Methodology

The SAM methodology offers civic actors a rights-based and evidence-based framework for understanding and participating in government service delivery processes. It is premised on the argument that social accountability is the:

Right to obtain justifications and explanations for the way in which public resources are managed (whether by public officials or private service providers) and to obtain justifications for the way in which these resources serve to progressively realise people’s human rights (in particular their socio-economic rights). This definition requires that officials take corrective action in response to instances of the ineffective use or abuse of resources in order to prevent their recurrence. (Centre for Social Accountability, 2011)

The way in which public resources can be effectively and accountably managed is through the implementation of a social accountability system consisting of five inter-dependent processes which map onto the public resource management system, shown in Figure 1 below.

Fig. 1: Social Accountability System

While originally used in South Africa to monitor and engage with provincial government, the methodology lends itself well to the local
government context. For example, in order for a municipality to address ongoing problems of access to and quality of municipal water, it needs to (1) allocate available resources to planned activities addressing whatever prevents access to clean and safe water, such as the maintenance of water pumps. In order to engage in this process, citizens should question how resources within the municipality have been allocated and whether the planned activities will contribute towards a safe and clean water supply to all municipal residents. By participating in budget and planning discussions, citizens can influence how available resources are prioritised against their most pressing needs.

The municipality then needs to (2) spend the resources allocated by (3) implementing its planned activities. It is unacceptable for allocated funds not to be spent (without clear justifications) or for allocated funds to be spent on unapproved activities (whether through corruption or mismanagement) as this undermines both service delivery and the role of oversight bodies who vote on and approve the plan and budget. Citizens should therefore demand justifications and explanations as to how funds were spent and whether planned activities were implemented. Where instances of corruption and maladministration hamper service delivery, corrective action should be taken (4) and, finally, (5) the municipality should account for its performance to oversight bodies.

The five processes represent opportunities for citizens to participate meaningfully in local government. The methodology provides basic tools for citizens to engage in each process by interrogating the government documents the processes produce (including budgets, plans, financial reports, performance reports, audit findings and oversight committee minutes). Equipped with both findings and an understanding of how government processes (should) operate, citizens are able to engage in evidence-based advocacy, demanding justifications and explanations for government performance and, where necessary, corrective action. Furthermore, by engaging with each of the five processes over time, citizens can ensure systemic issues hampering service delivery are addressed. For example, should a municipality fail to deliver a service (despite available funds) due to a lack of suitably skilled staff, citizens should demand that funds are allocated and plans developed to build capacity in the municipality (whether through training or recruitment) the following year to ensure that the service is delivered in subsequent years. By strengthening each of these five processes through active citizen participation, both service delivery and accountability are improved.

There are, however, two limitations to the SAM methodology. Firstly, because the tools focus on the analysis of government documents, the methodology lends itself to desk-based research and (for processes 2 to 4) post-hoc analysis. While oversight bodies are often similarly limited in their ability to hold government accountable, meaningful citizen engagement
in government processes would be further strengthened if desk-based analysis was complemented with real-time fieldwork monitoring and research. Secondly, in order to use these tools and to apply the rigorous methodology, citizens require a degree of literacy and specialist analytical skills that often exclude those most affected by service delivery, the poor and marginalised. There is therefore a need to develop additional tools to complement the SAM methodology.

5. MobiSAM

MobiSAM combines the use of the SAM methodology with a mobile polling solution. This polling application is being piloted in conjunction with a local newspaper house in an attempt to strengthen accountability and service delivery within a local municipality, in this case the Makana municipality. MobiSAM enables ordinary citizens (who depend on public services delivered by Makana municipality) to participate in ongoing service delivery polls; their collated responses will be publicised in local media and will also be transmitted to local council officials. MobiSAM offers the following support for systematic change:

- Gather and collate real-time socio-economic data from citizens, including their most pressing needs (e.g. the number of people without access to running water or sewerage services)
- Establish attendance of public officials in local facilities, for example how many health workers are in attendance at clinics on a given day, or how many teachers are at each local school
- Facilitate social auditing of service delivery, for example, by establishing progress on road construction, electrification, water reticulation or other infrastructural projects
- Encourage whistle-blowing and the reporting of corruption and maladministration.

Using this system, responses are compiled, collated and then visualised. Results of polls are then made available to the local newspaper house through a web interface. These polling results are then distributed to citizens via the print media, the newspaper’s online portal and local radio. By including location information (whether collected through user profiles, cell phone triangulation using cell phone tower locations, or where supported by the handset, GPS location), results of polls will be able to be visualised by geographical region.

MobiSAM represents an innovative opportunity to enhance SAM work at the local level by complementing the desk-based analysis of official government documents (such as budgets, plans and reports) with real-time input and feedback from Makana residents. In doing so, MobiSAM will popularise SAM tools as well as the need for effective public resource management processes to deliver services that address people’s most pressing needs. It provides an example of evidence-based engagement
with local government by citizens (in particular, those most affected by service delivery) and demonstrate how active citizen interventions are able to progressively strengthen service delivery.

Figure 2 illustrates the MobiSAM system, showing how it extends the SAM methodology (depicted in the centre of the diagram in blue squares). The figure demonstrates the interplay between traditional desk-based research (depicted as grey squares), and the mobile component of the monitoring and polling system (as white squares). The overall objectives that each phase of the system aims to achieve are highlighted in blue circles.

6. **System Design**

This section describes the requirements, design, and implementation of the MobiSAM system.

6.1 **Requirements**

The requirements for MobiSAM system

- Multilingual support. South Africa has eleven official languages, so to ensure a broad base of potential users, support must be provided for citizens to specify their preferred language, and then for polls to be sent to them in that language.

- Support a wide variety of phones. The range of capabilities of mobile phones owned by citizens is vast. To ensure a broad base of potential users, the client side of the polling system must be able to run on as large a range of handsets as possible.

- Minimum cost. Different communication techniques should be explored to find the one that is most cost effective. Cost should not be a barrier for participation.
Support different types of polling questions. These include (but are not limited to) ranking questions, short answer, multiple choice, likert scale questions and yes/no responses. Support should also be provided for users to define their own types of questions.

Support a range of different visualisations of collated results. Some polls will be more suited to particular visualisation techniques. The collation system must be flexible enough to allow users to specify and change the type of visualisation that is used.

Interoperability with existing systems. Results of polls (both raw data and visualisations) are required to be able to be imported into other applications. Provision should be made for exporting data in standard formats (such as comma-separated values for tables and PNG or JPG images).

The functional requirements of the system are represented in use case diagrams in Figure 3. The two actors in the use case diagram are the administrators, who manage polls; and users who take part in polls. As can be seen from this diagram, the administrator actor primarily works from a desktop computer, where they formulate polling questions, and then manage polls. Once the administrator determines that a poll has been completed by enough respondents, they are able to download the results to be used in other applications.

As shown in Figure 3, the user actor (otherwise known in this system as a citizen) undertakes polls using mobile devices. From the user perspective, to take part in any poll they must first register with the system. This registration information is used to ensure that each user only answers a poll once. It is important to note that although user data (such as their unique identifier – their cell phone number) is stored, a correlation is not made between users and their responses. Other important information that is stored is the user’s preferred language, and the suburb where they live. Once a language preference is specified, all polls are delivered to the user.
translated into that particular language. Suburb information is used for poll visualisations such as heat maps to show for each area, how important a particular service delivery is to respondents. As there can be multiple polls, users also require a technique to search for specific polls that they wish to take part in, and then to respond to them.

6.2 Design and Implementation

This section describes the design and implementation of the MobiSAM system.

MobiSAM is a web application implemented on a standard Model-view-controller (MVC) architecture. This ensures adherence to the principle of “separation of concerns” which allows for particular flexibility in the service provisioning. This architecture also allows for a fine-grained customization and adaptation of the service for various clients (i.e. computing devices) and for various end-users. For example, the Views components of the application can easily be adapted and customized for different mobile handsets, depending of the device capabilities of those particular handsets. MobiSAM also enables further connectivity from various clients through the web services interfaces that are exposed by the platform. This allows for a loosely-coupled integration of the MobiSAM service in other applications.

Figure 4 shows the general architecture of MobiSAM. MobiSAM is developed using the Yii PHP framework, with a MySQL backend. At the time of writing this paper, the web-based client is the only client that is currently available. As will be described in the next section, a baseline study is scheduled to take place late in 2011. In this study we will identify the top 12 mobile platforms that are being used by citizens across Makana municipality. If these platforms do not support the current web based
interface, specific versions of the client will be developed to target the platforms (in the figure above, this is depicted with the Symbian S40 client). Depending on the results of the baseline study, other clients may also be developed that take advantage of the capabilities of the popular platforms (in the figure above, these are depicted as RIM client and Android client). It is expected that these clients could include GPS support for location information.

7. DISCUSSION AND CONCLUSION

The MobiSAM pilot involves five separate phases, spread out over three years: preparation; introduction of MobiSAM; use MobiSAM to monitor the service delivery issue; encourage evidence-based citizen participation; and analysis of the impact of MobiSAM. The work described in this paper forms part of the initial phase of the project. As part of this phase, a baseline study will be undertaken in late 2011 to provide a base for which comparisons on the impact of MobiSAM can be made. This baseline study, amongst other things, will survey citizens to determine their current level of participation and satisfaction with local government, demographic information such as their preferred language, and as mentioned in the previous section, their access to mobile phones. This information will then be used to inform the design of additional mobile clients.

This paper has introduced MobiSAM, a polling application that is being used in South Africa to complement social accountability monitoring at the local government level. MobiSAM provides access to real time polling data, facilitating evidence-based engagement with local government in order to promote increased accountability, improved service delivery and meaningful participation.

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Women Empowerment in India through Mobile Phone—Challenges

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Abstract—The status of women in any civilized state shows the stage of evolution at which that civilization has arrived. From time immemorial two distinct and contradictory outlooks have existed regarding women in our society. While our scriptures have eulogized woman as symbolic of creativity, likening her to Mother Nature, the debasing institutions like “nagarvadhu” represent the harsh reality regarding her status in Ancient India. The Indian woman’s position in the society further deteriorated during the medieval period. During the British Raj, many reformers fought for the upliftment of women. However, in spite of their best efforts, the picture has not altered much because crime against women has not abated even in our own times [1]. Though education in women has been gradually rising, the female literacy rate in India is still lower than the male literacy rate. Compared to boys, far fewer girls are enrolled in primary and High schools, of which many drop out. Thus lack of education is one of the obstacles in empowering them. Relative lack of economic independence, decision making and dearth of health care facilities made them further vulnerable. As a consequence of all these factors, crime against women continue unchecked. One of the most practical means of empowering women in this scenario can be their acquaintance with the multiple uses of mobile phone technology. India has the fastest growing mobile network in the world where tele-density has increased to 70.239 % in May 2011[2]. However, rural India still lacks strong infrastructure of mobile communication and poor people in general and women in particular are not having access to mobile phones in spite of the very low call rates. The deep and strong penetration of the mobile service will definitely empower the women. This paper discusses the challenges in empowering the women through mobile phone in India.

1. Introduction

Although woman has been depicted as a symbol of beauty, creativity and “shakti” in our scriptures, the real picture regarding her status and role in typical Indian society has been largely dismal. She has not only been exposed to gender related violence and her subjugation in our male dominated society but also to age related vulnerability. The status of women in India has been subject to many great changes over the past few millennia. From equal status with men in ancient times through the low points of the medieval period, to the promotion of equal rights by many reformers, the history of women in India has been eventful.

The feminist activism in India picked up momentum during later 1970s. The protests related to sensitive gender related issues forced the Government to amend the Evidence Act, the Criminal Procedure Code and the Indian Penal Code and introduce the category of custodial rape [3]. As per the 2001Census women constituted 48% of the country’s total population. The
Constitution of India recognized the importance of women as a valuable human resource and declared 2001 as the Year of Women’s Empowerment (Swashakti). The National Policy [4] for the empowerment of women was also passed in the same year. But, it is an irony that Women’s Reservation Bill has not yet been passed in the Lok Sabha.

1.1 What Constitutes Women Empowerment?
In a general sense, women empowerment refers to empowering women to be self-dependent by providing them access to all the freedoms and opportunities, which they were denied in the past only because of their being women. In a specific sense, women empowerment refers to enhancing their position in the power structure of the society [5].

1.2 Women Empowerment in India—still an Illusion
Notwithstanding the remarkable changes in the position of women in free India, there is still a great divergence between the constitutional position and the stark reality of their deprivation and degradation. Whatever whiff of emancipation has blown in Indian society, has been inhaled and enjoyed by the urban women; their counterparts belonging to the countryside are almost untouched by the winds of change. The human rights scenario concerning women in the country continues to be dismal.

Though education is a powerful tool which can transform the lives of women and empower them in real terms, the existing number of illiterate women in India (17, 63, 81, 664 according to Census-2011) presents a dismal picture. This lack of education proves to be one of the significant constraints as far as economic independence of women is concerned. It is shocking that only 33% of women over the age of 15 are “economically active,” compared to 67% in China [6]. Violence against women is a serious issue which inhibits their physical and psychological evolution. As per the latest data published by the National Crime Records Bureau, the total number of crimes committed against women has increased from year to year from 1.31 lakhs in 1998 to 2.03 lakhs cases in 2009 [7]. Decision making by women at family level is almost nil. According to latest National Family Health Survey India, NFHS-3, women have no say in decision making in typical Indian households. Factors that limit their access to health care at the household level can be gender-related, purely economic, or supply driven. Women have limited freedom of movement and access to income. Survey shows that women face a number of hurdles in accessing health care for themselves, the most common being distance to a health care facility and the least common being getting permission to go. Notably, almost one-fifth of women report that not having a female provider is a concern and for one-tenth of women, finding someone to go with them is a problem [8].

2. CELL PHONE—A SUCCESS STORY OF SHINING INDIA
The Government of India has recognized the importance and potential of Internet and ICT and is trying to improve the process and delivery of
government services. Mobile telephony can reach areas where there are infrastructure constraints for internet service or where wired phone service is not a viable option. It has emerged as the new frontier where governments are making themselves more accessible through the remote delivery of government services.

India is on the threshold of mobile revolution. In a recent report, it is estimated that a large part of India’s revenue comes from mobile data usage. According to Pyramid Research, by 2012 India will be the fourth largest market for mobile data revenue. It must also be noted that 40% of all internet users in India are connected to the net only via their mobile phones [9]. According to the highlights of Telecom as on 31st May, 2011 press release No. 41/2011 by Telecom Regulatory Authority of India (TRAI) the tele-density at the end of May, 2011 reached the mark of 70.23 as compared to 52.74 at the end of previous year. The wireless subscriber base was 584.32 million as on 31st March 2010 and has increased to 840.28 million on 31st May 2011

3. CHALLENGES TO WOMEN EMPOWERMENT THROUGH MOBILE PHONE IN INDIA

3.1 Non-Availability of Mobile Phone to More Vulnerable Women

Gender disparity in society is often echoed in mobile usage; while technology allows some women greater social and economic freedom, in other cases, it simply upholds previously held social constructs. Women in slums and in rural India are more vulnerable than their counterparts in urban India in this regard, the reason being the non-availability of mobile phones and scarcity of resources to handle such threats. Lesser mobile phones with these rural women make them vulnerable to threats like kidnapping, molestation, rape and murder. Women who are most likely to be at risk for domestic abuse or isolation are often the ones who do not have access to mobile phones. The presence of a communication line can help ease out some anxiety of these women. Phones may empower women by giving them better access to social services. Given the privacy of talking on the phone, women can more easily report domestic violence or consult family planning agencies.

3.2 Non-Adaptability to Mobile Phone due to Illiteracy

Education is the strongest weapon which can transform the lives of women and empower them in the true sense. But lack of literacy among women especially in the backward regions imposes greater barriers on them. Further, women are not fully aware of the multiple uses of mobile phones and the government schemes and initiatives being offered for their welfare. Mobile connectivity can be used as an effective tool to deal with this developmental challenge. It can truly empower the lives of millions of women by spreading knowledge and skills to enhance livelihood. The launch of ‘Soochna Shakti’ in March 2011 by the Government of India is a
program in this direction. But the non-adaptability to mobile phones due to their consequent ignorance of the multiple uses of mobile phone technology is the main hindrance in the implementation of such programs.

### 3.3 Non-availability of Mobile Phone in Remote Areas

In most developing countries, rural communities do not have many facilities and services including telecommunication services that were initially targeted at urban population. The rural mobile teledensity (number of mobile phone lines for every 100 inhabitants) in India is still inadequate. The situation can only be improved through the introduction of the appropriate modern technology along with the participation of private sector licensees. Many areas around the world, such as Western Europe have become stagnant markets with decreasing opportunities for mobile expansion. Keeping this in mind, Rural Mobile Connectivity in India has been recognized by operators and manufacturers as a significant business and development opportunity [10]. Companies do not, nowadays, hesitate in deciding whether or not to carry out business in these regions.

### 3.4 Lesser Utilization of ICT by Govt. Agencies/Service Providers

ICT plays an important role in disseminating a wide range of information and advice leading to knowledge and attitude change among rural communities. However, gender discrimination constrains the realization of the full potential of ICT in reaching the rural women. Our government has taken certain initiatives in this regard but very few of them focus explicitly on reaching rural women. And even these few initiatives have their constraints.

Strengthening the ICT capacity can be an important way of reaching the rural women in India. ICT based enterprises have a potential to employ more and more women who are educated up to tenth or preferably 12th classes at the lower end of the BPO sector. These women can also have opportunities to train themselves for self-employment in IT sector. However, dynamic and relevant course content for rural women continues to remain a major challenge. Sufficient resources have to be allocated for this activity and special focus needs to be given to its application. Enacting and enforcing gender sensitive ICT policies can make a lot of difference in the lives of women who do not enjoy the fruits of empowerment.

### 3.5 Lack of Emergency Service Number for Counseling and Seeking Help

Emergency service number is a number that allows a caller to contact local emergency services for assistance. It is typically a three-digit number so that it can be easily remembered and dialed quickly. Though in India we have emergency numbers to contact the Police, Health Services and Fire department, an emergency service number for counseling and seeking timely help especially for women-related issues is still missing. This number,
if made available, could be used by women any time to seek consultation on issues like family planning, health, education and employment. An emergency telephone number call may be answered by either a telephone operator or an emergency service dispatcher. By determining the nature of the emergency, the Telephone operator would connect the call to the appropriate emergency service, to provide the desired assistance. In many parts of the world, an emergency service can identify the telephone number that a call has been placed from. The latest “enhanced” systems, such as Enhanced 911, are able to provide the physical location of mobile telephones. Help line numbers 112 and 983 are being used by women to seek help and counseling in Spain and Romania respectively.

4. Discussion
It has to be realized that women have a vital role to play in building up modern India for which their empowerment is essential. The task of women empowerment has to be started at grass root level by providing mobile phones to most of the vulnerable women and training them in the utilization of the multiple operations these phones can perform. The government agencies and service providers must also join hands in strengthening and expanding the ICT network. Provision for an emergency helpline number too can go a long way in providing security to the women in our country.

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Mobile Communication and Women Empowerment

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Abstract—Women Empowerment is the epitome of political, social or economic strength of women, developing confidence in their own capacities, being wise-enough and highly-powered to make decisions enabling them to break the barriers and tread on a new growth path. Women have the inherent potential to overlook any impediments, to commit themselves to their ambitions and eventually drive the nation by fulfilling them.

Virtual Communication is growing day by day, revolutionary work in the field of information and Communication Technology (ICT) makes communication very easy and cost effective tool for sharing information. Mobile Communication is one such revolution of 21st century and its penetration into the society is rapid than other ICTs tools.

In the context of empowerment and development, the two most imperative factors involved in any developing nation is of acquaintance and uses of appropriate technology by marginalized sections, such as rural women, this paper focuses on integrating the two in the context of women empowerment. The real empowerment is attained only when they are well acquainted with 21st century gadgets and their adequate usage which in turn is the development carriers of any nation. Essence of paper is to throw light on how mobile communication can aid Women Empowerment and how it is happening in real sense.

1. Introduction

Today, Indian women have made their presence felt virtually in every field. Women have ultimately come out of their ‘saree’ image and entrap the nation by dint of their hard work and power. Women Empowerment is in fact the ability of women to exercise full control over one’s actions. Empowerment of women in India is conspicuous by many live examples. Women are not only law-makers and law-controllers, but also Business magnates. Empowerment is the one of the key factors in determining the success of development is the status and position of women in the society. We put a special focus on empowering women and girls, because we believe they hold the key to long-lasting social change in communities. Empowering women must be a united approach, a cause that requires continued attention and stewardship by all. We need to augment our efforts for empowering women and enhance their progress. It is our moral, social and constitutional responsibility to ensure their progress by providing them with equal rights and opportunities. Today women with their smartness, grace and elegance have conquered the whole world. They, with their hard work and sincerity, have excelled in each and every profession. Women are considered to be more honest, meticulous,
and efficient and hence more and more companies prefer hiring women for better performance and result. The last decades have witnessed some basic changes in the status and role of women in our society. There has been shift in policy approaches from the concept of ‘welfare’ in the seventies to ‘development’ in the eighties and ‘empowerment’ in the nineties and emerging concept of participation in current decades. This process has been further accelerated with some sections of women becoming increasingly self-conscious of their discrimination in several areas of family and public life. They are also in a position to mobilize themselves on issues that can affect their overall position.

2. **Mobile Phone**

This omnipresent device has achieved a massive worldwide presence within a remarkably short duration and now offers - in addition to its primary use as a telephone - many different functions, especially in most recent incarnation of 3G and upcoming advance versions.

Also these devices have become indispensable in today’s world. But they are even more useful in the developing world, where the availability of other forms of communication—roads, postal systems or fixed-line phones—is often limited. Phones let fishermen/women and farmers check prices in different markets before selling produce, make it easier for people to find work, allow quick and easy transfers of funds and boost entrepreneurship. Mobile phones are, in short, a classic example of technology that helps people help themselves.

As it is categorized by scholars, mobile phones have brought three kinds of benefits (id2, 2007). First, incremental benefits, in which improving what people already do - offering them faster and cheaper communication, often substituting for costly and risky journeys and enabling immediate market access. Fisher-folks (men and women) in India, for example, can earn more money and waste less fish by phoning coastal markets to see which market has a shortage of supply.

Second, it offers transformational benefits that are something new. Innovative applications, such as m-banking and m-commerce, are bringing banking services to millions for the first time, and enabling people to use mobile phones to pay for goods and services. By using it, Migrant womens not only remain in constant touch with their family and friends but also carry out their much needed banking transactions, including remittances transfers.

Third, production benefits that result from the creation of new livelihoods, not only through professional telecommunications jobs but also through activities like re-selling air-time or phone cards. The rapid adoption of mobile phones has generated a great deal of speculation and optimism regarding its effect on women development not only in India but also in least developing countries.
In general, mobile phone has many features which are very useful for women. The contacts list and address book on phones is a social interface for working women. Without the phone, many of them would be quite lost in connecting with other people. The calendar function on the mobile phones can help them track their lives. Phones can also function as radios to remain updated with the news and latest developments around. It also eases stress by listening music. For some, the mobile phone also becomes a notepad -- send an SMS to one self and make it a reminder service. Owners also have tended to customize phones, with their own ringtones, themes and wallpapers.

3. **Mobile Phones and Women: A Developmental Combination**

Women from lower to upper strata in social system, such as labourers, farmers to business owners, the mobile phone provides them with required information when and where they need it. Now Women are progressively using mobile phones for multiple needs. Poorest women in many countries are putting their limited funds in mobile phone services due to monetary and social profit they bring. However, many women – particularly in low and middle-income countries – still do not benefit fully from the favorable outcome that having a mobile phone can improve their status and source of revenue and in this area some more efforts are required to be undertaken by government and other stakeholders in the society.

Having Mobile phone ownership to women offer them diverse payback like easy and better contact to health, educational, business and employment opportunities. Women mobile phone owners of every age, location and socio-economic status cite the increased feeling of safety and security that comes with mobile phone ownership. Therefore, having a mobile phone helps them feel more safe, connected and enjoying dynamic lives. The need for safety can be high in some areas of low and middle-income countries whilst the resources to handle threats to it may be scarce. Situations that may have previously provoked anxiety for women or their male relatives have been in some cases reduced or eliminated through the presence of a communication line through mobile phone. Reinforcing the way in which it addresses this universal need is a compelling way to communicate the benefits of a mobile phone to both women and men.

4. **Device for Communication**

Needless to mention the basic use of mobile phones is communication wherever whenever and whatever. When we talk about women being able to make decisions and proving herself it is obvious that without communicating it won’t be possible therefore to start with, to voice the mind of a women mobile phones becomes a gadget which can take her voice from one place to another within seconds.
“I Feel More Connected Because I Own a Mobile Phone”. Development and globalisation are making individuals more mobile, reducing the time family members spend together at home. In some areas, migration of family members to cities or even abroad is distancing these individuals from their families and friends. In this environment, a mobile phone can be an essential tool for maintaining contact with loved ones.

“I Feel More Independent Because I Own a Mobile Phone”. As growth takes hold in low and middle-income countries, more opportunities are created for women outside of the home. Women increasingly have the chance to go to school, work outside their homes or even find employment outside of their immediate towns and villages. A mobile phone can help foster a sense of independence.

Mobile Phones Unlock Economic Opportunities. The information, communication and services provided by a mobile phone are helping women save time and money, improve productivity, increase returns-on-investment and maximize household resources. A woman can create and take advantage of new opportunities to increase income for herself and her family via a mobile phone.

5. MOBILE PHONES ENABLE WOMEN’S VOICES TO BE HEARD

Women in many low and middle-income countries have historically had a smaller role than men in the political sphere or have been excluded altogether. Mobile phones are now providing women with a mechanism to become active in their communities and nations. Many women Pradhans and Sarpanchas in Indian Panchayatiraj Institutions, successfully using their mobile phones in this regard and gaining maximum benefits out of it. Today mobile phones are being used by them to organize, advocate, change and participate in politics and community affairs in local governance system. Moreover, mobile phones are also being used by them to build and strengthen women’s support networks outside of their immediate families.

6. WOMEN EMPOWERMENT IN INDIAN CONTEXT: A NEW INITIATIVE

In the information age, knowledge equals power and, increasingly, profit. Money is often scarce for the millions of Indian women who make their living in the informal sector. As per the Self Employed Women’s Association (SEWA) experience, women are willing to invest in information provided through mobile phones if it raises their incomes and improves their livelihoods.

7. MARKET INFORMATION VIA SMS MESSAGES

SEWA is a mixture of self help group, (NGO) and trade union comprised of over 1.3 million female members in India who work in the informal sector. One of SEWA’s objectives is to achieve “livelihood security”, which it defines as having work, food and social security, for its members by enhancing their
bargaining positions. The mobile phone is an excellent tool for achieving these objectives. A survey carried out by SEWA in Gujarat revealed that nearly one third of its members – around 177,000 women – owned mobile phones.

The agricultural sector provides a powerful demonstration of how information delivered using mobiles can increase women’s incomes. Each day SEWA sends agricultural workers SMS messages with up-to-date spot and future commodity prices for each market so they can determine when and where they can get the best price for their produce. This also enhances the women’s ability to plan crops and make informed harvesting decisions. Women have not only been able to increase their incomes; they have also saved money by not having to travel in order to get the latest market prices. Similarly, workers on the salt pans use mobiles to get the latest market information, using it as a basis for their selling strategy.

8. **Sharing Mobile Phones**

Another SEWA initiative is Fone Frend. “Fone Frends” are female micro-entrepreneurs who give people access to a mobile phone and other value-added services on a per-call basis. It is based on the “shared access” model in which a mobile phone is used as a public phone. As discussed earlier, in contrast to an ordinary phone, a mobile phone provides more services, such as mobile banking or tele medicine. Fone Frend targets thousands of underemployed or unemployed women in areas where there are limited economic opportunities. The ultimate objective of the initiative is to expand access to information and telephony. It links cellular companies with Fone Frend entrepreneurs in India’s underserved areas, providing an additional or new source of income.

Initiatives like this is commendable which need to be expanded and replicated in other parts of India too so that the potential of women empowerment can be utilized fully for the greater interest of the society.

**References**


Mobile Telephony and Economic Growth: 
An Econometric Study on India

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Abstract—The Telecom Sector has the multiplier effect on the economy contributing to the economic growth and overall development. Mobile telephony growth consists of the major part of telecom sector growth. This paper aims at analyzing the growth of telecom sector with emphasis on growth of mobile telephony and finding the contribution of mobile telephony in economic growth during the period from 2000-01 to 2009-10 in India. The methods of CAGR and OLS have been used to obtain the objectives. Based on our analysis, we find that mobile telephony growth has been phenomenal with CAGR of 70.10 % and increase of one million mobile phone subscribers leads to increase of Rs. 3691.14 crore in the GDP of the country ceteris peribus. Key words: mobile telephony, GDP, FDI, CAGR, OLS

1. INTRODUCTION

Economists have long examined the importance of social overhead capital (SOC) to economic growth. SOC is generally considered as expenditures on education, health services, and public infrastructure: roads, ports, and the like. Telecommunication infrastructure, whether publicly or privately funded, is a crucial element of SOC. Telecommunications has been recognized the world-over as an important tool for socio-economic development for a nation. The Telecom Sector, which has the multiplier effect on the economy, has a vital role to play in economy by way of contributing to the increased efficiency. The available studies suggest that income of business entities and households increases by the use of telecom services. Thus it contributes to the growth in GDP.

Today mobile telephone is the most prime and important component of telecom industry and its use has grown at a phenomenal rate as reflected by the following statement:

“Five babies are born every second worldwide, but 30 new mobile phones are subscribed to every second.” (MMT 2009)

In 1895, Guglielmo Marconi opened the way for modern wireless communications by transmitting the three-dot Morse code for the letter ‘S’ over a distance of three kilometres using electromagnetic waves. From this beginning, mobile communication has developed into a key element of modern society and has been playing a vital role in the socio-economic development of all the economies in the world as reflected by the following statement:

“Access to mobile and digital technology is an important driver of social and economic development, both in the developed and the developing world. Mobile phones offer far more than the ability to make calls. Billions of people in the
developing world live in remote and rural communities without access to healthcare or education, transport and up to date news – let alone banking or financial services. Mobile phone networks have the potential to transform the delivery of these services and make them available to many more people.” (Nokia 2009)

In recent times, India has emerged as one of the fastest growing telecom markets in the world, particularly by the unprecedented growth in mobile telephony. As per the latest estimates of Telephone Regulatory Authority of India (TRAI), the total telephone subscription in India reached 621.28 million on March 31, 2010, of which, mobile telephone subscription comprises 584.32 million i.e. 94.05 %. In 2008-09 and 2009-10, the mobile subscriber base has grown at 25 % every half year. With the successfully concluded auctions of the 3G and BWA spectrum, this growth is set to become even more pronounced. Globally in terms of mobile subscriptions, India is the world’s second largest mobile market after China.

However, this paper is concerned with studying the growth of mobile telephony in India and the econometric modelling of the impact of mobile telephony on the economic growth (measured in terms of Gross Domestic Product-GDP at factor cost) in India for the period from 2000-01 to 2009-10 using Ordinary Least Square (OLS) method. The paper also seeks to estimate the Compound Annual Growth Rate (CAGR) of the number of total telephone subscribers, foreign direct investment (FDI) in telecom sector, number of wire line subscribers, number of mobile subscribers and mobile teledensity in the country for the above period of study.

2. Literature Review

In earlier periods, telecommunications networks helped generate economic growth by enabling firms and individuals to decrease transaction costs, and firms to widen their markets. Hardy (1980) and Norton (1992) found that there is an “externality” component in enhanced fixed telecoms penetration – that is, GDP is higher, and growth faster in countries with more advanced telecoms networks. Roeller and Waverman (2001) estimated the impact on GDP of investment in telecoms infrastructure in the OECD between 1970 and 1990. They showed it significantly enhanced economy-wide output, allowing for the fact that the demand for telecoms is itself positively related to GDP.

Several more recent papers extend this analysis to mobile phones. Torero, Choudhary and Bedi (2002) showed in their research that first, for economies without many fixed lines, or where mobiles supplement low fixed-line rollout; there should be no inherent difference in the growth dividend of a phone, whether it is mobile or fixed. In developing countries, an additional phone, whether fixed or mobile, increases the small network size and adds to the economy’s growth potential. Secondly, where mobile phones complement fixed lines (in advanced economies), their externality effects will probably be different from those found for fixed lines. As
individual lifestyles change and as firms utilise mobiles in productivity-enhancing ways, we should see new economic growth from mobile networks as well.

Sridhar and Sridhar (2004) apply the RW Framework to data for 28 developing countries over the twelve-year period 1990 to 2001. The average compounded annual growth rate (CAGR) of GDP per capita in this period was minus 2.03 per cent, while the CAGR of mainlines was 6.60 and of mobile phones 78.0 percent. In their regression, they found that 1 percent increase in mobile phones penetration increases growth by 6.75 percent.

Aker and Mbiti (2010) examined the growth of mobile technology over the past decade and consider its potential impacts upon quality of life in low income countries of sub-Saharan Africa. They found that factors like population density and per capita income are positively associated with mobile coverage and factors associated with higher costs-namely, higher elevation, steeper slopes and distance from a main road and major urban centres-are negatively associated with mobile phone coverage. They concluded that mobile phone coverage and adoption have had positive impacts on agricultural and labour market efficiency and welfare in certain countries of Africa.

3. Objectives

The paper has the following objectives:

- To study the growth of telecom sector with emphasis on mobile telephony in India.
- To econometrically estimate the contribution of mobile telephony in the economic growth (GDP Growth) for the period from 2000-01 to 2009-10.

4. Research Methodology

This paper is entirely based on the secondary data taken from 1. Annual Report (2009-10 & 2010-11), Department of Telecommunications, Ministry of Communications & IT, Govt. of India, and 2. Annual Report (2005-06 to 2009-10), Telecommunication Authority of India (TRAI) and 3. Handbook of Statistics on Indian Economy (2010-11), Reserve Bank of India (RBI).

The growth of telecom sector specially mobile telephony in the country has been mainly analysed through the method of Compound Average Growth Rate (CAGR) estimated for the variables, number of total telephone subscribers, Foreign Direct Investment (FDI) in telecom sector, number of wire line subscribers, number of mobile subscribers and mobile teledensity for the period from 2000-01 to 2009-10. CAGR has been computed by fitting an exponential function to the above variables for which the exponential trend equation is defined as:

\[ y = a e^{bx} + c \]
The logarithmic transformation of the above function gives:

\[ Y = ab^t e^{u} \]  

(i)

where \( b = 1 + g \) and \( g \) is the compound annual growth rate.

and

\( Y = \) total telephone subscribers

foreign direct investment in telecom sector

number of wire line subscriber,

number of mobile subscribers and

mobile teledensity

\( t = \) time

The logarithmic transformation of the above function gives:

\[ \log Y = \log a + t \log b + u \]  

(ii)

And the values of \( \log a \) and \( \log b \) have been estimated using the following two normal equations:

\[ \sum \log Y = n \log a + \log b \sum t \]
\[ \sum t \log Y = \log a \sum t + \log b \sum t^2 \]

As equation (ii) is a log-linear function, therefore, CAGR has been computed by using the following formula:

\[ \text{CAGR (g\%)} = \frac{(AL \left( \log b \right) - 1) \times 100}{2} \]

In the above formula \( \log b \) has been taken 2 times obtained after solving above two normal equations as numbers of observations are even.

The main objective of this paper is to show the impact of mobile telephony growth on economic growth and mobile telephony growth is also derived to a good extent by FDI in telecom sector therefore:

In order to estimate the contribution of mobile telephony in the economic growth, Ordinary Least Square (OLS) method has been used taking the relationship between dependent and independent variable as follows:

\[ Y_t = f(X_t) \]

where
$Y_i =$Dependent Variable

$X_i =$Independent Variable

And the above functional relationship is expressed through the following equation:

$$Y_i = b_0 + b_1X_i + \varepsilon_i$$

where

$\varepsilon_i =$ random error term

The values of the parameters $b_1$ and $b_2$ have been estimated using OLS Method and estimated values are as under:

$$\hat{b}_1 = \frac{\sum X_i Y_i - n\bar{X}\bar{Y}}{\sum X_i^2 - n\bar{X}^2}$$

$$\hat{b}_0 = \bar{Y} - \hat{b}_1\bar{X}$$

where

$n =$ number of observations

$\bar{X} =$ mean value of the variable $X$

$\bar{Y} =$ mean value of the variable $Y$

The coefficient of interest here is $b_1$ which tells the change in dependent variable as a result of change in the independent variable.

5. THE GROWTH OF TELECOM SECTOR IN INDIA

Telecom sector has witnessed a continuous rising trend in the total number of telephone subscribers. From a meagre 22.8 million telephone subscribers in 1999, it has grown to 621.28 million at the end of March, 2010. Mobile telephone connections have majorly contributed to this growth as the number of wireless connections rose from 35.61 million in 2004 to 584.32 million in March, 2010. The wireline started to decline from 40.92 million in 2004 to 36.96 million in March, 2010 albeit it is stagnating now. The gross revenue of the telecom service sector for the year 2009-10 was Rs. 1,57,985 crores which is about 3.7% increase over the last year in spite of unprecedented recession in the market. Average Revenue Per User (ARPU) for full mobility service for GSM was Rs.131/- and for CDMA Rs.76 per month while the respective minutes of usage were 410 and 307.

The Present Status of Telecom Sector in India

- Indian Telecom market is one of the fastest growing markets in the world.
With its 621.28 million Telephone connection as on 31st December 2010, it is the second largest network in the world after China. It is second largest wireless network in the world with 584.32 million mobile connections as on 31st December 2010. Over 18 million connections are being added every month. The target of 600 million telephones by the end of 11th five year plan has been achieved in February’10 itself. Mobile telephones are increasing at faster rate. The share of mobile telephones as on 31st December 2010 is 94.05 % of the total phones. Overall tele-density has reached 66.17%. Urban teledensity is about 148%, whereas rural teledensity is at 31.22% which is also steadily increasing. Broadband connections increased to 10.74 million by November, 2010.

### Table 1: Indian Telecom Sector: Facts and Figures

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Subscribers (in Millions)</th>
<th>FDI in Telecom Sector (in Rs. Crore)</th>
<th>Wireline Subscribers (in Millions)</th>
<th>Mobile Subscribers (in Millions)</th>
<th>Mobile Teledensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-01</td>
<td>36.29</td>
<td>784</td>
<td>30.79</td>
<td>5.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2001-02</td>
<td>44.97</td>
<td>3938</td>
<td>34.47</td>
<td>10.5</td>
<td>1</td>
</tr>
<tr>
<td>2002-03</td>
<td>54.62</td>
<td>908</td>
<td>41.62</td>
<td>13</td>
<td>2.6</td>
</tr>
<tr>
<td>2003-04</td>
<td>75.54</td>
<td>409</td>
<td>41.85</td>
<td>33.69</td>
<td>4.4</td>
</tr>
<tr>
<td>2004-05</td>
<td>98.41</td>
<td>570</td>
<td>41.23</td>
<td>57.18</td>
<td>6.9</td>
</tr>
<tr>
<td>2005-06</td>
<td>140.32</td>
<td>2774</td>
<td>41.5</td>
<td>98.82</td>
<td>9.27</td>
</tr>
<tr>
<td>2006-07</td>
<td>206.83</td>
<td>2155</td>
<td>40.75</td>
<td>166.08</td>
<td>14.61</td>
</tr>
<tr>
<td>2007-08</td>
<td>300.49</td>
<td>5103</td>
<td>39.42</td>
<td>261.07</td>
<td>22.78</td>
</tr>
<tr>
<td>2008-09</td>
<td>429.72</td>
<td>11727</td>
<td>37.96</td>
<td>391.76</td>
<td>33.71</td>
</tr>
<tr>
<td>2009-10</td>
<td>621.28</td>
<td>12338</td>
<td>36.96</td>
<td>584.32</td>
<td>49.6</td>
</tr>
</tbody>
</table>

Source: Annual Report, Telecom Regulatory Authority of India, (2007-08 to 2009-10)

**Fig. 1: Share of Subscriber Base of Mobile Operators in India (as on 31st March 2010)**

*Source: Annual Report, Telecom Regulatory Authority of India, 2009-10*
6. Empirical Analysis

In order to study the growth of telecom sector, CAGR has been calculated for the different variables for the period from 2000-01 to 2009-10, which is shown in table 2.

Table 2: CAGR in Telecom Sector in India during 2000–01 to 2009–10

<table>
<thead>
<tr>
<th>Variables</th>
<th>CAGR (in per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Telephone Subscribers</td>
<td>38.10</td>
</tr>
<tr>
<td>FDI in Telecom Sector</td>
<td>33.50</td>
</tr>
<tr>
<td>Number of Wire line Subscribers</td>
<td>1.20</td>
</tr>
<tr>
<td>Number of Mobile Subscribers</td>
<td>70.10</td>
</tr>
<tr>
<td>Mobile Teledensity</td>
<td>63.10</td>
</tr>
</tbody>
</table>

Table 2 reveals that growth of telecom sector has been tremendous during the period of study as CAGR of total telephone subscribers is 38.10 % and 33.50 % for FDI in telecom sector. The table also shows that growth rate of wireline subscribers is mere 1.2 % while the growth for mobile telephony is 70.10 % and 63.10 % for mobile teledensity.

In order to know the contribution of mobile telephony in GDP growth three Regression Analysis using OLS model have been done result of which is shown in the following tables:

Table 3: Regression Statistics

Mobile Telephony (Y) and FDI in Telecom Sector (X)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t-Statistics</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>b0</td>
<td>-2.32</td>
<td>34.05</td>
<td>-0.07</td>
<td>1%</td>
</tr>
<tr>
<td>b1</td>
<td>0.04</td>
<td>0.01</td>
<td>6.98</td>
<td>1%</td>
</tr>
</tbody>
</table>

R Square: 0.8588
Adjusted R Square: 0.8412
Durbin-Watson Statistics: 1.883
F-Statistics: 48.69
Total Observation: 1
Table 4: Regression Statistics
GDP (Y) and Mobile Telephone Subscribers (X)
Dependent Variable: Y,
Independent Variable: X,
Correlation Coefficient: 0.946 (significant at the 0.01 level, 2 tailed)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t-Statistics</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>( b_0 )</td>
<td>264459.25</td>
<td>109885.83</td>
<td>24.07</td>
<td>1%</td>
</tr>
<tr>
<td>( b_1 )</td>
<td>3691.14</td>
<td>446.70</td>
<td>8.26</td>
<td>1%</td>
</tr>
</tbody>
</table>

R Square: 0.8951
Df: 9
Adjusted R Square: 0.8820
Durbin-Watson Statistics: 0.490
F-Statistics: 68.28
Total Observation: 10

Table 5: Regression Statistics
GDP (Y) and FDI in Telecom Sector (X):
Dependent Variable: Y,
Independent Variable: X,
Correlation Coefficient: 0.832 (significant at the 0.01 level, 2 tailed)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t-Statistics</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>( b_0 )</td>
<td>2666973.16</td>
<td>196102.72</td>
<td>13.60</td>
<td>1%</td>
</tr>
<tr>
<td>( b_1 )</td>
<td>141.57</td>
<td>33.36</td>
<td>4.24</td>
<td>1%</td>
</tr>
</tbody>
</table>

R Square: 0.6924
Df: 9
Adjusted R Square: 0.6540
Durbin-Watson Statistics: 0.490
F-Statistics: 68.28
Total Observation: 10

Table 3 shows that the value of \( b_1 \) is 0.04 which means that Rs. 1 crore FDI in telecom sector leads to an increase of 0.04 million mobile subscribers \textit{ceteris peribus}, table 4 shows that value of \( b_1 \) is 3691.14 which means one million increase in mobile subscribers lead to an increase of Rs.3691.14 crore in GDP \textit{ceteris peribus} and table 5 shows the impact of FDI in telecom of GDP which is that Rs. 1 crore increase in FDI in telecom sector leads to Rs. 141.57 crore in GDP \textit{ceteris peribus} as value of \( b_1 \) is 141.57.

7. SUMMARY AND CONCLUSION
There is a long tradition of economic research on the impact of infrastructure investments and social overhead capital on economic growth and investment in telecom is an important content in SOC. Telecommunications is an important prerequisite for participation in the modern economic universe. There is a long-standing literature attempting to gauge the economic impact of telecommunications, with the findings of Roeller and Waverman (2001) suggesting a substantial growth dividend in OECD nations.

This paper demonstrates the impact of mobile telephony on the economic growth in India by knowing the increase in GDP as a result of increase in mobile telephone subscribers. The paper also studies the growth of telecom sector with emphasis on mobile telephony for the period from 2000-01 to 2009-10.
The growth of the telecom sector has been massive which is highly contributed by the growth of mobile telephony as CAGR of mobile subscribers is 70.10 % and for mobile teledensity, it is 63.10 % for the period of study. Our econometric analysis concludes that increase of one million mobile phone subscribers leads to increase of Rs. 3691.14 crore in the GDP of the country *ceteris peribus*.

Thus our analysis demonstrates that mobile telephony growth has led to good increase in GDP growth. FDI also affects the mobile telephony growth as well as GDP growth in a positive way. Therefore we suggest that use of mobile telephony should be spread in all the areas especially in rural areas of the country as it leads to increase in the efficiency of all the sections of the society.

**REFERENCES**


Official statistics show that there has been a dramatic increase in the number of reported crimes against women and in such situations of utter emergency (i.e. in case of an accident, abuse attempt or being lost or so in an isolated area), most women are unable to find themselves out. This paper introduces an application which concentrates on the day-to-day requirements of a woman and also acts as a proactive measure towards any crime done against them. It caters to ease off their undesired yet urgent household requirements with just a few clicks.

"SAI—An Application for Women" is aimed at easing the lives of the women of our society using the small modules provided in the application. We have used Qt for developing this application for several reasons viz. it offers a robust, tried and tested application and GUI framework for the development of rich, compelling applications for Nokia Symbian Smartphones. Also, it greatly reduces the coding effort through intuitive APIs that deliver more functionality from less code. When it comes to the application’s UI, the web based technology in Qt Quick enables us to create compelling UIs faster. It has basically 3 different modes:

1. **HOME MODE**
   A list of different necessary items will be available. The user can check the required items and send it to desired number.

2. **EDUCATOR MODE**
   Here the users can play the audio of their choice.

3. **SECURE MODE**
   This allows the users to store their desired emergency contacts and initiate a call to the stored emergency contact when needed.

   Presently, all the modules provided in this application require manual directions (inputs) from the user to trigger a particular module according to the requirements. So, it provides a wide scope of future work that will concentrate on the following points:

   - Use of key capture event to read a slightly long key-press on the keypad (say for few seconds duration) which will eventually provide easy access to the respective module.
   - Location API can be added with “SECURE MODE” that will get user’s present location when required and send this location as a message to the emergency contact number stored in the file.
The vision of this project is to add to the mobile based applications thereby leading to an easy access to life changing services through which women in the developing world can achieve a greater sense of security, independence, economic opportunity and connection with the world outside their homes. This will lead to greater empowerment and control over their lives and those of their families.
Global Software Development Projects as a Model for Capacity Building in M4D

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Abstract — Capacity building in mobile technology is crucial in the context of today’s global IT industry. Programs initiated by universities and organizations are emerging rapidly worldwide with courses on the technology and business aspects of mobility. Beyond the platform discussions, some initiatives are encouraging students to think about the social impacts of mobility and its entrepreneurial opportunities by engaging them in M4D projects \([1,2]\). Rather than training students in different countries in isolation, the innovative aspect of our model is that students distributed across several countries are gaining key skills and competencies by collaborating together to develop M4D solutions. They are sharing local knowledge to develop a global understanding of the field of mobility and propose solutions to M4D problems integrating different views.

2005, we have been setting up annual global software development projects to engage and prepare students to work in distributed teams and develop software together \([3]\). Participants typically play the roles of business analysts, developers, and quality assurance. In 2009, the model introduced the development of M4D solutions rather than web solutions. Team work was facilitated by the use of Scrum and end-to-end cloud solutions. In 2009 nine students in the US, Senegal and India developed Target First Grade, a Java ME application for first graders in Senegal to practice with mathematics, reading, writing and geography. In 2010, forty three students in the US, Senegal, India, and Cambodia developed global solutions for Android, BlackBerry and Java ME phones to improve life on campus. In 2011, eleven students in the US, India and Senegal developed solutions on smarter energy, including a multi-channel solution for car pooling and a game to increase smarter energy awareness. Some of these solutions were piloted for evaluation in Senegal by the local teams.

Students unanimously appreciate the experience. In the next instances of the model, we plan to focus more on the development of applications for release on the marketplace and on the global entrepreneurial opportunities generated by this project.

1. Acknowledgment

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References

Mobile Communication and Community Development

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1. Introduction
Health care can be divided into primary, secondary, and tertiary care. In the context of developing and underdeveloped countries, secondary and tertiary services are concentrated in urban cities while rural areas that cover most part of the country are still served by minimal primary care health services. Medical professionals and doctors prefer to stay in the urban cities and hesitate to serve in the rural areas, due to the lack of medical resources in rural areas and the lack of incentives for them. Consequently, more than a million people—predominantly women and children—die each year in India, due to lack of healthcare facilities. Another 700 million have no access to specialist healthcare, as 80% of doctors live in cities. Besides, despite having 20% of the global disease burden, India has only 6% of the hospital beds. Therefore, mobile healthcare can act as a game changer to deliver healthcare services and create healthcare awareness to patients even in remote regions.

2. Aim
The aim of this poster paper is to suggest the utilization of mhealth to provide accessible, affordable and quality healthcare services in the developing countries such as India.

3. Discussion
The application of m-health and e-health in healthcare would decrease transfer of patients to a site with medical expertise along with reduction in the number of patient days in the hospital and decrease in reallocation of medical specialists to the patient which in turn will provide better organized and less costly healthcare. The key applications for mHealth in developing countries are: (a) Education and awareness, (b) Remote data collection(c) Remote monitoring (d) Communication and training for healthcare workers (e) Disease and epidemic outbreak tracking (f) Diagnostic and treatment support. Mobile devices could be used as a reminder to take medications, regular patient follow ups to check on the drug efficacy, to register births, obtain fingerprints for identification purposes and find information on locations where people need healthcare, help healthcare workers in gaining valuable epidemiological information which can help them in channelizing efforts.
4. Conclusion

With mHealth we can provide advanced healthcare services in an affordable manner, even in farthest corners of the country, but there are certain economical and technological barriers. To curb this problem, multiple stakeholders, public-private partnerships should be formed to meet the nation’s cherished goal of healthcare for all Indian citizens across the country. Along with it the technology should be kept simple, relevant and local, with involvement of users in the design and introduction of good monitoring, evaluation and communication strategies in the design.
Use of Mobile Phone Technology for Community Based Service Delivery and Surveillance for Safe Motherhood and Child Survival”

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1. BACKGROUND

Every year, about 64,000 mothers and 1.8 million children die in India and many of them are preventable. According to recent series of papers regarding health system in India published in the Lancet, one of the most important bottlenecks for India to meet its Millennium Development Goals related to child and maternal mortality is insufficient and suboptimal quality of delivery and monitoring of proven interventions (1). Appropriate and timely data has potential to improve maternal and child health outcomes (2).

2. OBJECTIVES

SEWA Rural and mPower Health is about to launch a project to develop an evidence based, scalable, user friendly mHealth model for maternal and child health surveillance and services that can reduce maternal, neonatal and infant mortality and effectively manage morbidity in resource poor settings.
3. Methods

This project will be implemented in 168 rural, poor and tribal villages covering Jhagadia block in Gujarat, India with a total population of 175,000. This project will leverage upon the community health platform created by SEWA Rural, a grass-root NGO, over last decade among these villages. We are focusing on process flow of health information system of proposed project and risk stratification system for this abstract. Adjoining figure describes the process flow.

1. Frontline worker (FLW) interviews the patient and enters pregnancy related information in the mobile application.
2. FLW sends the collected information via GPRS to the central server. This information is then automatically processed at the server end and patient is placed in one of the 4 risk categories (1 being lowest and 4 highest risk).
3. An automated response or advice is sent to FLW based on protocol.
4. On identification of a risk level 3 or high risk patient, a doctor is immediately notified.
5. The supervisor receives notifications when patients with either risk level 2 or 3 are identified.
6. The doctor relays appropriate medical advice to the FLW regarding the high risk patient.
7. The FLW relays this advice to the patient and cares for her or the child accordingly.
8. Risk level 4 patients (very high risk patients; woman or baby is experiencing convulsion or is unconscious etc) are referred to the hospital immediately by the FLW.
9. Supervisors visit and follow-up on all patients that come in risk category 2 3 and 4 regularly.
10. FLW’s are regularly reminded to follow-up all mothers at regular intervals, their schedule is made keeping in mind any at risk mothers or babies in their area.
11. The record for all patients that are referred to the hospital is updated there and the referral loop is closed.

4. Results and Conclusion

At the end of this project, a mHealth model will be ready for providing surveillance and services.

References


mLearning and mGovernance
Access-technology Agnostic Conceptual Model

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Abstract—The delivery of digital content and services to end users in an access-technology agnostic manner has the potential to promote equitable access. Components of relevant Information and Communication Technology (ICT) functionality comprise of computing, connectivity, content and capacity. These functionalities are extended to include the delivery mechanism. The delivery mechanism is responsible for the actual delivery of digital content and services to communities or individual end users. The purpose of this study is describing a content delivery mechanism that provides access-technology agnostic delivery of digital content and services to resource-constrained communities. The proposed delivery mechanism adopts the conceptual service delivery architecture of the telecommunications service delivery platforms. It reuses the concepts of network abstraction and access agnostic delivery pattern to ensure equitable access to digital content and services. Such a delivery mechanism would be able to capitalize on available technological capabilities of resource-constrained communities. This paper overviews the proposed access-technology agnostic delivery model and details a prototype implementation.

Keywords: Digital content and services, Delivery mechanism, Access-technology agnostic.

1. INTRODUCTION

A main thrust of ICT4D has been the delivery of digital content and services to resource-constrained communities (Pitula, Dysart-Gale & Radhakrishnan, 2010). Despite efforts there is little evidence of delivery mechanisms that facilitate relevant content and service delivered to end-users through any access-technologies and devices available to the end-users. Consequently a delivery framework to enable inclusive and equitable access to digital content and services remains a challenge.

Preceding efforts to address this challenge are the proposals on community information systems outlined by Bieber, Mcfall, Rice, and Gurstein (2007). Their deliberations, however, do not address the issue of access-technology agnostic delivery of information. Furthermore, many of the proposed content distribution models involved a single access-technology or a specific areas, points or nodes of access within a community (Jacobs & Herselman, 2006; Akinsola, Herselman & Jacobs, 2005; Lavhengwa, 2007; Mvelase et al, 2009). Further to this has been the use of specific content delivery formats (Agarwal et al, 2009; Patel et al, 2006).

Subsequently, digital content and services are distributed only through a specific physical network, and available only from isolated nodes of
access that cater for a specific format. This shift in focus, Botha (Botha, Makitla, Ford, et al., 2010) terms a digital difference. Where a digital divide focuses on the provision of technology to access services and content, a digital difference shifts the focus towards provision of content and services through technology that is available. In order to address this paradigm shift in community information provision, this paper describes an access-technology agnostic delivery approach. The following section outlines the Methodology used followed by a deliberation of the components of such a delivery approach to enable ICT functionality to resource-constrained communities.

2. Methodology

According to Olivier (2004:12), research studies with technical goals, such as this study, apply creative research methods intended to device new mechanisms to be used in computing. The quality of such creative methods is measured in terms of attributes of the creation such as its utility (Olivier, 2004:12). Design-science research approach (March & Smith, 1995:253) lends itself naturally for this nature of study.

A model is one of the artifacts that are developed through design-science research (March & Smith, 1995). In order to develop the proposed model, this study followed the seven guidelines of doing design-science research outlined by Hevner et al (2004). This study further conformed to the five-step interactive process of design and creation research methodology (Oates, 2006). Furthermore, because this study makes certain claims that the proposed Access-technology Agnostic conceptual model developed bears characteristics that make it better suited to address the problem, the model is tested and evaluated, specifically to ascertain that it does indeed have beneficial characteristics enabling it to address the problem of the delivery of digital content and services to resource constrained communities sufficiently.

Evaluation of the Access-technology Agnostic conceptual model in this case, is one of the guidelines in the seven-guideline list of doing design-science research (Hevner et al, 2004:85). Evaluation is a research activity within the design-science research aimed at developing criteria by which artifacts may be assessed (March & Smith, 1995:258). Furthermore, because purposeful artifacts are built to address hitherto unsolved problems, these artifacts are to be evaluated with respect to the utility they provide in addressing those problems (Hevner et al, 2004:78). Evaluation metrics define exactly what the research is trying to accomplish (March & Smith, 1995). In the case of this study, being able to deliver same digital content (service) to end-user devices that are connected to different access-networks and that support different content formats (access-technology) is a key evaluation criterion.

The approach adopted for evaluation in this study is an initial proof of concept. The concluding expectation for this study is to demonstrate that
the proposed Access-technology Agnostic conceptual model is practical and can be implemented. The “Black Box Testing Technique” (Krichen & Tripakis, 2004) was adopted; this technique hides the complexities of the system components and only focuses on the system functionality as viewed from the end-user perspective in accordance to the expectation.

The Access-technology Agnostic conceptual model is outlined as a possible configuration of a Digital Content Delivery Mechanism to achieve access-technology agnostic delivery of digital content.

3. Delivering ICT Functionality

ICT4D concerns itself with promoting the use of ICTs to enhance developmental initiatives which can be discernible as the realization towards the Millennium Development Goals (Sambasivan et al, 2009: 156; Dias & Brewer, 2009:75). Heeks (2008:26) argues that the prioritisation of ICT application in developmental initiatives relate to the economic, social and political life in the 21st century. He anticipates that future participation in such structures will be increasingly digital, and will potentially exclude communities and individuals without access to ICTs. Therefore Heeks (2008) and Unwin (2009) propagate addressing the uneven diffusion of access and participation in the information society as a critical developmental mission.

To this end, ICT4D is driven by three main thrusts (Pitula, Dysart-Gale & Radhakrishnan, 2010):

- The development of the necessary technical infrastructure in a sustainable manner,
- The delivery of digital content (information), as well as
- Building the human capacity to effectively use, maintain and manage the available ICTs.

ICT4D can achieve this through innovation in four key areas colloquially referred to as the 4C Framework (Tongia & Subrahmanian, 2006): connectivity, computing, content, and capacity. The next section describes how the 4C Framework has been adopted to define an access-technology agnostic approach to delivering digital content and services to communities.

3.1 Components of Delivering ICT Functionality

The 4C Framework is adopted as appropriate primary components for delivering ICT functionality to resource-constrained communities. Figure 1 depicts these components. Each of the components in Figure 1 is briefly outlined below:

3.1.1 Connectivity

Firstly, the community has a whole has supporting physical infrastructure such as road networks, electricity, community local networks and
telecommunication infrastructure. The connectivity element is addressed through development of the required communications infrastructure to facilitate human interaction and cooperation.

3.1.2 Personal ICT Devices

Secondly, individuals within the community each owns and has access to some technological or computing devices which they use to access the digital content and services that are accessible through the available community infrastructure. This is addressed by the both the first and second thrusts of ICT4D initiatives, namely, developing the required infrastructure as well as building human technical capability (ability to use technological gadgets effectively in this case).

![Fig. 1: Components of ICT Functionality Adapted from Tongia & Subrahmanian (2006)](image)

3.1.3 Digital Content (Information) and Services (Information Systems)

Digital content (information) and services (information systems) are delivered through the available infrastructure. This is addressed by the third thrust of ICT4D initiatives, namely, providing access to digital content and services.

3.1.4 Human Capacity

Individuals within the community have some working knowledge to be able to operate their personal ICT devices to access relevant content and services through the available community infrastructure. This also means the technical know-how needed to maintain and manage community owned ICT infrastructure, the ability to understand the available information as well as how to use the information systems to retrieve it.

Incorporating Delivery Mechanism as the fifth component facilitates the need to represent the crucial delivery of digital content/services to end-user
communities. Figure 2 below illustrates the relationship between the four components from Tongia and Subrahmanian’s (2006) 4C Framework and the additional component, the Delivery Mechanism.

![Diagram of Access-Technology Agnostic Delivery Model]

**Fig. 2: Components of Access-Technology Agnostic Delivery Model**

The information needs of the community (Dutta, 2009; Dhingra & Misra, 2004) inform the nature of digital content to be delivered to the end-user through some delivery mechanism. The digital content is made available to end-user communities through whatever access they may have to the delivery mechanism.

Community ICT resources comprise of *human skills* (technical know-how) and the supporting *physical and information infrastructures*. The communications or information infrastructure further comprises of community-owned or public infrastructure and the private or personal communications and entertainment gadgetry. This gadgetry can be described as a collection of electronic devices owned by private individuals or end-users. Together the *community infrastructure*, the *personal computing infrastructure* and *technical know-how* constitute the community’s technological capabilities. These community technological capabilities afford community members access to digital content and services that are available through the delivery mechanism.

The *technical know-how* additionally enables users to make effective use of their devices and access networks. This effective use of available technologies further enables users to acquire value from access to the information infrastructure.

The delivery of digital content and services to end-users in the community is ultimately enabled by the Digital Content Delivery Mechanism which interacts with all components associated with the effective delivery of ICT functionality.
We argue that for equitable access to digital content and services, the delivery mechanism has to ensure access-technology agnostic delivery. The delivery mechanism has to ensure the needed participation mechanisms for delivery of content and interaction with services to all users regardless of the access infrastructure they connect through or the computing devices they use. This will require separation of the service logic, the content presentation format and the underlying access network. The separation of concerns among components of the proposed model proves to be a very promising approach to achieving universal information delivery – to deliver content (information) through any access technology (connectivity) and to any potential end-user device.

4. ACCESS-TECHNOLOGY AGNOSTIC DELIVERY MODEL

To ensure access-technology agnostic delivery of digital content and services to resource-constrained communities, the delivery mechanism is presented and discussed in the following section.

4.1 Conceptual Model

Figure 3 represents the Access-technology Agnostic conceptual model developed, and is briefly outlined.

4.1.1 Physical World

The Personal ICT Devices used to access the ICT4D services, underlying Sensors and Access Networks through which the user is accessing services are all tangible objects in the physical world; they form part of the physical layer of the access-technology agnostic conceptual model.

4.1.2 Enablement Layer

The Enablement layer defines the platform’s explicit support for an access technology (communication protocol, device and content format). Specifically it adapts the delivery mechanism to the physical world, and represents the physical world to the internal components of the delivery mechanism.

Device Capability Negotiation Function is part of the Enablement layer, this function is envisaged to collect information about the capabilities and features of the end-user device (e.g. display size, CPU processing speed and direct download limit) and uses this information in rendering multimedia content to the connected end-user device.

Content Conversion Function is also part of the Enablement layer, this function is responsible for content-device capabilities matching. Since a service may produce outputs that need to be presented at the end-user device, this function adapts the content to the format understandable to the device.

The Network Abstraction Function is adopted from the service delivery platform (SDP) conceptual model (Christian & Hanrahan, 2007) and
abstracts the complexities of the underlying access-technology from the platform.

### 4.1.3 Access-agnostic Layer

The access-agnostic layer has no knowledge of the network resources, it receives requests from the Enablement layer (already in a form understandable within its environment) and it has the logic or algorithm to ensure that these requests do reach their intended services. As far as the access-agnostic layer is concerned, it knows only that it has to forward these requests to the interfacing layer which “subscribed” to be notified of such requests. It is not aware of the application-specifics; it is only the Interfacing function that needs to worry about application-specifics.

### 4.1.4 Integration/Interfacing Layer

The Integration/Interfacing layer is fully aware of what services lie outside of the platform. When a request is received from within the platform for one of the ICT4D services, it is the responsibility of the interfacing layer to invoke the appropriate service logic on the requested ICT4D service itself. The Interfacing layer therefore must have all the knowledge it needs in order to correctly invoke these services. The Interface layer represents the ICT4D services to other components in the lower layers of the platform.

### 4.1.5 Services Publishing Layer

The Publishing layer is shown as a layer for ease of description but is logically part of the Interfacing function. ICT4D services inform the platform of their presence by publishing/advertising themselves. Through these
advertisements, they provide sufficient information necessary to invoke the advertised service logic. The Interfacing layer, which is responsible for the invocation of these external services, subscribes to be notified as and when services become available.

4.1.6 ICT4D Services
ICT4D services are the actual digital content and services that are to be delivered through the available community access infrastructure. They are domain specific and are developed by or on behalf of ICT4D practitioners to address specific community needs. Examples of these services include eHealth, mHealth, mLearning, and weather services.

The proposed configuration presented in Figure 3 draws its inspiration from the Service Delivery Platform model and related concepts in telecommunications (Jain, 2007; Maes, 2007; Christian & Hanrahan, 2007; The Moriana Group, 2010). This study refers to this configuration as access-technology agnostic because it allows delivering information to the end-user independent of his or her technology of access. This configuration was adopted because it promises inclusivity, extended reach and equitable access to information.

4.2 Advantages of this Approach for Mobile Phone Users
With the proliferation of mobile devices as the most prevalent personally owned ICT the following four advantages associated with the Access-technology Agnostic conceptual model can be outlined:

4.2.1 Access-technology Independence
Because the access network is separated from the core service logic, a user-device can be connected to any access-network and still be able to access the service. The significance of “access-network” is that only a specific set of devices can support certain access networks (technologies). For instance, low-end mobile phones (e.g. Samsung GT-E1080i) may not be able to connect to the 3G networks, and as such any service available through the 3G networks is inaccessible to these devices, and by extension, to their owners or users.

4.2.2 Future-proof and Scalable
Underlying access network complexities are hidden from the service logic and execution environment, this makes it possible for new access technologies to be added to the enablement layer, it is also possible to support new and advanced devices as user’s upgrade their handsets.

4.2.3 Content Format Independence
The decoupling of service logic, service access and content presentation make it possible to present the same content (e.g. information about farming) in multiple formats (Webpage, mobile phone text message, or audio) depending on the requesting user-device capabilities.
4.2.4 Delivery of ICT4D Services to all

By plugging ICT4D services into the access-agnostic delivery mechanism, these services can be accessible through any access-technology and can be presented in any formats supported by the end-user devices. This is the enabling power of the proposed access-agnostic delivery mechanism.

This study argues that when configured as described in above, the delivery mechanism is able to deliver content (ICT4D services) to any device with the help of the device-capability negotiation and content conversion functions. The device can be connected to any underlying access-network, because the network abstraction function hides these details from the service logic execution environment. Content can also be presented in any format (text or audio) supported by the end-user device because the content conversion function is aware of both the content type and device capabilities.

The next section discusses the initial proof of concept implementation used to validate the Access-technology Agnostic conceptual model.

5. Reference Implementation

Instantiations of design-science artifacts serve to demonstrate feasibility and to show that artefacts of design science can be implemented in reality (Hevner et al., 2004:79). Therefore the final expectation for this study was to demonstrate that the proposed Access-technology Agnostic conceptual model is practical and can be implemented.

The initial implementation of the Access-technology Agnostic conceptual model demonstrated how a pre-existing service (online weather service), traditionally accessible through a website (www.rssweather.com) could be made accessible through multiple channels and in multiple formats (text/voice). The proof of concept was demonstrated using the Mobi4D communications service delivery platform (Botha et al., 2010). It was necessary to develop additional access network abstractions components to enable access-technology agnostic delivery of the weather service. The Figure below shows components that were developed to demonstrate access-technology agnostic properties of the proposed Access-technology Agnostic conceptual model.

The weather-service component receives weather requests from any underlying access network represented by the network abstraction components (HTTP RA, SSMI RA, MXitGateway RA and SIP RA). After retrieving the weather information from the service provider, the weather-service component sends the response back to the requesting network abstraction components. Formatting and presentation of the weather information is the responsibility of the network abstraction components since each has knowledge about the capabilities of the access-technologies they abstract. The reference implementation successfully made the weather
information available through multiple access-technologies and formats. This demonstrated the utility and technical viability of the proposed Access-technology Agnostic conceptual model.

![Diagram](image)

**Fig. 4: A Reference Implementation of Access-Technology Agnostic Delivery**

### 6. CONCLUSION

Ensuring equitable access to information is important both in terms of the importance of knowledge for development, and addressing global inequalities of opportunities. ICT4D has the potential to assist in this regard through its three main areas of concern, namely development of required ICT infrastructure, development of human capacity, and through the delivery of digital content and services.

Owing to the lack of delivery mechanisms in place to realize the equitable access to information, this paper presented an Access-technology Agnostic conceptual model, it also presented an initial proof of concept implementation of this model. The initial proof of concept implementation successfully demonstrated that relevant services and content could be made accessible through a diversity of technology commonly associated with resources constrained communities.

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A Social Web for Another Billion

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Abstract—The issue of Web-accessibility in the era of Web on Mobile in India is daunting, as most users are not likely to be sufficiently literate to browse the text heavy pages. Among many considerations in addressing this issue are the identification of the requirements for content consumable for those with different abilities and the determination of an approach for creating such content. Inspired by many success stories regarding participatory approaches, we propose a propagator (those who re-narrate content for wider consumption) approach for the creation of print-impaired friendly content. This segment is the majority of mobile users in India. This paper presents an approach for re-narrating web content for enabling access to print-impaired web users. A system called alipi for such re-narration is presented with examples.

1. Introduction

The Web has been remarkable in making a great collection of diverse content available at our fingertips. The widespread availability of mobile phones with Internet access expands the possibilities even greater. Access to phones crosses most socio-economic barriers, which presents very interesting opportunities and challenges [6,7]. Perhaps the most important challenge is making the content delivered to such devices truly accessible. Content is accessible, not only, if it is deliverable to a device, but that it also is understandable to the user of that device. Issues like illiteracy, disability, and languages are serious barriers to true access.

Historically, web content has been predominantly textual. More recently, audio, video, and image based content is also commonly available. Nevertheless, content is still dominated by text. Even when we consider video content, there are usually descriptions and user comments associated with them. Government policy documents and acts, for example, are always large textual documents.

Given the abundance of content and content providers--thanks to participatory platforms of Web 2.0--we propose an approach whereby users can provide content based on existing content. In fact, bloggers often perform such services, by writing blogs based on something(s) they read on the Web. We propose a structured manner of doing this, where the relationship between the source and target are preserved. What we propose can be termed as a social semantic web [10], a collective knowledge system [11] that builds on capacities and interest among Web users who can provide alternative narrations of content that is suitable for a specific target community need.
1.1 Oral Culture Versus the Internet

It is too familiar in the “South”, that a society is based on transmission of history, literature, law and other knowledge across generations-orally i.e., without a writing system. Internet has however been based on text i.e., a writing system. There has been an influx of video documentation on the Internet over the last couple of years. This effect can be attributed to a large extent on the availability of cameras on mobile phones that make it not only easy to capture but also to upload the picture or video to a site like YouTube.com.

South Asia, which has been lagging behind the West in the number of people connected to the Internet, is bearing witness to the power of the mobile device to empower millions with information, content and services. The power of mobile innovations and applications in content and services delivery is on the rise. It is time that we in South Asia, the nations and governments in the region, as well as service providers, give a thrust on mobile for delivering meaningful services, especially that could empower and enable efficient day-to-day life for the larger masses.

1.2 Non-Formal Communications and Community Radio

There is a profound lack of appropriate and effective learning opportunities in remote, rural and resource-poor parts of the world. Schools, by and large, do not cater to non-formal or life-long learning needs of adults or youth. Universities and colleges have at best a limited footprint in most rural and remote areas and courses are rarely framed to meet the livelihood, health or development needs of communities or their members.

Just as it is hard to imagine universities offering non-formal educational services in developing areas, it’s unlikely that community groups can fill the gap on their own. Local media, community development programmes, information and communication technology (ICT) centres, development and other localised services, even when information-based, are seldom effectively structured for engaged learning. There is however untapped potential in collaboration among these groups: educational institutions, local development agents, media/ICT groups and communities.

Community Radio has been advocated to play a large role in helping develop a culture of dialogs and information sharing for localized needs.

1.3 Accessibility and the Print Impaired

Web pages dominate with text. The Web-accessibility has been traditionally addressed as a concern by countries where illiteracy has not been a major issue and therefore accessibility concerns have been for the physically disabled. However, in countries like India, majority of people are uncomfortable with text, either because they are not literate or because they are literate only in their localized language.
There are several Assistive Technologies used for web browsing such as screen readers, speech recognition, screen magnification and keyboard overlays. There are web-page authoring guidelines developed by the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C) [1]. These guidelines help understand and implement web accessibility. However, these guidelines do not have a prescription for the print-impaired or for the needs of an “oral web”. The issue of Web-accessibility for the print-impaired can be considered as the issue of the next-phase of Internet users—the next billion new users who may not be as literate as the Internet users until now. This is a large class of people who cannot read the content on Web-pages and will include billions of people who are illiterate but might soon find it easy to access the Web through their mobile phones. This is also an issue for inter-cultural inter-language inter-contextual communication that the current web is trying to cope with.

On the one hand, we need to look at how authoring of Web-pages (the structure) and meta-information (appropriate meta-tags) can help and on the other, how the world of Web 2.0 can nurture a community around a Web-page so that the content becomes accessible to a wider group of people than what the capacity of the original author could address. For example, the sub-titling of TED talks [2] and and the Mozilla UniversalSubtitles project [3] not only support but relay on such community contributions.

2. Re-narration Web

2.1 The Idea

Lets take a web page, say of fire safety, which is originally authored in English as shown below.

HOME

Fire is the rapid oxidation of a material in the chemical process of combustion, releasing heat, light, and various reaction products. Slower oxidative processes like rusting or digestion are not included by this definition. The flame is the visible portion of the fire and consists of glowing hot gases. If hot enough, the gases may become ionized to produce plasma. Depending on the substances alight, and any impurities outside, the color of the flame and the fire’s intensity might vary.

A fire department or fire brigade is a public or private organization that provides fire protection for a certain jurisdiction, which typically is a municipality, county, or fire protection district. A fire department usually contains one or more fire stations within its boundaries, and may be staffed by career firefighters, volunteers, or a combination thereof.
Notice that a search for alternative narratives that are suitable for the Hindi speaker (from India) has found an image of an Indian fire engine and also found a Hindi narrative for the second paragraph and re-rendered the page by substituting the alternative narratives that are more suitable for the Hindi speaker. Similarly a Turkish or a French person could ask for re-rendering of the page and see parts of the age or the whole page depending on the contributed Turkish or French narratives out there on the Internet.

Figure 1 describes the general process of how various page observers can see more appropriate renditions of the original page that serves as the source for alternative renditions.

As we noticed in the page rendition for the Hindi reader, only part of the original page was re-narrated to a Hindi context. This means that alternative narrations were contributed for only parts of the original page. As Figure 2 shows, alternative narratives can be contributed to parts of a page by narrators who have an interest in narrations for a certain user group.

Technically, this is achieved by annotating a blog post as an alternative narration of a particular page of a source page. For example, a11y.in/a11ypi/idea/firesafety.html is the source page shown above. As explained in the idea page a11y.in/a11ypi/idea [9], a blog post that is meant to be an alternative narrative saves as meta information a reference to the part of
the source page that is the source for the alternative narrative. In the Hindi blog case the meta information was part of the paragraph tag in the blog and has the attributes foruri and rec:

This information is analogous to backlinks in blogs. However, the semantics attributed in this case is that the text in Hindi is an alternative narrative for the text at “id” div1 in the source page http://www.a11y.in/a11ypi/idea/firesafety.html and the “rec” attribute indicates that this narrative is recommended for Hindi speaking contexts.
2.2 Adaptation to a Mobile Context

These contributed alternate narratives, in addition to associations [4] also make it easier to deliver a web-page as a slide show or effectively as an audio/video rendition, on smaller screens such as those of mobile phones and tablets. For instance, the fire safety page mentioned above can be rendered by serializing the associated information fragments on a mobile device. When a person on a mobile device receives a link to the above page on fire safety and the person can only understand Kannada, the page can be rendered like a slide show with an audio option. A snap shot can look like this:

![Slide show with audio option](image)

This Kannada narrative is picked up by contributed narratives available on the Web. This content for this slide is available as a blog, which provides an alternative fire engine picture for Karnataka visitors and Kannada replacement paragraph for Kannada speakers. Similarly, the audio rendition of this is picked up from another narrative. Such a blog would look like:

**Blog of Aravind**

*post saturday*

![Blog post](image)

Looking at the HTML source, we see the meta links that help a web crawler identify the re-narration relationship between the original fire safety page and the contents of the blog for a target community [8].
Traditionally, bloggers have been a dynamic network of *citizen journalists* who publish various interpretations and opinions on the Web—this work is frequently about relating interesting work by rewriting it for their readers. These days we see this activity more in smaller grain on Facebook and Twitter like Web 2.0 platforms. The association between the original page (source) and re-narrated page (target) is primarily in the author’s and readers’ mind with perhaps an additional link to the source page and/or some quotes. The explicit relations between items are typically not indicated. For example, a reference to a particular image, paragraph, or audio fragment are not indicated. Also, it would be hard to specify these meta relationships without some assistance by “blogging” tools.

There are specific benefits for having such references in an explicit format rather than implicit or non-specific. For example, it is possible to contextualize the source content such as for re-narration and other community annotations i.e., for *propagation* of a specific purpose, a meta annotation of an intent.

### 3. Objectives and Conclusions

#### 3.1 Current Directions

A goal of Alipi is to enable localization and contextualization of laws and policy documents that concern the citizens of India, so that these documents become available on the mobile phones of the many print-impaired people. Towards this, we have authoring guidelines that document authors can use [4]. Then we have developed the re-narration model so that an effective process can be initiated via the communities of interest or through those who have a mandate towards such activity. Filters [4] help identify such communities of interest in certain context. For example, in the case of government documents that are put online, it may be natural for the authorities to announce the authorized re-narrators on their web-sites. This can become a directive to the Alipi’s narration recommendation algorithm using which only the official translations or localization/contextualization are provided as choices to a user. The Re-Narration Act case study on alipi.
janastu.org shows a document regarding the law related to minimum wages and using an Android based phone to demonstrates that the print-impaired community of domestic workers can now “browse” (listen-to/read-Kannada-version-of) this document using the Alipi toolbar on the Firefox browser.

3.2 Implementation and Tools
Alipi model development is supported by prototype work that gave us the comfort of its feasibility over time. One of the tools is a Firefox browser extension that helps in selecting elements of a web-site that are of interest and assist in re-authoring the page on the client side. The changed content can then be blogged some where. The same extension can also help a person browsing the web in choosing alternative narrative when they are available. The Alipi toolbar is supported by a web-service that simulates a web-search index that responds to a query for re-narrations available for a web-site (an url). The alipi toolbar for Firefox and its avatar for an Android based mobile device are available as git-hub repositories from alipi.janastu.org.

3.3 Conclusions and Future Work
Accessibility provisions are all about transformation of information from one form to another which is often different from the original form of dissemination-intent. The re-narration web is about explicitly discussing and clarifying that this provisioning is fundamental and therefore needs to be reasoned and relaxed. The re-narration is also essential for the literate to follow something that is published in another context or a foreign language.

Print-impaired users are people able to use their vision and their hearing capabilities, but have difficulties accessing written text. A non-disabled user navigates within the web page and understands its structure instantly by relying on image connotations or paragraph titles for example. It is however frustrating for a print-impaired user to use assistive technologies such as content readers in order to understand the page structure: using an auditory description is not adapted to their needs since they can see and would rather rely on their vision than their hearing. Another barrier is the language. In fact, if the spoken/written language is not familiar to the user, it would not help them understand what is going on. Thus, the idea of Alipi accessibility guidelines is to allow a lay out a web-page’s content in a certain way that allows print-impaired users to understand its structure by indicating connectedness of fragments in a page. Alipi tools aim to assist in sufficiently re-narrating the structure of the page so as to render it in a print-impairment friendly manner.

There are many aspects of the proposed approach that need to be pursued. Assessing trust of content authors requires a trust model for contributors. When there are more than one re-narrations a choice of which one to render must be made. Such choices can be based on author rating or user choice. Another option is to present alternative views for which a
ranking among choices is required. Again, rating or user choice is relevant for this purpose. For user preferences friendship networks based on “like”, “follow” or such relations could be utilized. Such friendship networks would need to be handled. And last but not least, we need to study the various forms of narrations and what makes this popular and useful for delivery over the mobile phones and particular for the print-impaired.

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A Survey of Cell Phone and Computer Access and Use in Marginalised Schools in South Africa

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Abstract — In this paper we present findings of a study conducted to assess cell phone and computer access and use in township and rural schools in the Eastern Cape Province of South Africa. Our study was informed by an earlier study done in township schools in the Western Cape Province. Using a similar activity based questionnaire, we found that multi-modal access to different technologies is common. Access and use of computers decreases from a major town to a rural area; while access to cell phones does not decrease but their use decrease slightly. Level of study also impacts on ICT use.

1. Introduction
The contribution towards mobile for development made by cell phones and their use in Africa cannot be overstated. In a region where access and use of computers is hampered by resource limitations and unavailability of infrastructure and skills required to use computers, the proliferation of cell phones has given new opportunities to accessing the internet to many people. In this paper, we describe a study that was undertaken in marginalised schools in the Eastern Cape province of South Africa. The study sought to assess access to and the use of cell phones compared to computers.

Drawing from a study that assessed access and use of cell phones amongst grade 11 learners in a township school in Cape Town, in the Western Cape Province of South Africa, we wanted to explore the access and use of cell phones and computers in other marginalised contexts. Research is needed on how technology, and in particular cell phones, can be used to support development in education, health, banking etc. Such research presupposes an understanding of penetration among young adopters.

2. Context

2.1 Cell Phones in Africa
Research on ICT in Africa found only 15% of all households to have a working computer, while just 5% reported having ‘a working Internet connection’ [1]. South Africa has one of the best rates of Internet penetration on the continent, estimated at 10% [2]. However, teledensity drops close to African averages in marginalised areas [3], where the vast majority of the South Africa population lives [4]. The deployment of fixed-line infrastructure in such contexts faces a number of challenges [5]. At the same time, unequal availability of computers poses challenges to Internet access for young people. For example, in the Eastern Cape Province where our survey was conducted only 10% of the students have access to a computer laboratory, as opposed to 95% for richer provinces such as Gauteng and the...
Western Cape [6]. Wireless and particularly mobile access to the network seems to be a more viable solution [7].

Several studies have shown that cell phone penetration is on the increase in Africa, and provides an alternative way to access and use the internet [8]. While in the rest of Africa one-third of the population has a cell phone [9], in South Africa figures vary between half and three-quarters of the population, while a number of people regularly use more than one SIM card [10]. Increased penetration holds promises for new and interesting possibilities for education [11]; banking [12] and poverty alleviation [13]. Kreutzer [14] mentions some studies on cell phone sue among South African youth [see; 15; 16; 17; and 18]. However, the author remarks that more detailed research, particularly regarding members of marginalised communities is needed.

### 2.2 Overview of the Original Study

Our survey was informed by study conducted in 2008 in Cape Town [14]. The study was conducted with youth in a low income urban township area to assess the cell phone usage and ownership patterns. The study also focused on the prevalence of mobile internet usage vis-à-vis traditional computer usage. The study took into account differences along gender and socioeconomic divisions. This study provided a substantial background and methodological insights for our own survey, and is referred to as the “original study” in this paper.

Using a detailed activity based survey results showed that the proliferation of the cell phone, Internet access is becoming widespread among the youth even though they have limited to no access to traditional computer-based internet. The study also found interesting data on the phone capabilities and the activities that learners could do on the phone. It was also evident that learners had more access to a cell phone as shown by the 74% who had used it the previous day when compared to the computer. Perhaps the most important contribution of this study is that while it is important to know what ICT young people are using, understanding what they use it for is as important. Wherever appropriate, figures from the original study [14] are referred to for comparison and validation of our own findings.

### 2.3 Access to ICT—Rural—Urban Digital Divide

While South Africa is relatively advanced in terms of ICT compared to the rest of Africa [19], it has one of the most uneven and unequal societies. The digital divide, the gap between those with adequate ICT access and those who have limited to no access [20] runs across socio-economic inequalities South Africa inherited from the apartheid era.

Geographical location and the environment surrounding a person also contribute to whether or not that person has access to ICT [21]. While ICT penetration and access is fast improving, many areas in the country lack proper infrastructure [22]. As pointed out by [23; 24] this is particularly true of small towns and rural areas.
In this paper, we expand on the original study [14] by including the analysis of how difference in the location of a school affects access and use of cell phones and computers among students. Our hypothesis is that distance from urban centres impact on the access and use of cell phones and computers negatively. A second dimension we added to the original study [14] was the difference between students of scientific and humanities subjects. Although there is no reference to this variable in the literature, our hypothesis is that science students might show a greater propensity to use technology. Finally, the age of the students is expected to affect their experience with technology, their use and skills.

3. Methodology

3.1 Process

Our study was informed by a similar survey conducted by another researcher [14]. The original study [14] was used as a framework for an activity involving student-teachers doing an Advanced Certificate in Education in ICT at Rhodes University [25]. Two groups of approximately 20 in-service teachers in township and rural schools administered the questionnaire in their classes, collected and preliminarily analysed the data.

Most teachers in South Africa teach more than one class across the grade and usually across subjects. Teachers were asked to administer one questionnaire per class. Teachers had between 3 and 8 classes. In each class, the teacher asked one question at a time and learners responded by way of raising their hands. The teacher then noted the number of respondents and the class details (name of school, number of students, subject and grade) on a single questionnaire for each class. We left the administration of the questionnaire (and collection of data) to the teachers, and none of the authors were present at the schools when this data was collected.

This method was welcomed by the teachers as it was not time consuming. However, we realise that data collected by inexperienced researchers without supervision might raise concerns about integrity and validity. To ensure proper use, we piloted the questionnaire in the classes of student-teachers as part of the ACE (ICT). The findings were then the object of classroom discussion as part of the course.

The administration per class as opposed to per individual posed some constraints on the type of background variables which could be captured. While subject and grade, which are obviously the same for all students in one class, could be included, gender could not. Moreover, aggregate responses for a set of activities by one student could not be part of our study. The exclusion of valuable data compared to the original study [14] were trade-offs for the method of administration, which allowed for quick and simple inclusion of a large and diverse sample.
3.2. Tool

Our only data collection tool was a short activity-based questionnaire (see Appendix A) derived and adapted from the original study. The use of a research tool developed elsewhere, for a different sample and with a different administering process in mind required some adaptation.

Consistent with the original study, we employed a quantitative methodology. A questionnaire of 12 closed-ended questions was discussed with the student-teachers who administered it to their students. Only closed-ended questions were used to facilitate data collection and analysis. All data were analysed using descriptive statistics. More complex methods such as chi-square dependency test would have required extensive explanation to the student-teachers. Given the small percentages for some of the answers, the application of such tests would have also posed problems of validity. We realise the limitation of quantitative methods such as questionnaires in capturing the nuances of technology use in a developmental context. However, we believe that some key adaptations compared to the original study [14] make our survey meaningful.

Compared to the original study, we used a sub-set of questions. We focused on aspects which emerged as interesting in the original study [14] such as previous exposure and daily use of cell phones and computers, issues of access and ability to perform different activities. The distinction between daily and sporadic performance of different activities (e.g. checking emails) could not be included, as it would have made administration very complex and prone to errors, possibly undermining the integrity of our data.

A second difference was that the original study [14] was carried out at high schools in the township of a metropolitan area, while our study included schools in the townships of small town and in rural areas as far as the former homeland of Transkei. In South African terms, a “township” indicates the area at the periphery of an urban settlements were individuals classified as “non-whites” under apartheid were previously required to live [26]. Under Apartheid, “homelands” were considered independent states were individuals classified as “blacks” could claim citizenship. Although the homeland system collapsed after the end of Apartheid, these areas are still predominantly rural and characterised by endemic poverty and lack of services. Township and rural schools serve marginalised communities and are generally characterised by poor infrastructure and quality of education [24].

A third difference compared to the original study [14] was the inclusion of many more classes at all levels of study from Grade 2 to Grade 12. The South African curriculum is divided into a foundation phase (Grades R to 3); an intermediate phase (Grades 4 to 6); a senior phase (Grades 7 to 9) and high school (Grades 10 to 12). While lower phases are often combined in one school, most students have to travel to reach (and sometimes move
close to) high schools, particularly in rural areas. The inclusion of all levels of education and of a number of different classes resulted in a much larger sample compared to the one in the original study.

The original study [14] was a pilot for a more extensive study by the same author. The wider scope of the latter study included socio-economic variables which are not the object of the present study. In the author’s own words, the pilot “has laid the ground work for more reliable quantitative usage-based research”. For these reasons, we refer to the pilot study rather than the follow-up study [15] for comparison.

3.3 Sample
Respondents to the survey were students at a township or rural school and were members of a marginalised community. As was the case in the original study, isiXhosa was the home language of all students. Most students could be expected to have low English proficiency. As suggested by the author of the original study, we used simple English for the questions. We tested the questions with the teachers who were going to administer these questions in their classes as a way of having them assist us in identifying difficult questions.

The inclusion of schools in the survey depended on the presence of teachers attending the ACE (ICT) course at Rhodes University. Most teachers came from the Township in Grahamstown (were Rhodes is located) and from Dwesa, a coastal rural area in the former homeland of Transkei where Rhodes participates in an ICT-for-development project [25]. In both areas, the proactive engagement of the University resulted in substantial access and use of ICT. The presence of a teacher involved in an ACE (ICT) itself suggests that students might have been encouraged to participate in ICT-related activities independent of the survey. For these reasons, schools in the two areas cannot be considered as representative of other township and rural schools in South Africa. However, in terms of the comparison with the original study, the author notes that computer use by students might have been influenced by computer projects at the school. As ICT-for-development activities increase in educational contexts, such situation will become more and more common.

The survey included 1922 students. Approximately 44% of these studied in rural schools and the rest (56%) in township schools. Approximately one-third studied scientific subjects (such as maths, natural sciences, technology and business/economics) while the remaining two-thirds studied humanities subjects (such as English, social sciences and life orientation). Students in foundation phase, who do all subjects, were considered as half science and half humanities. Students span across grades from 2 to 12 and numbers vary considerably.

Students in high school were substantially more likely to come from township schools than students in lower phases (80 vs. 45%). This could
be attributed to high dropout rates in rural areas and to the fact that many rural students tend to complete their education in township schools. These considerations, however, are based on anecdotal evidence and the correlation between the location and level could be due to chance. The correlation between rurality and lower levels of education, though not central to this study, is taken into account and further explored by considering township and rural students in different phases separately. High school students were also 10% more likely to study a scientific subject.

4. Findings

4.1 Cell Phone Access

The vast majority of the students (88%) have used cell phones before and 72% had used them the day before. Approximately 60% claimed to use a cell phone every day and an additional 10% reported sporadic use. Only 5% claimed they never used a cell phone. The apparent discrepancy on daily use is explained by the distinction between ownership and access, highlighted in the original study [14] and discussed below.

Students who reported using a cell phone might refer to a cell phone to which they have access, but not necessarily on a daily basis and not necessarily their own cell phone. This interpretation is consistent with the figure of 65% who claimed they owned a cell phone, while 31% had access to someone else’s. These two figures combined are more than the total of students who claimed to have ever used a cell phone, suggesting that some students have access both to their own and to someone else’s cell phone.

Township and rural students showed similar levels of previous and daily use. Humanities students were more likely to have used cell phones before and to have done so the day before (11 and 15% difference respectively). Township students and humanities students were 10% more likely to own a cell phone (70 vs. 60%) than their counterparts, while figures for access to someone else’s cell were the same.

High school students were 12% more likely to have used a cell phone before, but 25% were more likely to have done so on the previous day. High school students were also 20% more likely to own their own cell phone and 10% less likely to have access to someone else’s. Figures for previous use and ownership for high school students in both township and rural schools are similar to those in the original study [14] (the whole sample and three-quarters respectively). There seems to downplay the impact of geographical location on access and use of cell phones compared to level of study. Higher figures for cell phone ownership might account for a significant difference (35%) in reported everyday use between high school students and students in lower phases.
4.2 Cell Phone Use

The most common activities students could perform on their cell phones were text messaging (71%), playing games (62%) and listening to radio (61%). Multimedia functionalities such as playing music, taking pictures and videos followed with 53, 51 and 44% respectively. Network capabilities such as instant messaging, Internet search and email came last, with 37, 28 and 19% respectively. The distinction between traditional, multimedia and network capabilities seems relevant, as it captures different sets of skills as well as different types of cell phones.

Aggregation of features and per person administration in the original study [14] prevents direct comparison of the figures. However, the hierarchy of activities presented here was confirmed. Also, it is clear that as respondents gain access to better devices, their use of more advanced features will follow.

Township and rural students showed similar figures for traditional activities, but when it came to multimedia features such as music, pictures and videos the former consistently showed figures 13% higher than their rural counterparts. The difference was even more favourable to township students in terms of network activities (instant messaging, Internet and email) with figures 37, 29 and 22% higher respectively.

Humanities students were slightly more likely to use almost all cell features, with a 10% difference in email use. High school students were more likely to be able to use most cell phone functionalities. This was particularly striking for network features such as instant messaging, Internet and email, for which differences ranged between 38 and 30%). Though the least used among the activities included in this survey, email is particularly interesting and allows for direct comparison between cell phones and computers.

4.3 Computer Access

Approximately half of the students claimed to have used computers before. Only 15% reported daily use of computers and an additional 34% reported sporadic use. Consistent with the type of technology and with findings in the original study, these figures are substantially lower than those for cell phone use.

Substantially more township than rural students reported having used computers before (54 as opposed to 29%). This distinction was not there for previous access to cell phone. Figures for sporadic use were similar for township and rural students. Township students, however, were approximately 15% more likely to use a computer daily or not at all. High school students were 22% more likely to have used computers before. High schools students were more likely to report everyday use of computers compared to their counterparts in lower phases (26 vs. 10%). Figure 1 provides a graphical representation of the comparison in everyday use between high school and lower phase students in township and rural schools.
Most students reported accessing computers in public places such as school and library (28 and 12% respectively), while only 17% had computers at home. The combination of all figures suggests that some students might have access to computers in more than one place.

While figures for access at school were slightly in favour of rural students, 20% more township students had access to computers at home. Easier access might account for the higher percentage of daily use compared to rural students.

The only difference between humanities and science students in terms of computer access was that the former were more likely to access computers at a public library, while the latter were more likely to do so at school. This is aligned by a more natural association of the educational use of computers with subjects such as mathematics and technology.

High school students were 11 to 16% more likely than students in lower phases to have access to computers at home or at school. This might account for the significantly higher previous exposure to computers noted above and be explained by the same reasons.

### 4.4 Computer Use

The most common activities students could perform on a computer were playing games (37%). typing and playing music with 28 and 27% respectively. Network-based activities such as searching for information, downloading files and checking one’s email accounted for 22, 17 and 12% respectively. In absolute terms, almost 10% more students could access the internet and check emails on a cell phone than could on a computer.
Township students reported between 15 and 25% higher proficiency in all computer skills. High school students were more skilled in using computers than students in lower phases. Differences ranged from 24% for playing music and games to 10% for using emails. No significant differences could be noted between different sets of skills. The absence of differences suggests that all skills developed organically as students progressed through their studies, possibly as a function of greater access to computers.

Figure 2 provides a graphical representation of the comparison in email use on cell phones and computers by students in high school and lower phases in township and rural schools. This confirms a striking difference according to location and some progression according to level, though not for rural students. An interesting observation, not captured in this figure, is that 5% of students in (mainly rural) schools where nobody had ever used computers were able to access their email over the phone.

5. CONCLUSION
In terms of use, almost twice as many students have used cell phones than computers. Two-thirds of the students use cell phones daily, compared to just 15% who use computers. Location was not a major determinant of cell phone use, but significantly impacted on one’s use of computers. Level of study also had a similar impact, but on a smaller scale.

Mixed access to technology seems to be a common feature of both cell phone and computers use, at least for a portion of the students. While direct comparison of the two technologies is problematic, it is clear that township and high school students have readier access.
Traditional activities such as playing games and music were more common than network-based ones for both cell phones and computers. Township and high school students seemed consistently more confident in all activities. While such difference was homogeneous for computer-based skills, it was more noticeable for network-based activities when it came to cell phones.

The distinction between humanities and science students, though worth exploring in its own right, did not yield particularly interesting results. Location (township vs. rural) and level (high school vs. lower phases) seemed to impact more significantly on cell phone and computer access and use.

6. Acknowledgement

We would like to thank MTN and the sponsors of the Telkom Centre of Excellence at Rhodes University for their contribution. We would also like to acknowledge the continuous support of the Deputy Dean of Education at Rhodes University.

References


## Survey of Cell Phone and Computer Access and Use in Marginalised Schools

### APPENDIX

#### Questionnaire for Learners

<table>
<thead>
<tr>
<th>Name of School</th>
<th>No of learners</th>
<th>Subject Taught Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have you ever used a cell phone?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>2. Did you use a cell phone yesterday?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>3. Do you own a cell phone?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>4. Do you use someone else’s cell phone?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>5. What are you able to do on a cell phone?</td>
<td>Send and receive sms</td>
</tr>
<tr>
<td></td>
<td>Record and play videos</td>
</tr>
<tr>
<td></td>
<td>Listen to the radio</td>
</tr>
<tr>
<td></td>
<td>Play music</td>
</tr>
<tr>
<td></td>
<td>MXIT</td>
</tr>
<tr>
<td>6. What kind of a cell phone do you have?</td>
<td>Nokia</td>
</tr>
<tr>
<td></td>
<td>Motorola</td>
</tr>
<tr>
<td></td>
<td>LG</td>
</tr>
<tr>
<td></td>
<td>Voda phone</td>
</tr>
<tr>
<td>7. Is your cell phone on</td>
<td>Prepaid</td>
</tr>
<tr>
<td></td>
<td>Pay as you go (top up)</td>
</tr>
<tr>
<td>8. Have you ever used a computer?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>9. Where do you use a computer?</td>
<td>At school</td>
</tr>
<tr>
<td></td>
<td>Internet café</td>
</tr>
<tr>
<td>10. What are you able to do on a computer?</td>
<td>Send and receive an email</td>
</tr>
<tr>
<td></td>
<td>Download music, games etc</td>
</tr>
<tr>
<td></td>
<td>Search for information on the Internet</td>
</tr>
<tr>
<td></td>
<td>Typing</td>
</tr>
<tr>
<td>11. How often do you use a computer?</td>
<td>Everyday</td>
</tr>
<tr>
<td></td>
<td>Once in two weeks</td>
</tr>
<tr>
<td></td>
<td>Never</td>
</tr>
<tr>
<td>12. How often do you use a cell phone</td>
<td>Everyday</td>
</tr>
<tr>
<td></td>
<td>Once in two weeks</td>
</tr>
<tr>
<td></td>
<td>Never</td>
</tr>
</tbody>
</table>
Mobile Communications and Fighting Corruption

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Abstract—Corruption is a serious threat to the governance all over the world, which erodes the institutional capacity of governments and destabilizes the democratic values, and consequently tailors the sufferings of the mass-people and challenges the legitimacy of the government. Global history and contemporary evidences suggest that unless we collectively do fighting corruption and fix it firmly on the agenda of policy makers, avenues for overcoming the barriers of it will never create. In fact, there are a number of channels for fighting corruption. The most innovative and up to date channel for combating corruption is surely mobile communication based. This avenue, which is trendy of its kinds, seeks to enhance understanding and consensus on why and how we need to work more strategically and comprehensibly on the incorporation of mobile communications for fighting corruption in the policy and programme agenda on governance and development. The current round of studies on combating corruption allows the focused synthesis method in an opportune fashion.

Keywords: Curbing, Fighting, Combating, Corruption, Transparency, Accountability, Governance, ICT, Mobile Communication, and Development

1. Introduction

Corruption poses a serious governance as well as development challenge. In general, corruption erodes the institutional capacity of governments and destabilizes the democratic values, discourages investment and damages development efforts, and consequently tailors the sufferings of the mass-people and challenges the legitimacy of the government. In the political domain, it undermines good governance by subverting formal processes and creates tension and frustration to the society, while it in elections reduces transparency and accountability, in legislative bodies distorts representation in policymaking, in the judiciary wipes out the rule of law and in the public administration results in poor public services delivery.

Apart from this, in today’s world, there are crucial links between corruption and human rights violation, poverty, exclusion, environmental degradation, vulnerability and conflict. And there are growing recognitions in governments all over the world to integrate fighting corruption into their governance agenda, while development partners, basically multilateral and bilateral donors, seek to enhance equity, transparency and accountability in the development works; and they intend to have comprehensive understanding and consensus on how we need to work more comprehensively on curbing corruption. Here the solution, up to date of its nature, comes to address the ICT based channel that is increasingly approaching to the wide-ranging mobile communications. Now the focus is shifting why and how we need to work more strategically and coherently for converging mobile communications as a means to curbing corruption leading to good governance and development.
The basic concerns here are to what extent and how the current anecdotal and research evidences around the world on the incorporation of mobile communications for combating corruption add value to the governance and development, and how lessons can fit into policies and policies can fix into the development, and how new opportunities and conceptual as well as practical challenges towards curbing corruption can be mainstreamed within the nascent growth of ICT in general and mobile communications in particular.

The current round of studies on combating corruption allows the focused synthesis method in an opportune fashion. In fact, focused synthesis allows collecting and documenting information as well as data from a range of sources as diverse researcher’s personal experience, staff memoranda and unpublished project documents, web and media evidences, discussions with experts and stakeholders, legislative hearings, anecdotal evidences and stories, and published materials. Aminuzzaman (1991:45) points out that focused synthesis differs from traditional literature reviews by discussing information obtained from a variety of sources beyond published articles.

2. Corruption Perceptions

Simply, corruption is misuse, abuse or nonuse of delegated authority, and thus there are four forms of corruption: corruption as neglecting official duties; corruption as bribery; corruption as leakage; and corruption as patronage. UN witnesses that corruption may take in many forms with varying degree of intentions from the minor use of influence to institutional bribery, and it may not be confined just into financial gain, rather leads to non-financial advantages as well (see UN, 2010). Transparency International (TI) denotes corruption as the abuse of entrusted power for private gain (see Corruption Perceptions Index Report 2010).

The concerns for ethics and standards in public life, and strategies to control corruption are now almost global and central to democratic governance and management of public services (OECD, 1999 & 2000; Hoddes et al., 2001). Citizens and service users expect public officials, whether elected, appointed or employed, to serve the public interest with fairness, and to manage public resources properly on a daily basis (Larbi, 2007). Public ethics is a pre-requisite to underpin trust of civil society, which is a keystone for good governance as well. Hence, fighting corruption reinforces to build trust between government and stakeholders, and government and international community. Many of the developing countries, even some of developed countries have been coincided for combating corruption (Talukdar, 2009).

Corruption flourishes when uncontrolled behavior is combined with discretionary power. Such type of behavior destroys the public trust and values of the government. Larbi (2007) notes down that for developing and maintaining public trust and confidence in government and its officials,
it is important to develop and maintain system of accountability and transparency. These include putting in place the right legal, institutional and administrative arrangements and procedures that enable and support transparency and accountability in public office holders and institutions. Florini (1998) observes that governments are increasingly answering to the call for transparent governance and easy public access to all kind of official government information. Jong &Vries (2007) observes that transparency presupposes a stable and democratic system of government, a free press and the absence of systematic corruption.

Studies, for instance the HDR 2009, support that our world is extremely unequal that makes obvious the huge differences in human development. In fact, corruption and unequal distribution of recourses, public services and opportunities across and within countries are the basic ingredients of the disparity in human development. The unequal distribution is again tailored by a number of substantive irrational theories coupled with corruption.

There is evidence that the rule of law and corruption free politico-administrative culture ensure secure and standard living. For example, countries which perceived low levels of corruption in terms of the Corruption Perceptions Index (CPI) are basically tailoring the robust governance system that resultant in secure society, wider social inclusiveness and standard living of citizens. Of course, there are other factors behind their successes, but this is undeniably crucial one. On the other hand, corruption forces to cutback pro-poor growth and development, facilitates crime, produces offspring terrorism, and erodes trust in governance. Here the ultimate prototype countries are those that professed high levels of corruption as per the CPI. It is certainly true that corruption is a serious threat to the governance all over the world, which is acknowledged by all of the contemporary studies on public sector transparency and accountability and on governance and corruption.

3. Mobile Communications

Mobile communication is a part of ICT intervention, which signifies all satellite communications based on the use of mobile and other wireless technological tools like laptops and PDAs with wireless internet connections. As time goes on mobile phone is becoming the most widely available platform for information dissemination and interactive communication. And as a result of technological advancements, it is likely to be generated in an all-in-one device which can be carried and used almost anywhere any time. More importantly, mobile phone is being tailored with internet, and now many countries across the globe are enjoying 3G (Third Generation) version facilities of cellular phone, while some of them are in 4G (Fourth Generation) version; and many innovative applications are scaling up with particular focus on nets, dimensions and quality. Specifically mobile
communication is dealt with simple public awareness, market promotion or health information services to multifaceted financial and government transactions including fighting corruption.

Yet the popular and vast use of mobile is confined to peer-communication, that is to say voice, SMS and beeping. In fact, the scaled-up mobile services are limited geographically in developed areas. So, what hinders the wide use of scaled up mobile applications without any border so as to get developing countries easy access to those? The response\(^1\) is evident at Sida Review 2010:12 written by Hellström (2010a). In another writing Hellström points out that the possibilities are endless for potential using of mobile solutions for good governance purposes (see Hellström 2010b). The possibilities are likely to be explored for fighting corruption as well.

Global anecdotal evidences and research substantiations basically from a number of African countries demonstrate that Information and Communication Technology (ICT), largely mobile communication, is expanding citizens’ sense and opportunities to participate in political decision-making and electoral process, and in governance and development undertakings. ICT unlocks the scope for public to be better informed and pro-activated with access to information, dissemination of information and social mobilization. Strand (2010) points out that a better informed and active citizenry, who can put pressure on national institutions to be accountable and responsive to citizens’ needs and priorities, is a fundamental component of a functioning democracy.

The challenge goes here the understanding gap between the political community and civil society proponents of ICT based, especially mobile communication based fighting corruption. People in general, and academics, columnists, media and civil society organizations in particular are ever increasingly challenging their governments to open up systems for public scrutiny. The positive practitioners in the ICT field around the world are fighting to create a congenial political support so as to get governments agreed to unveil ICTs, particularly mobile technologies as tools as well as approach in governance, development, administrative and judiciary reform processes and outcomes, which in turn are likely to remove the opportunities for corruption.

\(^1\)First of all, the cost of communication must go down – SMS is much overpriced and so is voice and data traffic. Secondly, many applications and services never reach out to the masses due to poor marketing and the non-existing meta data about the available applications. Subscribers must know what solutions are available, why and how to use them. This will lead to volumes intensive which will eventually lower the price of the particular service. In other words, there is a huge need for marketing (of the product) and education (for the end user) in order to make mobile applications sustainable. Thirdly, many interventions are not designed with scale in mind. Few implementers are familiar with all the costs involved and seen from a technological point of view, the requirements on networks and different requirements on handsets and end-users that mobile applications have must be understood better.
4. RATIONALE OF USING MOBILE AND WIRELESS TECHNOLOGIES FOR FIGHTING CORRUPTION

Indeed, global history and contemporary evidences suggest that unless we collectively do fighting corruption and fix combating corruption firmly on the agenda of policy makers, avenues for overcoming the barriers of it will never create.\(^2\) Definitely advancing this pressing agenda will require a strong and enlightened leadership together with a more determined effort to engaging the media and ICT interventions especially mobile communications. Definitely incorporation of mobile telecommunications in the policy and programme agenda on governance and development, and the innovative use of mobile phones for ensuring transparency and accountability are expected to create a results-based avenue so as to treat public, public-official, politicians, civil society representatives, development as well as human rights activists and scholars to come together for fighting corruption.

A significant negative correlation between a country’s degree of mobile phone penetration and its level of perceived corruption is evidenced at a research of Bailard on 46 nations between 1999, a time of less use of mobile phone, and 2006, a time of widely use of mobile phone (see Bailard, 2009: 341). The researcher also draws an assumption on Africa that the net effect of the rapid and massive diffusion of mobile phones in Africa would be the reduction of corruption by decentralizing information and communication, thereby shrinking the veil of secrecy that shields corrupt behavior as well as altering the cost-benefit calculus of corrupt behavior by strengthening oversight and punishment mechanisms (see Bailard, 2009: 350).

In fact, access to mobile phones empowers the citizens by providing wide access to information so as to make extra pressure on the government to be more transparent and accountable; in other word, massive penetration of mobile communications makes public officials and politicians more conscious to the delegated authority and so to the responsibility of public services delivery. McNamara in Hellström (2010a) points out that basically it is the interplay of four elements\(^3\) that creates a virtuous circle of innovation that can benefit all citizens.

\(^{2}\) In the 1990s, international initiatives were taken, basically by the European Community, the Council of Europe and the OECD, to put a ban on corruption. For instance, in 1996, the Committee of Ministers of the Council of Europe adopted a comprehensive Programme of Action against Corruption and, then, issued a progression of anti-corruption standard-setting instruments. And the United Nations Convention against Corruption was adopted by the General Assembly by resolution 58/4 of 31 October 2003, and in accordance with article 68 (1) of resolution 58/4, the Convention entered into force on 14 December 2005.

\(^{3}\) Access: innovations in network design, communications hardware and infrastructure financing are steadily expanding the mobile ‘footprint’ to cover a larger percentage of the population; ii. Affordability: relatively low total cost of ownership, due to the combination of prepaid service plans and cheaper mobile handsets, makes it easier for citizens to afford and use mobile services; iii. Appliance innovation: the growing multi-functionality of mobile devices and innovations are making these devices more adaptable to a range of needs and services relevant to all citizens; iv. Applications: there has been a vast increase in the past few years in the development and roll-out of mobile applications.
Mobile Government is one of the innovative as well as up to date developments over e-government. The high rate of mobile phone dispersion and its technological nature, that is to be accessible anywhere anytime, opens a new network for governments to reach their citizens fast, while people can provide immediate feedback to the governance issues as well.

### 4.1 m-Governance Perspective

m-Governance can be defined as a strategy to extend the reach of e-governance, and its implementation encompasses the utilization of all kinds of wireless and mobile technologies, services, applications and devices for good governance. Singh (2010) points out that it has emerged as an effective tool for good governance in not only facilitating openness and transparency, but also in creating a flow of information between departments, institutions, and various layers of the government. Kailasam (2011) notes down that e-governance is the use of information and communication technologies (ICTs) to improve the activities of public sector organizations, while m-governance has the potential to help make public information and governance services available anytime, anywhere to citizens and officials.

While e-governance is widely used in Europe, America, Canada and Australia, the situation is somewhat unlike in most of the Asian and African countries mainly because of poor internet access and low PC penetration. Surprisingly there is high density of mobile phone users in both rural and urban areas in Asian and African countries. This is especially true for Bangladesh and India from Asia, and Kenya, Rwanda, Tanzania and Uganda from Africa. After Kenya, Rwanda, Tanzania and Uganda, Indian government initiated m-governance expecting to be suited there. Kerala, a role model state of India, has already demonstrated the success in m-governance leading to fighting corruption. Singh (2010) observes that Indian government realized a long time back that mobile is no longer a tool meant only for information and communication; rather it is a medium for empowering the citizens and a powerful enabler of good governance. In spite of the fact that the mobile-density in Bangladesh is almost same as in India, the government here has limited intervention to invite the m-governance as an opportune fashion on e-governance. The reason behind it, the country is yet to develop a good back office ICT infrastructure.

Interestingly, rapid advancement of mobile technologies has incorporated a number of mobile communication tools beyond a simple mobile phone itself in the way forward of m-governance. And these are 3G/4G cellular phones, laptops and PDAs with wireless internet connation, which in fact, are turning the developed countries in m-governance.

### 4.2 Expert Opinions

Anoop Kumar Srivastava⁴ in Shingh (2010) says, “There are still areas in our country where even newspapers do not have a reach, while the mobile

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⁴Anoop Kumar Srivastava is principal secretary, IT, Government of Meghalaya, India
technology is becoming all pervasive. Moreover, any information sent through mobile is directed to each individual and appears to be giving a personal touch.” He adds, “The scope of m-governance is tremendous which can bring immense convenience and benefits to citizens”.

Ajay Kumar in Shingh (2010) says, “M-governance is an amazing technology as it offers government services on-the-go to its citizens. It extends services from office premises and regular office hours to an anywhere anytime mode.”

Johan Hellstrom (2010b) says, “Access to mobile telecommunications and the innovative use of mobile phones are often described as the universal panacea. There are a number of promising initiatives looking at citizen to-government accountability using mobile solutions in East Africa”.

5. How Mobile Communications can Fight Corruption

Mobile communication can fight corruption in two ways. First of all, it helps to build good governance that reduces the scope of corruption through providing improved governance related services in a smart, precious, convenient and swift way. For instance, it promotes public awareness, facilitates civic virtue and education, updates government news and information, and enforces public administration, rights to information and law execution. It also ensures free, fair and participatory electoral process, responds to disaster and crises, collects public response and data on governance and development, engages civic monitoring in development process, oversees the governance process, tailors incentives, mobilizes implementation of government decisions, manages public employment and internal management, and supports in basic public goods and services delivery like in agriculture, health, education and communication, and law and order issues. Secondly, it can directly fight corruption through ensuring increased civic participation and promoting systematic transparency in governance and development process, and holding governments increasingly accountable. Hellstrom (2010a) witnesses that mobile phones help create an informative, connected, innovative and converging society all over the world. He also notes that due to technological advancements, it is today much harder to suppress human rights abuses as anyone with a mobile phone can record, SMS and MMS news of events even as they are happening. He observes that mobile phone is also used in citizen-based journalism and social media forums, and makes it possible, in theory, for anyone to participate in the reporting of news events.

5.1 Discloser of Assets and Liabilities

A number of emerging democracies in Africa have put in place mechanisms to improve accountability and transparency, and to minimize conflict of interests that could lead to corruption. One of the key mechanisms being used is the disclosure of assets, income and liabilities by some categories of

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elected and appointed public office holders (Larbi, 2007). Larbi points out that the discloser of interest represents a growing trend in the avoidance and resolution of conflict of interest and has become a part of anti-corruption strategies; still its efficacy depends on compliance and enforcement mechanisms. Using examples from three African countries – Ghana, Tanzania and Uganda, he addresses 4 lead questions: a) Who must disclose? b) What must be disclosed? c) Where to disclose? d) Who has access to the information? (see Larbi, 2007). Here, in fact, the last two questions entail scope of using mobile and other wireless network technologies so as to reach the disclosed information to the country people, while the response to the first two questions is supposed to go to the concerned government’s decision.

5.2 Electoral Accountability

In particular, more democratic and more open systems of government are assumed to provide accountability and consequently to contain corruption which hurts the interests of the majority of a population (Lederman et al., 2005). Hence, frequently, electoral accountability is regarded as a precondition for improving wider governance (Adsera, 2003; Bohara et al., 2004). Mobile communications (basically use of SMS and mobile devices) for citizen input to political decision-making are evidenced at the write-up of Kailasam (2011) where he demonstrates evidence from experience in the UK. He observes that most of the UK experiments with electronic voting, including voting via mobile phones, are meant to discover more convenient ways to involve citizens in political decision-making. Here he points out several concerns that would have to be attended to before voting over mobile phones gains widespread acceptance. For instance, questions of security and secrecy are top of the list, while solution is evident at Liverpool and Sheffield local elections in May 2002 when PIN numbers were given voters to use if they would want to vote by text message.

Hellstrom (2009) observes that mobile applications related to elections have been fairly well explored in East Africa. He adds bulk SMS has been used to advertise political parties and candidates in the run-up to the Ugandan elections in 2006 and Kenyan elections in 2007, and was used to urge Ugandans to go and vote during the referendum in 2005. He also witnesses that in the run-up to the 2007 Kenya elections, the Electoral Commission of Kenya launched a voter registration service where voters could SMS the ID number to receive a verification of voter registration. Hellstrom (2010a) witnesses that mobile applications in election observation and monitoring have so far not been tried out systematically in East Africa; but elsewhere in Sub-Saharan Africa, mobile phones have proved very useful in election monitoring and for parallel vote tabulation. He adds that there are also examples where mobile phones are used for citizen-based monitoring or crowdsourcing. He explains that crowdsourcing involves outsourcing a specific task to a large group of people and allows regular citizens to report
Evidence supports that information and communication technology, especially mobile and other wireless tools were extensively as well as systematically used throughout the election cycle including the voter registration, election monitoring and parallel vote tabulations, and election campaigns in the presidential election of Uganda in February 2011. Web notes demonstrate that mass SMS broadcasts were widely deployed by all major candidates and parties and some had also developed interactive websites and social network functions to communicate with voters. For instance, in response to interactive people’s calls, the president YK Museveni, through using an automated robocall system (Voice Over Internet Protocol), delivered a pre-recorded message telling voters: “Hallo, I greet you. Thank you for your support. As you go to vote, please vote for Museveni, the man in a hat.” On the other hand, the Uganda Electoral Commission made possible for voters to check the details of the registration through the website. More importantly, the registered voters could also check their details registration information using SMS by sending their voter identity number to the dedicated short code 8683. In addition two tailor-made versions of Ushahidi titled Uchaguzi and Ugandawatch2011 were developed respectively by Citizen Election Watch–IT (CEW-IT), a local organization, and DEM-Group, a coalition of four local civil society organizations.

5.3 Effective Accountability Mechanisms and Well-Built Overseeing Systems

Democratization, however, may not always be able to contain corruption. Certain studies have cautioned that while established democracies have a better track record of controlling corruption, in new democracies, corruption is more likely to persist or even grow (Doig and Theobald, 2000; Moran, 2001; Shen and Williamson, 2005). Thus, democracy should run with effective accountability mechanisms and well-built overseeing systems (Talukdar, 2009). Here functioning m-governance can play a vital role so as to ensure increased public accountability and civic overseeing system. The three channels of mobile communications, specifically voice, signaling and data, along with wide-ranging wireless technologies need to be used for enabling the government agencies and departments to perform and/or discharge their allocated responsibilities in plug and play fashion. Singh (2010) believes that the road ahead for m-governance is a challenging one, but it has a sure shot opportunity to enhance delivery of government services, and it will surely steer the government to a service oriented mindset and make the government more agile, responsive, accountable and action-oriented. Kailasam (2011) witnesses that because of its immediacy as well as convenience,
m-governance reduces the barriers to public service operations, encourages citizens or service providers to make use of the technology where previously barriers were discouragingly high.

5.4 Civic Participation in Governance and Development Process

In fact, m-Governance is not just about efficiency, transparency and accountability in public management and public services delivery, but also for citizen activism, and thus to civic participation in governance and development process. For example, among others SMS can be used to get citizens involved in the fighting corruption. Kailasam (2011) documents that half of cabinet agencies, in Philippines, have SMS-based services that allow citizens to ask for information or to comment and complain about government officials and services, while in China, the 150 million mobile phone owners can now send SMS to the 2,987 deputies of the National People’s Congress.

5.5 Democratic Decentralization

Extending democracy in local level (meaning democratic decentralization) provides an enabling environment for wider participation, inclusiveness and pro-people development, which all together makes citizens’ sense to demand political as well as administrative accountability and transparency to contain corruption (Talukdar, 2009). Singh (2010) thinks that agenda for better performance of local authorities should prioritize the creation of mobile extensions to well-established programs of e-government. He also notes that given the extent of global interest in utilizing mobile and wireless technologies for local government, the business opportunities that arise in the markets for devices, systems hardware and software, and outsourced services, and staffing are considerable.

A working paper on m-governance project status in Kerala, India, demonstrates that in order to take the full advantage of the mobile and wireless ICT technology as well as dealing with the fluidity of the interaction with the mobile society and a booming mobile usage rates, the Kerala State Government (a subnational government) has initiated action to set up about 20 m-Government Services offered by 8 departments identified for pilot level implementation and to deliver services though mobile phones accessible to the citizens in the field, in the street, at home or other convenient locations on a 24 x 7 basis, rather than the users having to visit Government offices or log on to the internet portals to access services. Evidence supports that the m-governance project in Kerala aims at building benchmarks in m-governance services across state governments in India and subnational governants around the world. For instance, M-Voting; Green Kerala Express, a reality show aired on TV channel, where citizens give marks to Panchayats on the basis of their performance. Another example includes M-Governance Strategy, Roadmap and Revenue Sharing after pilots in consultation with stakeholders (see http://www.itmission.kerala.gov.in).
5.6 Anti-Corruption Commission and Civil Society Organizations

There has been the broadening of anti-corruption strategies and reforms to be more inclusive by engaging and involving civil society organizations, the media and the public. This is in recognition that anti-corruption agencies (ACC) per se are not effective in dealing with corruption, unless accompanied by other measures (Larbi, 2007). In this context, a three-way anti-corruption mechanism is required. Firstly, the ACC should run with a legitimate protection; explicitly it is expected to be a constitutional body. Secondly, it can directly fight corruption using number of anti-corruption tools, for instance, voice and/or SMS based corruption hotlines. Experience from Uganda suggests that such hotlines must be well equipped with the strategy to respond and make actions. Hellstrom (2010b) observes the Anti-Corruption Commission of Uganda (ACCU) which has a hotline where citizens can report corruption and other malpractices, but ACCU has not developed a systematic way on how to follow up on calls: there is no database in place, calls are not mapped and data is not collected and stored. Thirdly, the focus should be on involvement of government agencies, departments and local government bodies in m-governance planning, process analysis and implementation. This approach helps to change the mind set-up and attitude of public officials, which in turn lead to pro-active as well as transparent governance and reducing corruption. Kailasam (2011) identifies that m-government provides an additional channel for interactions of all stakeholders in governance, for example - service deliverers, policy makers, service consumers, civil society representatives.

5.7 Public Awareness and Civic Virtue

It is difficult to sustain anti-corruption reforms without....effective public/civic education (Gyimath-Boadi, 2004). Civic education to build corruption awareness and civic virtue in schools tend to sustain anti-corruption reforms. Donors are increasingly intended to fund projects/programmes that fit for civic education to build corruption awareness and civic virtue in schools, and for institutional reforms. This is apparent both in available examples and from a wide range of anecdotal evidences (see Talukdar, 2009). Here ICT in general and mobile communications in particular can do a great intervention. For civic education to build corruption awareness, one approach may be deferring the job to organizations/ institutions which have capability to run successful outreach and/or awareness campaigns using SMS and to some extent other mobile communication channels (e.g. Voice, Voice to Text, Text to Voice, data transfer through GPRS, Mobile web, and Video and Audio recording and sharing through MMS gateway). Programme for civic virtue in schools can do the same way but the bulk SMS service would not be suitable here since the target group is specific. So building a good data base is a must for this. In addition, through the donor supported projects standard quality mobile sets may be distributed to the students so as they have a wide ranging access beyond the simple SMS and/or Voice.
5.8 A Cutting-Edge Dogma

Certainly, there needs a cutting-edge dogma which must address fostering the competencies of politicians and civil officials including judges, enabling the quality and freedom of commissions, enhancing the capacity of public institutions, and creating an ideal environment for investment and economic growth (see Talukdar, 2009). In all spheres as stated above, mobile communications can work as a custom-made approach as well as tool, but innovation and continual research are a must for aptness.

5.9 Public Integrity, Key Performance Indicators and Change Management

Institutional approach to public integrity, based on codes of conduct, formalized guidelines and the like, has met with mixed success. Externally managed and regulated approaches have not often produced the behavioral results (Collins, 2006, Doig, 1995, 2003). Performance measurement and reporting is now widespread across the public sector of many industrialized and industrializing countries (Taylor J., 2007). The common tool that is used for this process is Key Performance Indicators (KPIs). Anecdotal evidence supports that 3G/4G mobile phones along with a wide-ranging wireless technologies can do much here. Yet, further research as well as change management integration is required to know how mobile communications can increasingly work for improvement of public integrity and performance. Collins (2006) thinks that a more critical determinant of change may be the capacity to think (reflexiveness, or critical thinking) at both organizational and individual levels rather than just ability to follow rules. Talukdar (2009) identifies that professional training, knowledge building and knowledge sharing can make a judicious combination of these two (i.e. capacity to think and ability to follow rules), which enhance professionalism that resists corruption. And now this study claims that mobile communications do have endless opportunities in the domains of professional training, knowledge building and knowledge sharing.

5.10 Documentation and Dissemination of Best Practices and Lessons Learning

Finally, tackling corruption in public and political spheres requires multiplicity of approaches and strategies (Larbi, 2007) including documentation and dissemination of best practices and lessons learning, and policy adjustment. Nevertheless traditional charging, arresting, trialing and punishing or penalizing approaches should go herewith parallel way. The apprehension here is if the selection of corruption allegations goes too unruly as well as politically motivated (as was in during military backed interim Government in Bangladesh -2007 to 2008), it brings nothing but wild immense unrest to the civil society and market forces, and to the public sector (see Talukdar, 2009). Mobile technologies certainly can do much at this final stage. For instance, mobile communications can widely
disseminate best practices, and help in documentation and participatory policy formulation and/or alteration. Even just using a bulk mobile SMS an exemplary punishment for corruption can spread to millions of people within a second.

6. Key Challenges Ahead

Studies identify following two broad categories of barriers for mobile communications in social and economic development (see Verclas, 2010; Conley et al., 2010; Mechael, 2008; Mechael et al., 2010; Hellstrom, 2010b):

1. barriers to demand and use; infrastructure (network, electricity), access to devices, literacy, languages, awareness, trust, privacy, affordability, user-friendly and useful content, etc.
2. barriers to content creation and provision; awareness, ICT expertise, tools, sustainability, finance, scalability, innovative business models, etc.

In fact, these are major obstacles for using mobile and wireless technologies for governance, development and fighting corruption as well. In addition, Hellstrom (2010a) points out that in order to avoid the forever pilot syndrome that most ICT4D projects battle, it is important to design with scale in mind and to be familiar with all the costs involved when implementing a project. Singh (2010) notes down that when designing m-governance applications, another important aspect of the architectural framework is to understand and capture the existing knowledge about processes and workflows, and then the next step is to map the solutions that can be translated into applications.

Thus examples and evidences from global and/or regional experiences may not work properly in another place nor should these. Every country context is uniquely different. Lessons learning from global and/or regional experience are important, but the replications must be localized. The final key challenge herewith is the mindset of the governments, politicians, public office holders, stakeholders and end users. Unless the mindset gets changed, structural development in merging mobile and wireless technologies for fighting corruption will not guarantee for institutional growth of using mobile communications for ensuring transparency, accountability and civic participation in administration and governance, and political and development process. So, changing the mindset requires huge efforts from government, media, academics and civil society organizations, where again vast mobile intervention among others can bridge the gap.

3. Conclusion

Labelle comments on CPI Report 2010, “Allowing corruption to continue is unacceptable; too many poor and vulnerable people continue to suffer its consequences around the world. We need to see more enforcement of existing rules and laws. There should be nowhere to hide for the corrupt or their money”.

Ms Huguette Labelle is currently Chancellor of the University of Ottawa, and Chair of the Board of TI.
Despite the fact that there are wide-ranging prospects of using mobile technologies for fighting corruption and good governance both in developed and developing countries, it is still in a nascent stage to improve participation in governance and political decision making and to ensure transparency and accountability. In developed countries, m-governance and e-governance are likely to run simultaneously since their e-governance is based on a strong platform and m-governance comes worldwide in an opportune fashion over e-governance because of its real-time as well as anywhere anytime passage, while for developing countries, unless e-governance platform gets reached in a paradigm, m-governance cannot well function in spite of the fact that they have endless possibilities of using mobile and wireless technologies as part of governance, development and fighting corruption. In fact, m-governance cannot function just based on mobile technological advantages; rather it must require a good office /e-governance backup system. Kailasam (2011) points out that not all applications can run on mobile devices nor should these. He suggests that m-government should be conceived and developed as part of overall e-government strategy and programme.

So m-governance is neither impulsively positive nor negative, and it is not immediately fixable in all governance activities, programmes and functions; in fact its effectiveness depends on particular country context and conditions. Nevertheless systematic incorporation of mobile communications in fighting corruption will surely ensure downward, horizontal and vertical accountability of public administrations and governments, and tailor improved transparency and participation in governance, political and development process.

References


Mobile Based Attendance Management System

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Abstract—Managing the attendance using traditional approach is really a cumbersome process. The person has to maintain the attendance record in registers and file using pen and paper. The problem with this approach is that it requires lots of paper which are the part of our non-renewable natural resources. We are in the age, where we have to think about sustainable development. Managing the attendance using mobile phones, provide an alternative way in this direction. Communication between teachers and the parent is also an important issue that should also be considered, because parent can only get the information about their ward after the interaction with teachers. So, we also tried to bring the system which enables parent to receive the information of their ward on daily basis.

1. INTRODUCTION

Attendance is taken every day on each working day whether it is college, school or any other institution and in this process every institution wasted lots of paper just for keeping the record. With such small reasons, our natural resources are depleting at the enormous rate and it can be possible that our descendants don’t able to get those resources. It is also important to inform guardians of the students about the absence or presence of their ward. Some reputed schools and colleges are there, who do it by arranging meetings between them at a specific interval of time. But that’s not enough, parent need the report of their ward on regular basis.

So, there is a need to solve this problem and automate this process so that for the absentees’ student, the sms or by any other means we should able to inform that their ward is absent. This could be very helpful for both the teachers and their guardians to keep an eye on their ward about their activity, his interest, their regularity etc. So, they can take appropriate action accordingly.

2. RELATED WORK

Many systems and applications have been developed in this regard to solve the automating the process of attendance, but almost none of them fulfil the whole requirements. Many problems can be seen on those existing applications, some lack GUI, some lack automating the process of informing the care taker or guardians. There are software available for automating such problem of attendance but being the fact that desktop it consumes more energy or power consumption that the mobile.

Nowadays, attendance is generally taken on the piece of paper in register. Using mobile for taking attendance, consumes not only less energy
but also helps in reducing the wastage of paper and can serve as green way for taking the attendance. Use of paper, nowadays can be eliminated by the use of mobile or automating the process of attendance. As now generally every person has a mobile device and thus can read the sms easily on the spot to get the status of their ward in their college or school.

Thus although there exists a system for implementing this feature as desktop application[^11] for particular college or school or any other place, But with the mobile, we get solution that is green and eco-friendly i.e. consume less energy and power and also provide a good interface and easy to use for taking the attendance. Mobile being portable can help teachers or any other user to take attendance on their mobile and view the various statistics to analyze the attendance record of the student.

3. Proposed System
We tried to implement a system which overcomes the limitations of the existing approach. Taking the attendance on mobile phones instead of traditional approach is one step forward to sustainable development. Doing the same work on mobile phones not only saves our resources but also enables the user to get easy and interactive access to the attendance records of student. We tried to make an application that can help the teacher to take attendance of the students through their own mobile device. What could be more interesting for that!!

The problem that guardians or parents are not able to get the status of their child time to time or we can say on daily basis. The application that we are building can allows teacher or any departmental head to take the attendance through their mobile devices, manage records, inform to their parents or guardians to the status of his/her child of what actually they are doing it. It provides a good interactive user interface to get the user of taking the attendance and he become able to send the sms to the mobile number given in the details of the students in the file. User should make sure that the mobile number entered is of their mobile device. So sending emails and sms or calling them individually is old process now. It reduces many things like energy coefficients thus green method and helps user to get reduce the effect of greenhouse gases.

4. Platform Selection
The system is implemented on S60 Symbian platform. So, all Symbian based mobile phones (i.e. S60 Nokia phones or any other device capable of running .sis file) are supported by the system. Symbian OS is a C++-based system. Therefore, to support the native OS, C++ becomes the major programming language. Besides, Java (possibly J2ME), which always provides platform-independent solution to developers, can also be a choice. Qt language is used to develop the system since it uses the concept of write once, compile for n which is faster than Java based applications.
4.1 Symbian

Symbian is a mobile operating system (OS) and computing platform designed for smartphones and currently maintained by Nokia. The Symbian platform is the successor to Symbian OS and Nokia Series 60; unlike Symbian OS, which needed an additional user interface system, Symbian includes a user interface component based on S60 5th Edition. The latest version, Symbian^3, was officially released in Q4 2010, first used in the Nokia N8. Symbian OS was originally developed by Symbian Ltd. It is a descendant of Psion’s EPOC and runs excessively on ARM processors, although an unreleased x86 port existed.[1]

![Fig. 1: Symbian OS Layered Architecture](image)

4.2 Benefits of the Symbian Platform to the Industry and to Consumers[4]

The Symbian platform is designed to be extendible – and is shared between all Symbian devices. What this means is that software need only be developed once for it to work on any Symbian device with the same UI. For different UIs, some extra work is needed to optimize the application.

This software could be stand-alone or used only by the user of the device. However, just as easily, the software could be a networking application, enabling users to communicate with other users, or to access a resource somewhere on the Internet.

The effect of this open platform will be the enabling of a Symbian economy. No longer will mobile devices only interact with a limited range of other devices (usually mobile devices from the same manufacturer, or...
Mobile Based Attendance Management System

PCs – via bespoke connectivity software). Users will be able to interact with any device using the Symbian platform. Consequently, it is to be expected that we see a lot of high-quality software systems, produced by different vendors, downloadable to wireless devices at low cost. This reduction in costs can only mean that competition intensifies – which is obviously in the interest of consumers.

Among the many Benefits to the consumer, perhaps the key ones are that there will be more software to choose from, as the reduced porting costs mean lower entry barriers for software developers and that consumers will also be able to seamlessly interact with many more users than ever before.

4.3 Qt for Symbian and its Architecture

Qt for Symbian offers:

- Cross-platform application development without needing to know Symbian C++
- Qt Mobility APIs for taking advantage of mobile features
- Qt APIs have been implemented on top of Open C/ Symbian APIs

![Architecture of Qt for Symbian](image)

4.4 Advantages of Qt

- Target multiple platforms from a single source
- Shorter development time – faster time to market
- Reduced maintenance expense
- Avoid OS-subgroups in development organization
- Enjoy true platform independence
- Target a new platform in weeks, not months
- Rapidly respond to evolving market requirements
- Remain insulated from platform changes
• Qt is actively maintained and developed to support all new mainstream OS variants
• Focus development efforts instead on value-adding innovation
• Qt delivers real, lasting competitive advantage
• Qt increases the productivity of developers by making C++ programming faster, easier and more intuitive
• Qt delivers true platform freedom – targeting a new platform is measured in days or weeks, not months or years

5. System Architecture

5.1 Brief System Architecture Diagram

Architecture diagram (fig 3.1) shows the overall architecture of the system, how the complete process moves on. The teacher takes the attendance on his/her mobile phones and mark the attendance, the record is then stored in the database so that can be fetched later on when required. The mobile will then generate the sms and send the sms to the parents or guardians of the students informing them about the attendance status of their child in the class.

The interaction between the teacher and the mobile is two way as it’s not just the teacher marks the attendance of the student present in the class, the teacher can also access the records like search for the attendance on the particular date or view the attendance status of the particular students on a specific date, along with the basic operation of creating, deleting the class, inserting the students and editing their existing records. The interaction between the mobile phone and the database too is two way as the mobile phones are used not just for storing the data but can also fetch that data. The data required for the above operations can be fetched from the database and viewed by the teacher on his/her mobile phones as per his/her requirements.

![Fig. 3.1: Overall System Architecture](image)
5.2 Detailed System Architecture Diagram

Detailed System Architecture diagram (fig 3.2) is the self-explanatory. This diagram shows all the modules which are being used in this system and also show how user can navigate from start-up screen to other operations till send sms. Other descriptions are being mentioned earlier.

![Detailed System Architecture Diagram](image)

Fig. 3.2: Detailed System Architecture

5.3 Use Case Diagram

![System Use Case Diagram](image)

Fig. 4: System Use Case Diagram
5.3.1 Description of the Use case Diagram

The above use case describes the facilities enjoyed by the user in our case mobile user.

The use cases shown above are:

1. Create Class
2. Search Attendance
3. Delete Class
4. Take attendance
5. View Attendance
6. Insert Student
7. Edit Student

These are the facilities that are provided to the user by our application. The use cases shown above use functionalities provided by other use cases to get the work done.

5.4 Interaction Diagram of System

5.4.1 Sequence Diagram

Fig. 5 represents the sequence diagram for whole system which is a kind of interaction diagram that shows how processes operate with one another and in what order. All the modules and their order of accessing are being shown in the diagram.
5.4.2 Collaboration Diagram

Fig. 6 represents the collaboration diagram for the whole system which is also a kind of interaction diagram that focuses upon the relationships between the objects. They are very useful for visualizing the way several objects collaborate to get a job done and for comparing a dynamic model with a static model. Collaboration and sequence diagrams describe the same information.

8. Better than PC Based System

It is better than PC based system in many ways:

1. In an environment of inadequate and erratic Power (Electricity) supply, the Mobile phones are much better than the Computer; Desktop or Laptop. The Mobile phone requires a small fraction of the power requirement of Computers and has power storing batteries that tend to store power for a longer period, when compared to Laptops.
2. It provides mobility to the users to access the attendance record at any time and at any place.
3. The Mobile Phone is relatively cheaper than the Computer on the average, so economically it has an advantage over that.
4. In an environment of poor maintenance culture, Mobile phones are less prone to malfunctioning when compared to Computers. So, Cheaper Maintenance is the next added advantage for any system based on mobile phones.
5. The reduction in Paper material being used in traditional method of pen and paper based attendance system, thus preserving the Forests of the world (the small phone can contain hundreds of thousands of pages of books, and written materials). It is a Green technology.

6. Availability wise also it is preferable, today mobile phone is available to every other person as compared to computer. So, any institution does not need to incur any extra cost while installing the system.

7. **Advantages and Limitations of the Proposed System**

7.1 **Advantages**

The advantages of our system are as follow:

- Ease up the process of attendance.
- Easy Analysis of data.
- Better user interface.
- Made access to the record of attendance available 24X7.
- Reduced dependency on natural resources for paper.
- Easy generation of summary of attendance.
- Make the process of attendance a green process.
- Provide communication between teachers and parents.
- Automatic SMS will be sent to parents to inform the status of their ward whether present or absent in the institution.

7.2 **Limitations**

The limitations of our system are as follows:

- Informing the parents for their child attendance status regularly can be irritating if they are not interested.
- Small screen of the mobile is a big limitation and can leads to difficulty in marking the attendance of the system.
- Limited storage capacity of the mobile is also a limitation in the system and due to this large number of records can’t be kept in the mobile.
- It can be a little bit costly for the teacher to send the sms from the mobile every time she takes attendance in the class in case he/she has not used message card.
- Speed of the OS of the mobile is less than the computer if compared with computer so it has speed limitations if compared with computer based attendance system.

8. **System Screenshots**

Some of the system screenshots are:
8.1 Class Menu
Screenshot (Fig 7) shows the different menu options that the user have to choose from like creating the class, take attendance, view the attendance record, search the attendance of particular student, inserting the new student in the class, edit details of the existing student in the class and the last is deleting the class.

8.2 Take Attendance
Screenshot (Fig 8) shows the screen for marking the attendance of the student whether present or absent along with the necessary details of the student and the current date. As the teacher or any other person who is taking the attendance submit after marking the attendance then automated sms are generated and sent to the parents or guardians of all those students who are marked absent. They are informed about the presence or absence of their ward from the class. In general parents are informed of the status of their child in the class.
9. Testing of the System

The system has been tested in the real time by giving the mobile phone Nokia 5233 with application installed in it to the professors of one of the reputed institution “Bhagwan Parshuram Institute of technology, Delhi” and then taking the attendance in the class. The feedbacks from the various professors are then recorded. Most of the professors are quite satisfied with the system. The feedbacks from the parents also are recorded in this process.

10. Conclusion and Future Work

In this paper we have discussed about the problems caused due to the use of traditional approach in taking the attendance and solutions for that through the use of mobile and provide a new approach.

The goals achieved in following this approach: Automate the attendance management using mobile devices to reduce the dependencies on natural resources and also provides a way of communication between parents and teachers. Integrating the student’s mobile phones with the application so that the application detects automatically the students that are present is a great thing to be added in the future.

Integrate it with the centralized server of the college/school so that the server will send the sms to the guardians of the absentee’s students and informing them about his or her ward. We will try to generate the daily report that will be submitted to the centralized server for its record. This can also use Bluetooth technology or Wi-Fi technology for communication between device and central server within campus. These are some future works which can be implemented further.

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mOpportunities and Business Models
User Experience of Mobile Business Support Services for Rural Micro and Small Enterprises

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Abstract—The penetration of mobile phones and technologies in developing countries has led to innovative developments of various mobile solutions. Rural micro and small enterprises find themselves in the midst of such developmental mobile initiatives and have shown to overcome many barriers. This potential however is contrasted by studies that show relative high dropout rate and non-use. Frustration with mobile technologies interaction is a major obstacle for effective use. The ease of use implies that both the service interaction and the user interface are properly designed. Providing usable mobile services is more complex: even though the ease of use is one important, it is not enough. Other aspects such as behavioural, social and emotional aspects of the users need to be taken into consideration. Hence this paper explores the power of user experience and explores how micro and small enterprises use mobile services. We further identify the missing gaps and propose a mobi-incubation solution for rural micro and small enterprises.

1. Introduction

The potential and perceived benefits regarding innovative mobile phone usage for social and economic development is becoming enormous [1]. Many perceive mobile connectivity as a tool that helps to offset a lack of resources particularly in the developing countries by providing access to a range of services hence spurring development [2]. In rural areas in developing countries like South Africa, enthusiasm for Mobile for Development (M4D) has come in waves [3], many agree that mobile technology offer micro and small enterprises opportunities to deepen interactions with existing customers, replace travel, improve market information flows and productivity as well as increase Gross Domestic Product (GDP) [1, 4].

In South Africa, micro and small enterprises are estimated to account for approximately 38% of production and 71% of jobs [5, 6]. However, a recent Global Entrepreneurship Monitor (GEM) report indicates that South Africa is struggling in entrepreneurship. The GEM report further shows a drop
of 40% in the number of start-ups in 2009 as compared to 2008. Moreover, there is lack of entrepreneurial activity in rural areas as compared to urban areas [7]. Most reports consistently show this sector face a dichotomy of challenges including, a low level of overall training and education, lack of access to finance due to a difficult regulatory environment, infrastructural inadequacies, a lack of active markets and the lack of access phenomenon [1, 7, 8].

In an attempt to curb these problems several Information Technology for Development (ICT4D) innovative solutions have been proposed. Lately most solutions revolve around the mobile for development (M4D) solutions. This paper focuses on mobile business support services. Mobile business support services in this case refer to data and functionality that also has representation online, and may be available on a mobile device—referred to as a native application. The main purpose of these services is to support business activities [9]. The users of these services include micro and small enterprises (MSEs). It is important to note that the success and sustainability of these services is dependent on the end users. When users can use mobile services, it means that the services are easy to use. This brings us to user experience (also referred to as UX). Many researchers have identified that UX is essential for any product’s success [10-12]. They also noted that UX has some challenges. The first challenge is user experience itself. Over the last decade, the study of user experience has increased explosively. It has been studied by psychologists, sociologists and philosophers. The irony is that researchers have not come to a consensus to what UX can be defined as [13].

This paper applied an explorative research methodology whereby we adopted inductive logic to study relevant literature available with an aim of describing and identifying the missing gaps in MSEs and UX, thereafter we proposed a mobi-Incubation solution for rural micro and small enterprises.

This paper starts off by discussing user experience and draws an understanding of mobile user experience (MUX). It then exemplifies how MSEs use mobile business support services, while identifying the current gaps in these services and MSEs challenges. Lastly it proposes a mobi-Incubation framework for rural micro and small enterprises and highlights the design implications to be considered when designing such solution.

2. USER EXPERIENCE

The goal of Human Computer Interaction (HCI) research has been the development of effective and efficient interactive products [10]. Many researchers focused on well known and widely accepted quality measures of products in task oriented settings with usability and utility emphasising the interactive product’s ability to satisfy users’ goals with ease. However, HCI has grown to accommodate a new generation of interactive software and electronic products that has come into market; hence HCI now encompasses a whole study of human endeavour and activity [10]. As a result there
has been a growing interest in “design for user experience - going beyond usability and utility” [11].

Despite the huge interest in UX, it is still a vague concept and different researchers view and define it from very different perspectives ranging from traditional usability to beauty, hedonic, affective or experiential aspects of technology use [14, 15]. Most user experience definitions in literature agree that user’s internal state affects the user experience, so user experience is personal [13].

As can be seen in the figure above, the current user experience depends on the previous experiences, the user’s motivation and the context of use while it influences the user’s actions and the future experiences [17]. The user’s previous experiences are then based on the expectations of how things work and their result are created [14]. This corresponds to the user’s mental model and is present even before the interaction starts [18]. The whole interaction between the user and system happens in a dynamic context (for instance social, situational, locational etc) that influences and gets influenced by what the user does and experiences [13]. The user has a motivation, why the interaction must be initiated [18], and the goals that shall be reached by the actions. These actions are performed in an interaction with the user interface of the system, which manipulates the internal state of the system and influences the user’s experience and cognitive process that develop the further plan of action [15, 19]. After this interaction, the user has gained impressions and then processes the experience, adding
them to the memories, adapting the future expectations, the mental model
and the emotional attitude towards the system [18]. The natural personal
view explains how user experience is shaped into the use over time and
the highly subjective experience connected to the context [15]. From this
discussion the authors mentioned described common factors that influence
user experience being, user, content, and context. The questions remains
how does one determine if there is a negative or positive user experience?

Roto [13] presents that a user gets negative experiences when the usage
does not meet expectations. Positive experiences form when expectations are
exceeded. User experiences are neutral when expectations are met but nor
exceeded. In this paper we use the terms “negative” and “Positive” UX terms
to refer to different user experience in relation to the user’s expectations.

When it comes to mobile user experience, it brings forth added
complications and dimensions due to the mobility of the interaction and
the personal nature of the technology [19]. The following section examines
the mobile user experience.

3. MOBILE USER EXPERIENCE

Chittaro [20] cautions that if human computer interaction (HCI) aspects
of mobile technologies are not properly addressed, users will not
enthusiastically adopt mobile computing. This author further argues that
mobile services will not be successful if we do not understand mobile users
and design for their contexts.

Subramanya and Byung [21] focus their study in user experience on three
dimensions namely device-related issues, communication-related issues
and application related issues. Device-related issues deal with hardware
features that would facilitate ease of use of the device and accessories.
Communication-related issues focus on efforts to enrich interpersonal
communication and application-related issues deal with mobile application
interactions. The latter they identify as the most important layer and
contributing directly to the user experience by compensating for underlying
device and user constrains due to the mobility.

Botha et al. [22] explored the mobile user experience in a mlearning
interaction and expanded Hassenzal and Tractinsky’s components to
include the following:

- **User**: the mobile user, mobile use;
- **System**: mobile device, mobile business practices, network
  affordances, mobile applications, mobile interaction;
- **Context**: mobile context

Having identified the factors that influence mobile user experience,
the next section discusses mobile business support services and their users
the MSES.
4. Mobile Business Support Services and MSEs

Shifting our focus to mobile business support services, these are data and functionality designed specifically for mobile use and can be accessed over a communication network. These services are aimed at assisting micro and small enterprises (MSEs) to run and manage their businesses. In most developing countries, MSEs constitute the vast majority of firms, generating a substantial share of both overall employment and output [7]. Given their significant economic role, one might expect MSE growth to drive overall increases in output and income levels [23, 24]. In many cases, however, their largest economic contribution appears to be one of maintaining—rather than generating new—employment and income for the poor [7, 23].

Most micro and small enterprises are informal, unproductive and they struggle to survive [7, 24]. Figure 2 below shows the phases in MSE development. GEM report by Mass and Herrington [23], shows that 75% of the start-up MSEs fail during the first 42 months of establishment.

![Fig. 2: Phases in MSE Development Interpretations of Mass and Herrington [23]](image)

Most reports consistently show that the main issues facing contributing to MSE failure in South Africa are: a low level of overall training and education, lack of access to finance due to a difficult regulatory environment, infrastructural inadequacies, a lack of active markets and the lack of access phenomenon [1, 7, 8]. Nichter and Goldmark [25] grouped the challenges facing MSEs into four broad categories: contextual factors related to the business environment, social or relational factors, firm characteristics, and individual entrepreneur characteristics. The funnel shape shown in figure 3 emphasizes that the factors range from broad (contextual) to narrow (related to the individual).
Many researchers claim that the most common technology among MSEs is the mobile phone [1, 2, 24, 26]. Recent studies indicate that MSEs in the developing world are using mobiles rather than landlines or other ICTs [1]. Of late, a small number of ventures (some by private companies, others by governments, or NGOs) have begun to explore what mobiles can do for farmers and MSEs, beyond voice calling and person-to-person SMS [2].

Donner and Escobari [27] reviewed mobile services for MSEs and found that there is relatively little evidence for the assertion that mobiles help people start new businesses. Only Samuel et al. [28] make this case, reporting that among a sample of MSEs in Egypt and South Africa, 26%-29% of businesses attributed their start to the availability of the mobile. Despite a dearth of new enterprises, the mobile is essential to the economic survival of those households [27]. Donner and Escobari further mapped the services to the value chain proposed by Porter [29], these authors found that one or two activities of the Porter’s value chain. As such there is a gap in a sense that there are no mobile business support service(s) that enhance the nurturing process of micro and small enterprises by providing various business activities which assist them to grow. Therefore, there is a need to provide MSEs with appropriate services to nature hence increased sustainability and profitability.

The lack of mobile services that fully support the business activities brings forth a negative user experience. As such there is a need to investigate MSE needs in order to provide appropriate services which support their
value chain. Furthermore, there is a gap in a sense that there are no known mobile business support service(s) that enhance the nurturing process of micro and small enterprises by providing various business activities which assist them to grow.

The crux of this paper is therefore motivated by the belief that the mobile phone has the potential to support business activities thus improving the sustainability of micro and small enterprises in developing countries. This idea however is dependent on the uptake of mobile business support services by MSE the end-users. New MSEs can take advantage of mobile business support services to grow and become successful.

5. PROPOSED MOBI-INCUBATION SOLUTION

Many of the challenges discussed above are generic to South Africa, development in rural areas poses special challenges because of geographic isolation and sparse population [8, 30]. Local disadvantaged communities in rural locations lack access to entrepreneurship development [7], an issue that is recognised by many organisations and observers [23, 30, 31]. A recent study suggests that the evolution of peripheral rural regions within many development countries has been bleak and discouraging [32]. The report concluded that the main reason is the weak natural supply of entrepreneurs and firms. As a result of challenges inhibiting entrepreneurship government institutions, NGOs and private companies initiated the business incubation concept [30].

A business incubator may be defined as an organization that facilitates the process of creating successful new small business by providing them with a comprehensive and integrated range of services [33, 34]. They are geared towards stimulating a pipeline of entrepreneurs who would start businesses that would remain sustainable. In most cases business incubators are funded for a limited amount of time, and the incubator clients are aided for short periods of the incubator’s lifetime. Services offered during the incubation may include specific types of office space, flexible lease terms, access to technology, financing, and technical assistance (such as marketing, legal, finance, HR, and other business development services) [34]. By providing entrepreneurs with these services, and enabling them to reduce their overhead costs by sharing facilities, business incubators are able to significantly improve the survival and growth prospects of new start-ups [33].

There are a number of incubation challenges unique to South Africa. Incubation theory designed for the developed industrial countries does not have the same application in South Africa [35]. The large geographical areas as one of the crucial differences and challenges to South Africa, individuals require access to support in remote and rural areas, but it is naturally not possible for Incubators to be established in each of these areas. In addition, a large proportion of the rural South African inhabitants have limited access
to education, live in poverty, and generally experience a low quality of life. Therefore, these communities provide a logical starting point for new innovative solutions. It is important to recognise that these disadvantaged rural communities have rather unique circumstances and characteristics, which are quite different from the average urban resident. However, as a result of the mindset of providing education programmes based on what’s on offer, rather than what communities require, many business incubation programmes lack the capacity and skills to meet the training and development needs of the communities they service [35].

Having looked at the challenges that face micro and small enterprises and business incubation in rural context, this paper acknowledges that there is a need for using other technologies to facilitate the business incubation process. This study therefore explores the potential of using mobile phone as a tool to facilitate this process. The figure 4 demonstrates how mobile phones can be used to support micro and small enterprises in rural areas [36].

![Fig. 4: The Concept of Mobi-Incubator](source: Chelule et al., 2011)

Mobi-Incubation enables rural entrepreneurs to receive coaching and mentoring remotely via the internet, using a mobile phone which enables the mentoring, monitoring and guidance of entrepreneurs wherever they are located (Chelule et al, 2011). More importantly, the rural entrepreneurs are connected to a wide network of coaches and investors spreading the costs and exposing them to a wide range of expertise and experience. It is important to note that in this process a system needs to be developed to manage the mobi-Incubation process. This process requires careful attention to user experience elements. Hence the following section outlines the design implications to ensure positive user experience.
6. Design Implications

Based on these preliminary findings of exploratory study, we present the following set of design implications. These implications will be developed and iterated upon in the future.

- Micro and small enterprises require general business support services in order to assist them to smoothly run their business (Chelule et al 2011). These services may include an array of support such as entrepreneurial training and business development advice, as well as services concerning general business matters such as accounting, legal matters, advertising and financial assistance.
- Micro and small enterprises often appeared to lack self-confidence to take individual initiative. Therefore Mentoring is necessary whereby will be coached and advised on various business related aspects such as investments, general support and life skills mentoring.
- Due to low education level it is necessary to provide technical support for rural entrepreneurs whenever needed.
- The mobi-Incubation solution should be easy, simplistic and culturally situated. The design should cater to illiterate, semi-literate and literate rural population.
- The mobi-Incubation solution should facilitate sharing of knowledge between the micro and small enterprises.
- The mobi-Incubation solution should support synchronous as well as asynchronous modes of communication.

7. Future Work

This paper has presented the preliminary findings from an ongoing PhD study. The next phase of this study involves the development of the mobi-Incubation solution. This is a user experience study, we need to design and iteratively test mobi-Incubation solution that appropriately map the mental models of micro and small enterprises and take into consideration their diverse needs keeping in mind the low literacy levels and the context. We will further investigate the impact of the mobi-Incubation application with regards to UX. The primary goal of the research is to propose a user experience framework for mobi-Incubation in rural areas.

8. Conclusion

Rural micro and small enterprises play a vital role in the rural economy; they not only provide essential goods and services, but they also provide rural jobs. Most of these retailers are informal and they face array of challenges including: a low level of overall training and education, lack of access to finance due to a difficult regulatory environment, infrastructural inadequacies, a lack of active markets and the lack of access phenomenon. Many perceive mobile connectivity as a tool that
helps to offset a lack of resources particularly in the rural areas by providing access to a range of services hence spurring development. Rural population across the world is therefore considered a high potential emerging market. Mobile solutions potential however is contrasted by studies that show the relative high dropout rate and non-use. Frustration with mobile technology interactions is a major obstacle for the effective use. We propose that mobile technology be used during the business incubation process. To ensure sustainability of both micro and small enterprises and the growing economy, it is necessary to design and develop a mobi-Incubation application that aims to provide a seamless user experience in all aspects—content, context and user needs. Hopefully this will empower micro and small enterprises to build successful and sustainable business which will contribute to the economic growth of the country.

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References


Leveraging Information and Communication Technology for the Base of the Pyramid-Innovative Business Models in Education, Health, Agriculture and Financial Services

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Abstract — Many ICT4D projects have a short lifespan, being donor-driven pilots lacking an economically viable, long-term value proposition. Still projects can have significant impact. In finance, momentum is building in the range of services delivered as well as in the number of initiatives. Successful projects have grown to reach more than 5 million customers each. In agriculture and rural development, large-scale ICT projects are directly linked to income-generating activities, making their value easily visible for end-users. Healthcare is an extremely dynamic sector of ICT4D, but has mostly attracted donors. Market-based approaches focus on remote diagnosis or drug authenticity verification. There are very few education projects with market-based approaches targeting the poorest. To build on the success of current initiatives, stakeholders will need to partner and focus on multiplying an impact that so far still leaves most of the world out of reach of healthcare, education, financial services or agro-services.

1. Introduction
This paper synthesizes the conclusions of the study “Leveraging ICT for the BoP” sponsored by AFD-Proparco, Ericsson, ICCO, France Telecom-Orange, and TNO and conducted by Hystra and Ashoka from October 2010 to June 2011. This study aimed to learn from “what works” in terms of full projects (as opposed to technologies) combining both an economically viable model and socio-economic impacts on their end-users, in the field of ICT for development (ICT4D). This work is thus based on the in-depth analysis of existing projects led by various types of actors (social entrepreneurs, NGOs, private companies...), in 4 sectors of “development” where ICT has already shown it could play a key role: healthcare, education, agriculture, and financial services. This paper presents first the overall conclusions of this work. The full report is available on www.hystra.com.

2. A very dynamic field...with stronger rhetoric than reality
ICT has long been talked about as a lever that would enable developing countries—and particularly the least developed ones—to take “shortcuts” to development by using the latest generation of equipment and software, hence avoiding the decades of trial and error that developed countries have gone through. Indeed ICT can deliver information and expertise to people who do not have either physical or financial access to these resources, and
help remote BoP citizen consumers and entrepreneurs make significant improvements in their lives. And today seems to be the right moment, when connectivity has extended sufficiently for this wave of “socially-beneficial” services to ride efficiently on technology: 90% of the world population now has access to mobile networks, and mobile phone penetration rate in developing countries reached 68% in 2010, with 3.8 billion mobile phone subscriptions in these markets [1].

However, ICT is no “silver bullet.” The study looked at four sectors of ICT4D (ICT for Development): education, health, finance and agriculture. While there is a wide variety of viable or partly viable business models, more than half of the 280 projects screened were still young and/or not financially sustainable. The field of ICT4D is nascent, from the oldest proven projects using computers (such as eChoupal and Drishtee[2] for example) dating back to the early 2000’s to new business models such as RML, Esoko, or txteagle taking advantage of the recent spread of mobile phone—the prominent tool of ICT4D. Projects that have reached the “million customer landmark” remain the exception. As mobile phone development is recent and on-going, it is still too early to speak about results in a definitive manner.

Additionally, many ICT4D projects have a short lifespan, many being donor-funded and donor-driven pilots lacking an identified, economically viable, long-term value proposition. Many ICT4D initiatives completely rely on donor funding for financing (136 of the initiatives studied here), while some use some measure of subsidies in their operating models (35 initiatives). The remaining projects, though possibly market-based today, have often used grants in their initial phases to grow. Many projects have mistaken population need for consumer demand, providing a service that the targeted end-users or beneficiaries were not willing to pay for. The result is the creation of business models that, while well intentioned, were not sustainable.

Additionally ICT4D projects and their proponents face the challenge that the direct impact of ICT on development projects is hard to single out and measure. By nature, even projects that would not have been possible without ICT encompass other dimensions beside the technologies themselves, and often the ICT component is not entirely devoted to social purposes. For example, Drishtee, an Indian social enterprise which has set up rural IT kiosks, uses its computers for ICT training, but also as internet spots for other purposes for villagers, and at the same time the Drishtee model encompasses non-ICT services such as the physical delivery of goods. All this makes it difficult to assess results of ICT itself and take action to improve the ICT component of development projects.

3. ****VARIous LevelS of Financial Viability, with More Viable Cases in Finance and Rural Development**

While not always the panacea, a number of the cases studied can have a significant social and economic impact, from lower costs of money
transfers (Bradesco, FINO, M-PESA) to increased agro-productivity and revenues (CKW, eChoupal, eKutir, Esoko, RML, txteagle) to enabling access to appropriate health information (mPedigree, HealthLine) or even providing cardiac care for the poorest (Narayana Hrudayalaya Hospital-NHH), to educating the most remote (BBC Janala, Drishtee). In order to better understand the common barriers to scale faced by these initiatives across sectors (finance, agriculture, health and education), we organized our in-depth analysis of 16 ICT4D examples in four cross-sector clusters, based on the business models of these cases, as indicated in the Figure1 and detailed hereafter.[3]

3.1 Value Added Information Directly Accessed by End-Users

Services directly accessed by end-users are usually delivered over a mobile platform; end-users interact directly with the technology to access the service. Such services must be customized, i.e. culturally relevant and offering either localized or personalized information, to be adopted by the local population. They can then have significant positive socioeconomic impact on the BoP, from saving lives with relevant health advice (HealthLine) to significantly increasing agro-revenues with information on both prices and best practices (RML). Building such a tailored offer requires time (typically several years) and investment in the millions of dollar range;[4] registering enough customers to justify this high initial investment and keeping them active additionally require high on-going marketing expenses.

Players setting up such services must be aware that breakeven will take years and must carefully balance investment in fine-tuning their offer and marketing expenses, to register a sufficient number of clients. Additional challenges include retaining topical experts as staff in a teleservice operation which they may not find motivating or rewarding enough, and the need for dual approval by both ICT and sectorial legislators—yet financial rewards in case of success are significant as the marginal cost of service delivery to one more client is quasi-null.

![Fig. 1: Case Studies in this Paper by Business Model and Sector [3]](image-url)
3.2 Value Added Services Accessed through Local Agents

These services are provided via “local agents”, i.e. people with a minimum of education who act as the interface between technologies and end-users. Compared to “direct access”, this model overcomes the need for technology ownership and minimum literacy level, and can thus potentially reach deeper into the BoP. It can also offer more extensive and complex services than direct access as it includes a human intermediary between the technology and the end-user. Such services can either be very specialized, such as telemedicine consultations (Narayana Hrudyalaya Hospital), or can use the physical infrastructure in place for their agent network to cater to a range of needs—not necessarily all ICT-based (eKutir, eChoupal, Drishtee). This “diversification” is a necessity for local agents to remain economically viable today, since only selling “ready made” information is not a strong enough value proposition against what cell phones can increasingly offer via direct access models.

This model requires smaller initial investments than the direct access model to design tailored technology services, as local agents do the last mile customization. However it needs a sustained financing mechanism for the initial set-up costs of each agent (including technology, but also the cost of selecting and training agents). Once established, trusted agents (typically chosen among opinion leaders) can easily sell new services, thus not requiring as heavy marketing expenses as direct access models do. This model can also benefit from multiple sources of revenues due to its wide range of services—from fees for expert consultations to commissions on products sold through this channel.

Challenges are thus to fund expansion (rather than the initial service development) in terms of financing new agents as well as training them to become trusted and informed sales people, and to find “aligned” partners to offer a wide enough range of relevant services. Additionally, as each agent must typically serve several hundreds of people to be viable, this model only makes sense in dense enough areas.

3.3 Crowdsourcing/ Crowdfunding Models

Crowdsourcing models treat the BoP as participants in a value proposition: doing small tasks or gathering local information aggregated by technology for larger institutions, against compensation. Crowdfunding models match BoP entrepreneurs without access to traditional finance and investors looking for small business opportunities. Both models thus directly bring funds to the BoP.

These models, still young, are fine-tuning their value proposition. As they reduce the costs of gathering data (or of screening investment opportunities), they should be able to redirect these cost savings towards payments for the service they offer.
The key challenges ahead are the scale up of their back-end for large quantity of information from numerous sources, and the recruitment and on-going motivation of trustworthy “crowd” participants who will source reliable and quality inputs.

3.4 Financial Services

Financial services offered via ICT can either be:

- A substitute to existing practices (e.g. mobile money transfers replacing physical money transfers like in the case of M-PESA, or loan repayments through cards at point of transactions instead of in-person payments in the case of FINO); or
- An entirely new practice for unbanked populations (e.g. life insurance available via mobile phone, or “meso-loans”[5] for social entrepreneurs, such as those offered by MYC4 to African entrepreneurs).

In both cases they require a robust secured platform and either local agents to sell the service initially and manage the cash, or/ and a direct interface between technology and end-users. They must create trust in the technology and—when agents are needed—in the agents, for example by leveraging existing trusted networks such as airtime resellers (M-PESA) or post office agents (Bradesco-Banco Postal).

The business models seen tap into various (and generally multiple) sources of revenues: from government for social transfers channelled more efficiently via mobile phones or small shops equipped with IT (notably done by Bradesco in Brazil and FINO In India), to insurance companies for the sale of new micro-insurance products to the BoP, to telecommunication operators when the service increases their customer retention, to end-users via fees on their financial operations.

Moving forward, existing initiatives that use agents will need to densify and better secure their agent network to make their offer easily accessible to all. This implies often first to piggyback on existing networks, then to create new ones for a second step of expansion, as well as to improve cash management to avoid that these agents bear the risks of carrying cash that their clients now avoid. Governments can play a large role in promoting such services through explicit policy support or even by using these services for their social transfers, while companies launching these initiatives should be aware that they will need to invest both in increasing financial literacy to sell complex services such as insurance, and in sustaining customer relationship to maintain users active.

As shown in Figure 2 below:

1. There is an equivalent proportion of business models based on direct access to technology or on a local agent intermediary, that have survived the pilot phase and use some type of market mechanism;
2. The different sectors studied display distinct levels of maturity in terms of encountering economically viable mechanisms, whatever business models they use.

Fig. 2: “Financial Services” Is the Most Mature Area in Market-based ICT4D Projects

- In finance, where the need is that of 2.5 billion unbanked adults, momentum is building in the range of services delivered to the BoP as well as in the number of initiatives: money transfer systems are being complemented with account holding, lending, and insurance (at least 3 programs of insurance via mobile phones were launched in the past 6 months). There are now more than 80 mobile money services around the world, purely market-based. Successful projects have grown to reach more than 5 million customers each (up to 28 million in the case of FINO).

- In agriculture and rural development, a variety of fairly large-scale and mature ICT-enabled projects demonstrate economic viability and provide significant social and economic value. Such projects are directly linked to income-generating activities (for example providing better selling opportunities for agro-products), making their value easily visible for end-users. In our study, 30 projects out of 53 agro projects identified were partly market-based and still running. The largest projects (eChoupal, Drishtee) have impact on several million people.

- Healthcare is an extremely dynamic sector of ICT4D, but to date has mostly attracted donors. Out of the more than 100 projects in ICT4health identified for this study, only 20 were at least partly market-based and had survived the pilot phase. While donor projects were often focused on awareness campaigns or health data gathering and analysis, market-based approaches focused
on remote diagnosis or drug authenticity verification. They serve up to a few million clients in the case of basic information (simple health information for HealthLine), and several hundred thousand customers in the case of specialized remote diagnosis (cardiac diagnostic for Narayana Hrudayalaya Hospital).

- At the other end of the spectrum, there are very few education projects with truly market-based approaches targeting the poorest—be it BoP children or adults who still need education and professional training. We found only 21 ICT4D projects specifically focused on education, less than half of which had at least some market-based component. Education was included in the business models of specific projects mostly as training and to help build the capacity of adults.

- However, some not-for-profit projects (e.g., MoMath [6]) and the success of BBC Janala (providing paying English lessons to several million Bangladeshis over multiple media platforms) have demonstrated that demand for general education support is emerging. Yet without government procurement it remains to be proven that there is sufficient purchasing power at the Base of the Pyramid to pay for the development costs of ICT-based education (support) services. What is missing at this stage is a demonstrated commitment by most governments to procure education-supporting services from private providers.

3. **Entrepreneurship is key to Starting Successful Services, while Cross-sector and Cross-actor Collaboration is key to Scaling**

Interestingly, across the sectors and business models, successful projects share common characteristics:

- They are focused on the ability and willingness to pay of their customers, rather than on externally identified social needs and supposed demand.
- They are built from the ground-up through a trial and error approach, flexibly evolving over time based on end-user feedback until they match demand.
- They end up capturing a sufficiently large share of customer’s mind and wallet (through a related set of services) to recoup the initial investment and to minimize the proportion of revenue that is devoted to marketing expenses once an ICT channel is built.
- They leverage this channel to the maximum with a wide range of services, combining varied revenue streams. ICT4D is a low price-high volume market, with unit price of each service in the order of magnitude of a few cents to a few dollars at best. The larger the offering of services, the easier the customer base expansion and cross-sales of complementary services becomes, thus speeding up cost recovery, and maximizing impact.
The first two characteristics describe an entrepreneurial debut, requiring time before “getting the business right” (one or two years of adjustment is the minimum) and often necessitating a corresponding high initial investment (in the order of magnitude of several million dollars) to finance these adjustments.

Notably because of the inherent conflict between these entrepreneurial characteristics (needed for initial proof of concept) and the systemic approach required to scale, a number of obstacles fall in the way of ICT4D project leaders interviewed for this study, be they managers within large corporations or social entrepreneurs.

• They need an adequate policy framework to develop, often requiring changes in existing regulations to allow the use of ICT in their development field, and sometimes depending on government support for success. In many cases the need for multiple approval processes (e.g. telecom regulation and healthcare regulation) for unusual offerings considerably slows down projects.

• The difficulty in this field is to combine a very local understanding of people’s habits and demand with the necessary technical expertise and the specific sector expertise—this means a need either for partnerships or for growing the required internal capacity, both for the core team and field employees.

• They need funding at several levels:
  • Equity investment (possibly under the form of patient capital) for the company,
  • Loans for their local agents—often considered unbankable, and with loan amounts between those of MFIs and of traditional banks, and
  • Donations or investments by third parties sharing their interest in developing the service (notably for awareness, marketing and the training of employees).

• Technology remains an issue, in the pilot phase to design an interface with great usability, and more importantly in the scale up phase when the backend needs to be adapted to larger numbers. Social entrepreneurs seem to suffer more from a lack of digital literacy and IT expertise, because many are field practitioners (as opposed to managers of ICT4D projects within large companies).

• Finally, though this is not a challenge mentioned by the project leaders, our research seems to point that there is no “quick and dirty” way to test services locally—they all need several months, if not years, of field testing to be suited to local needs—which further lengthens what is usually an extensive service design and technical trial period before service is made available widely.

These issues are at the same time significant challenges and an exciting opportunity in the sense that—if addressed systematically and
systemically—they could generate high social and economic returns. Market-based solutions in ICT4D are a high risk, high return game. In this perspective, ecosystems of ICT4D initiatives and stakeholders would favour the scale-up and replication of ICT-based businesses. Indeed, to scale up, an ICT4D project needs of course the “ICT” part (robust and locally appropriate technology with adequate network), the “D” part (locally relevant development content), but also an adequate political framework, supportive or at least permissive for innovative initiatives to develop. Such ecosystems not only require encompassing several actors (from the public, private and citizen sectors), but can also benefit from encompassing several areas (notably those studied here—agriculture, finance, health, education), serving a wider share of their customers’ needs and leveraging infrastructure to generate several revenue streams. This evidence would notably point to the establishment of regional clusters of ICT-enabled businesses in given geographies, providing a wide range of services for a comprehensive socio-economic impact.

4. GOING FORWARD: BUILDING ECOSYSTEMS FOR RURAL DEVELOPMENT AND OTHER OPPORTUNITIES

Rural areas seem to have the most to gain from ICT4D. The key issue that their inhabitants face in terms of development is their lack of access to many services. Building a sustainable business case on health, finance, agriculture and education can be facilitated in a rural setting thanks to the immediate visible economic impact of such services—previously unavailable, and suddenly bringing a whole new set of possibilities to rural populations until then disconnected from the rest of the world.

Though rural development is indeed one of the opportunities of ICT4D socially and economically speaking, it is too early at this stage to state where the most promising venue will be. The area with the largest potential will depend on:

- The number of potential clients (both individual and businesses) for a given service—most of the world population in health; children, students and adults requiring training in education; adults in financial services; and in agriculture most people in rural areas
- The improvement it will represent compared to previous offerings, which will determine how much people could be willing to pay
- The novelty of a service—harder to promote if it is entirely new and does not replace an existing practice as it necessitates consumer’s education

And finally, as all actors of one given sector need to collaborate to successfully create efficient ecosystems of ICT services, their willingness to participate as a whole sector in these new types of “social businesses” will be key to enable a given sector to make the most of ICT. Indeed, all have a role to play. Much relies on:
Governments to encourage the use of ICT;
Aid agencies to inform all stakeholders and support adequate models via research and financing lines;
Social entrepreneurs to develop innovative, grassroots, locally appropriate businesses with strong partners;
Large corporations to invest as heavily as is required to scale up existing models;
Financial institutions to provide the various types of capital needed for these businesses;
Citizen sector organizations to help recruit the adequate workforce and build awareness on the ground on the benefits that ICT can bring in many fields of development; and
Research institutions and academia to help understand the case for health and education ICT business models and find how to better measure the impact of ICT (and compare its cost-efficiency to that of alternative means of development).

Because of the need for ecosystems that is specific to the ICT sector, our key recommendation is for actors to work together to co-create solutions where ICT is the best way to bring development, making sure to answer a proven demand rather than estimated needs, and being careful about promoting an ICT solution when cheaper, more efficient alternatives might exist.

More specifically, and as detailed in the full report, making the most of ICT4D through market-based approaches would require to:

1. Focus on problem-driven approaches for sustainable projects to emerge out of the myriad of existing trials
   a. Start from the ground-up, first identifying local problems to then develop equally local solutions
   b. Create the necessary ICT capacity among practitioners
   c. As a large player, foster the emergence of small ICT4D ventures

2. Support existing entrepreneurs, promoting cross-sector synergies and removing current barriers to scale
   a. Promote or take part in cross-sector collaboration
   b. Assist in awareness building, training and recruitment of clients, staff, and agents
   c. Simplify regulatory process
   d. Create a range of adequate financing tools

3. Create a systemic environment for cross-border replication
   a. Build a holistic platform for replication of successful social businesses
b. As governments or international development agencies, work on setting up a regional platform (or take part in one if it already exists).

4. Conclusion

Most of the cases we have studied are early success stories, with much yet to be written. As mobile penetration continues to increase in many markets, and as handset functionalities expand, more people will be enabled to play their potential in the global economy. Indeed, the challenge is not only to materialize the tremendous benefits that can be generated by bringing the existing success stories to those remaining billions who could benefit from them. It is also to bring those who still cannot (mainly due to low literacy and low purchasing power) to a level where they could access ICT and the services it enables. This is of paramount importance to prevent the further deepening of the gap between an ICT-capable part of the world and the rest.

We are aware that many of the applications, services and business models that will take ICT4D innovations to the next level remain to be created in the coming years. Still, the projects seen in this study provide exciting insights that point to many opportunities for scale and replication. To build on the success of current initiatives, and to invent new, more impactful business models for sustainability, stakeholders will need to partner and focus on multiplying an impact that so far still leaves most of the world out of reach of healthcare, education, financial services or agro-services.

We hope that this paper, like ICT itself, will not be an end but part of the means to create more effective approaches to foster development.

References


[2] See case studies of these two projects (and the other projects quoted here) in the full report available on www.hystra.com.

[3] This paper initially included a case study on a mobile-based insurance service, which we were asked to remove just before publication due to unexpected issues with possible legal implications. This paper still builds on the lessons learnt from that project as well as the 15 others, but only 15 case studies are presented in this document. “Insurance via mobile” on the graph refers to that 16th project.

[4] Though in theory new development platforms should allow faster and cheaper development of services and applications, the cases seen in this paper have all struggled for at least a year to build a suitable technical infrastructure.

[5] Mesoloans: loans for amounts that are larger than microcredit amounts, and lower than what traditional banks would offer.

Assembling and Aggregating Mobile Phones: The Social Ecology of Grey Mobile Phone Markets in Urban India

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Abstract—The paper makes a case for information and communication technologies (ICT), with a focus on the mobile phone related businesses against the broader backdrop of the developing economy of India. ICTs come to India through two routes; the global employment route of IT information companies or the development route of donor-driven services to bridge internal digital divide. Local and context specific small businesses are organic, market-driven and self-sustaining bringing affordable mobile phone and other ICT services to underserved contexts. Our paper reports from research on the grey mobile phone markets in urban India. We argue that a) Mobile Phones have largely emerged in developing economies as grey or illegal products and services b) Grey markets display specific characteristics as businesses c) Grey markets immerse in a cultural milieu of coded informal culture. The first focuses specifically on the variety of products and services in the market, second on the organizational arrangements and business practices of ICT grey markets and third on a variety of cultural codes that govern businessmen in grey markets. Our research is a response to the relative paucity of knowledge about grey markets dealing with ICT products, especially mobile phones, and their socio-business practices. As mobile phone proliferation and PC penetration are set to increase following augmented broadband and 3G investments from the Indian state and service providers, our research is a timely and relevant mapping exercise of ICT dispersion and immersion via grey market mechanisms.

1. Introduction

Information technology in India conjures images of information parks, software hubs, technical support centres, in short, cutting edge technology landscapes. This reality is interspersed with overwhelming public evidence of information technology existing in nook mom and pop businesses of (re) selling, (re)assembling, (re)cycling and (re)servicing ICTs. It provokes attention towards the flourishing non-formal or grey markets in India working with sparse and unstable infrastructural resources kindled by human endeavour and dynamism. This reality needs to be explored, studied and reported. Our paper reports from research on the non-formal, unorganized yet ubiquitous ICT markets in urban India. The aim is to explore two arguments; a) ICTs have largely emerged in developing economies as grey or illegal products and services b) ICT grey market display specific characteristics as businesses. The first focuses specifically on the variety of products and services in the market and the second on the organizational arrangements and business practices of ICT grey markets. Our research is a response to the relative absence of knowledge about grey markets dealing with Mobile phones [including accessories, second hand phones, procuring phone parts for repair and maintenance], their business practices...
and scaffolding socio-business networks. India, like many developing economies, is witness to thriving grey markets predominantly as part of and tethered to the expansive networks of non-formal economy. Mobile phone grey markets being under-represented research subjects, the paper contributes to this emergent body of cross-disciplinary work and presents an opportunity to understand the organization, circulation and servicing of ICT products. As mobile phone proliferation and PC penetration are set to increase following augmented broadband and 3G investments from the Indian state and service providers, our research is a timely and relevant mapping exercise of ICT dispersion and immersion via non-formal market mechanisms.

Small shop keepers are primary agents of grey market goods and actively mediate technology diffusion through their client community. From the basic mobile phone stores selling small units of talk time to those that repair, format, and maintain mobile phone hardware and software, the entrepreneurs behind these stores assumed a variety of roles: They forge relations with procurement channels like grey markets, mediate between mobile phone companies (even multinational corporations) and the consumer, expand business loops while renewing existing ones, and encourage apprenticeships for relevant repairing skills [23]. Much of this paper attempts to outline the processes by which grey markets become conduits of ICT use and adoption. Since grey markets fall outside the purview of formal legislation they are largely driven by an internal system of informal market regulation created and controlled by insiders and stakeholders shaping business processes. Grey markets consist of several business nodes and this paper purports to map and analyse the following: Firstly, the assemblage of grey market hubs and networks and secondly, the variety and organizational arrangements of mobile phone, the PC and other ICT products and services. We believe that the first two contribute to mapping of the third, the functioning of grey market socio-business relations. Some of the questions we set to ask in order to probe the three statements are; 1) can we identify a physical arrangement/layout of grey markets 2) what are the dominant modes of distributing mobile phone products and services across sellers 3) how is demand identified, and clients solicited and serviced 4) Finally, given the furtive nature of business can we preclude an assemblage of practices shaping and channelling business resources among retailers to maintain and balance the precarious nature of non-formal economic relations.

We discuss the results of our investigation on grey markets as an assortment of human players and networks contributing to a collective business culture of survival. We particularly focus on the modes and channels of communication configuring the grey market culture, supporting business activity and most of all, securing practices operating outside the pale of the formal/legal economic system. We use primary field data from mobile phone retailers and service providers operating outside of formal
Assembling and Aggregating Mobile Phones: The Social Ecology of Grey Mobile Phone licensed channels in Mumbai and Bangalore. We explore and research dominant social and communication networks guiding the procuring of products and servicing skills, channelling intra-retail competition, maintaining pricing and managing client loyalty. In fact, these are imperative for securing, survival and sustenance of the mobile phone grey market. With little formal data about the markets, we rely on ethnographic and qualitative data to highlight our findings and discussion thereof.

ICTs come to India through two routes; the global employment route of IT information companies or the development route of donor-driven services to bridge internal digital divide. Local and context specific ICT based services in small grey market businesses are organic, market-driven and self-sustaining bringing affordable services to underserved contexts. The paper makes a case for the diffusion of ICTs, with a focus on the mobile phone in grey market businesses against the broader backdrop of the developing economy of India.

2. METHODOLOGY

Since this study focused on uncovering interpersonal business and social networking practices that build create and conduct grey markets, it was useful to employ ethnographic methods. We used a variety of qualitative methods comprising open-interviews, observations of a typical ‘day in the life’ of markets and shops and base-line surveys of business outfits. Thus far, we have completed field observations between February and July 2009 in Mumbai and between July and September 2009 in Bangalore. We undertook semi-structured and open-ended interviews with shop owners to allow us define everyday dealings, client demands and business networks. We also noted the variety of communicative and social networks supporting enterprise building taking care to keep focus on everyday networks contributing to overall business sustenance. We further assembled data from field observations and key informants, those who were vocal insiders and know the market, for an overview of businesses especially those that helped us understand intra-market organisations and information networks. We conducted field work in 6 markets in Mumbai, 3 in downtown and 3 in the suburbs, interviewing 10 shop keepers. To understand grey-ware business in small shops and their linkages with the larger markets we interviewed with 5 PC assemblers,

10 mobile phone repair stores, 5 PC/mobile phone aided business (lottery sales, photo studio, cyber café, computer training institute) in two low-income or slum districts in Mumbai. In Bangalore, we interviewed 5 mobile shops that offered mobile phone content downloading, 1 supplier of large bundles of content to such shops, and 1 street hawker peddling pirated DVD.

The initial thrust of the study was to observe social networks connecting the diverse markets, ICT products and human agents connecting various
hubs, nodes and deals in a variety of businesses. From an initial and broad understanding of the markets’ physical layouts we narrowed our focus to understanding internal and intra-market organisations to channelize business units and products. Of particular importance were practices that allow the market to function in harmony without drawing external threats to its connecting business nodes, human agents (wholesalers, dealers, and brokers) work around market limitations and tap local demand. In Bangalore, our focus was the grey market in digital entertainment content, and we examined various channels through which such media could be procured, as well as the connections between them. All interviews, except those with the 10 shopkeeper in the grey market districts in Mumbai, were audio recorded and transcribed. We broadly coded data, and organized the data into emerging themes. These formed the basis of our findings and discussion sections.

3. LITERATURE REVIEW

Many entities are involved in the set-up of ICTs in any country – governments, academia, multilateral organizations, corporations and non-profits. All have stakes in the performance and impact of ICTs on a population having channeled substantial infrastructural investments (13, 15, 17]. India, by and large, has adopted two main paths to ICT immersion. The first path tied globalization of Indian economy to the ICT boom. This saw the onset of cutting edge IT campuses, high-tech support centres, back-end processing offices and enclaves of customer support. As corollary to the first, the second path witnessed government and non-government agencies rushing to bring favorable impacts of ICT to regions excluded from the boom. Soon, for-profits, corporates, academic research centres began to invest in ICT for these ‘information technology have-less’ regions to find common cause for broader development concerns such as e-governance, education and health [8]. At a broad level, it was felt that access to information, be it health, agriculture, education or government schemes, would at some level lead individuals to act on that information and empower themselves. Technology initiatives purely based on faith held by donors and little preparedness are difficult to sustain in the long run, let alone empower these regions [11, 18]. We use the grey market, for the purposes of this paper, to denote small businesses like street-shops, household enterprises to medium-sized retail businesses practicing non-formal organizational and accounting practices. The employee pool comprise of family, kin, neighborhood or friendship networks working under unregulated and unconditional employment situations [1]. Micro, small and medium enterprises are the major source of income, jobs, manufacturing, and services in developing economies. The wide range of goods, services, trading and retail covered by these businesses is probably the only outlet for the millions in low-income brackets. Duncombe & Heeks [6] characterize these ‘firms that show a greater business focus and which deliver broader/longer term benefits of competitiveness, innovation and exports’. In our sample of mobile
phone businesses, all sustain by optimizing technology, human resource management geared to optimizing local market requirements and labour conditions. Furthermore, they are dependent on the broader culture of grey or informal business practices to organize and synchronize opportunities afforded by ICTs and the market.

Grey markets or grey market economy is businesses removed at varying degrees from legal frameworks, existing in a state of unease with formal mechanisms and regulations governing commerce. It denotes the buying and selling, in short, the flow of a variety of goods through distribution channels and public markets controlled by human agents operating through informal and mutual understanding of the rules rather than by a contract of relationships recognized by the legal system of a the country. Hence, it is fair to say that grey markets are of, for and by the informal economy. Ghersi [9, 16] defines the informal economy as a group of underground activities that have legal ends, but employ illicit means. They must be carried out illicitly due to the high costs of operating in the formal sector, even though they are non-criminal in nature, meet a demand for products and services, and make them affordable to large sections of the population. A useful point to begin a discussion of grey markets is to define non-formal economic relations. A broad definition of non-formal (or informal) economy includes household enterprises that are self-accounted with family or casual employees or the formal sector employing casual or intermittent labor all of which work under varying conditions of (un)regulation [1,20]. The term informal economy was coined by social anthropologist Keith Hart in 1971 during his field work in western Africa [12] to denote survival economies of the poor whose individual economic transactions do not ever rise to the taxable limit. Lugo and Sampson [16] in their study of e-informality in Venezuela, explore arguments concerning the concept of the informal economy as a socio-economic phenomenon. They conclude that ICTs are exploited in the same way as other economic activities by those actors that operate in the informal economy’. Informality has been linked to the lack of property rights and bureaucratic obstacles restricting individual initiative and an energetic solution to the problem of too much costly regulation and legality. The economic costs of circumventing institutional arrangements to achieve low-cost and informal business exchanges drive key players/businessmen/agents to operate outside the rule of law and possibly a spontaneous and creative response to the bureaucratic state’s inability to satisfy the basic needs of the masses [4, 5]. The collaborative ‘character of networks in the informal economy is understood in terms of mutual co-operations even between competing informal networks to support each other. Unlike the inflexibility of the formal demand and supply channels grey markets exploit the grounded informality practices to create a flexible environment of informal supply and demand with many of business collaborative practices are derived from a considerable portion of business associations within a familial, kin group or other native social networks [16].
Piracy and pirated ICTs within informal sectors is a stream of business inherently more public, risky and consisting of a furtive web of people connected by social networks. Small operators such as the street vendors, work by virtue of flexibility in many aspects of business; clients in the form of pedestrian traffic, semi-durable infrastructure (for easy dismantling and relocation) and ease of attaching additional products and services [16]. In Morocco authors Ilahiane and Sherry [12] focus on the ‘articulate entrepreneur’ who is the ‘processing conduit’ for global ICT products at the centre of a thriving informal economy, popularly called the black market. The authors explore the multiple, complex and carefully cultivated business relationships and call them ‘a mosaic of economic relations’. In New Delhi, India’s capital city/state, euphemistically known as the capital of piracy, is home to a ‘bleeding networking culture’ of pirated electronic products. Networks in Delhi use a combination of regional and transnational sources to feed local markets. They are usually part of the pirate network of distribution, which also ‘bleeds into other parts of the city which is a coordinate of media markets, small software and hardware factories, and local shops that interact with customers [24]. Urban metropolises like Mumbai and Bangalore offer a unique location to explore our research subject. Mumbai, especially, is not only home to an extraordinary vibrant and organic commercial culture but a thriving shadow economy crisscrossing the more formal ones at various points of contact. Arguably, the informal sector accounts for 68% of economic activity in Mumbai city. The vibrant grey markets, be it in fortified downtown districts or street vending businesses, are driven by the informal businessman, in-charge of disbursing ICT products and servicing large sections of the population. Mumbai is a site of various uncertainties; of employment, wages, housing, citizenship and security [2,7, 19]

Employing previous studies this paper analyses the phenomena of the expansive grey economy as a persistence of alternative business infrastructures, human agents and their multiple social networks in the absence of access to formal business channels and mechanisms.

4. Findings and Discussion

In this section, we outline organizational structuring of some of the primary business processes including physical layouts, logistical and administrative relations of grey markets in the commercial districts of two metropolitan cities, Mumbai and Bangalore. We focus on some of the features that point to fairly entrenched practices in the buying and selling of mobile phone products and services operating in the domain of non-formal economy. We make the following observations and discuss each of them with supporting ethnographic data. They are 1) Grey markets shared varying states of engagement with formal economic structures affording business viability 2) Physical layouts of markets are manifestations of securing business transactions 3) Various wholesale and retail business components in grey markets are marked by intra-organizational arrangements to
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optimize collective benefits for of stake holders. Most importantly, grey markets possess the twin virtues of durability and flexibility to adjust to the fluctuating state of legal and market conditions. In all of these, we bring out the multi-nodal presence of social networking as prime capital in the arrangements of business processes of the grey market economy. Services depended largely on two factors. First, it required an enterprising entrepreneur who sense demand for greyware and second, prudent use of skill-availability.

4.1 Grey Market Physical Arrangements

The growth and concentration of grey markets show a pattern. Grey markets usually constellate in specific locations and tend to fortify and secure business transactions, living as they do under surveillance and threat from law enforcers. There is constant attention paid to protect and safeguard business routes, networks and circulation of goods. These concerns culminate in the physical market place comprising of a variety of wholesale shops and retail shops servicing end-users. It is imperative that the site of business exchange between shops and the client is made safe and secure for transactions. In Mumbai, markets congeal around a marked and visible location associated with grey economic activity. Historically, specific areas in the commercial downtown districts are identified as places selling branded and unbranded merchandise of mixed quality, unclear guarantee and negotiable price tags. These ay even house goods that are smuggled, stolen and locally assembled. With exploding suburbanization and the consequent movement of population away from overpriced downtown areas, grey markets dispersed across the city but still congeal together in small safe havens to transact without threats of displacements.

Arun works in a mobile phone store in Mumbai for Uday, a kinsmen belonging to the same village in North India. Uday’s shop is squeezed into a chock-a-block west suburban Mumbai grey market. He said, “… you see there is a row of markets selling imported goods along this side of the road. This shop is part of a cluster of shop belonging to one owner who employees people like us; usually form his village, to manage business. This shop sells A-Z of mobile phones accessories and hardware … we are vigilant about swoop-downs and random checks from the police but we have security in numbers and stick together…. I know each and everyone in this row of shops… even their horoscope (laughs)…”. Amit operates a multi- product store along with mobile phones and accessories in the more entrenched markets of downtown. He commented “…. this market is recognized for its foreign-goods since time immemorial…last 5 years has seen an influx of mobile phones, computes/laptops, PC parts, CDs, DVDs, MP3 players… everything from the most expensive to the cheapest….we are a recognized safe haven… we don’t have to go in search of clients they all come to us…”

Grey markets shape their physical business environment to optimize and secure nodes of communication between key players, the buyers,
sellers and consumers of ICT products. Points of contact and exchange are sheltered from the public eye nevertheless allowing a dynamic, negotiable commercial environment to flourish within marked territorial precincts. Amit added … with regard to mobile phones most of our clients are small mobile phone store owners, those who repair phones and come from all over Mumbai. They believe this is the one stop market where transactions, buying and selling, can be brought to fruition, resulting in mutual benefits, however small…”

However, there is a distinct set of grey market activity as street hawking and freelancing countering the fixed and material presence of established markets. These share some of the practices in procuring, selling and soliciting end-user clients but transact in the more visible public spaces to attract business. These are risky businesses lacking the structures of shelter created by the more established grey markets. They function as gateway or the last mile connector or conduit; brokering technology consumption and use especially for the low-income client evolving a rich peer to peer channel of informal exchanges of media devices and content. Street hawking selling pirated stuff, be it DVDs, mobile phone products and accessories, were risky business. We spoke to one of them on the roadside in Bangalore, who sells DVD s ‘like hot cakes’ but is well aware of the risks posed by his greater exposure. His wares were laid out on the sidewalk on a tarpaulin with ropes tied to the corners, allowing the load to be bundled up and whisked away in seconds. Near the end of our interview, a police patrol came by and he was forced to do just that, disappearing down an alley along with several other merchants.

4.2 Internal Self-Distribution of Grey Market Business

ICTs as grey commodities appeared in traditional grey market districts among the rough-hew ecology of buying, selling, sourcing, maintaining and evolving product stockpiles, skill and servicing depots. Markets, especially the more established districts in downtown Mumbai followed unwritten rules of organizational arrangements. This was firstly to brook peace among competing businesses by 1) channelizing allocation of various sales and servicing units, 2) harmonizing demand/supply across the units, and 3) internally organizing dealers, wholesalers and clients to optimize business flow. Given the precarious legal status of the markets, these silent rules were critical to curtail disharmony and their public spill-over between business units. As we mentioned earlier, security is forged and secured across the market, manifesting in externally marked commercial districts and internally organized business processes. The two lend the vital socio-economic scaffolding necessary for everyday maintenance, upkeep and expansion of commercial activity.

We observed some of the management strategies in the distribution of hardware units and repair services amongst wholesalers, retailers and agents. Also evident is a similar practice sourcing and channelizing skills
needed to run mobile and PC assembling, repair and maintenance units. We identify several layers of recruiting, sourcing and communication channels that bring and bind diverse players in the market. There is a simple structuring of demand and supply amongst the various shops by allocating specific hardware and servicing units to specific persons in the trade. The mobile phone grey market ecology is diverse given the ubiquity of demand for mobile phones. This grey market encompasses several products and processes; a variety of handsets from branded top of the line smart phones to the unbranded iPhone and more basic models. The unbranded variety comes in all shapes and sizes, very cheaply, and with low shelf life. Apart from the mobile handset and accessory shops there are the aligned auxiliary businesses of mobile ‘unlocking’ and software upgrading, hardware repair and maintenance and content downloads to mobile memory.

Mobile unlocking and software upgrading is exemplary of grey practice. Sunil, a store keeper in a suburban Mumbai market said ‘... We get at least two or three iPhones or Blackberries to unlock… since they are network locked. Actually Blackberry allows unlocking officially through its website but charge a hefty fee. We get pirated software to unlock phones from dealers who import form Dubai and Malaysia… We only network with the dealer and don't know the import business of piracy… for cracking iPhone there is this free site on the web form where we download a program called ZIPhone… but we have to be alert and search consistently since unlocking software have a temporary life on the web…”. The mobile software formatting and downloading business is more brisk. Sunil added “… For upgrading, we use several software for different mobile phones like Jaff, Universal and Infinity etc. and through these software you get files and you can program the mobile phone software like you can always keep on adding some additional software like an MP3 player and so on…these are available on a peer to peer share on the web… I actually don’t do it… I have a group of friends who are into this full-time and we share stuff… ”.

The mobile repair and servicing ecology consists of three main and connected nodes: the local mobile repair shop, a circulating market for refurbished or used mobile hand set and the grey hardware market. Mudassar has a small shop in the nook of the slum and sells mobile coupons, repairs and sells used/refurbished handsets. He said “… I basically repair watches and began selling mobile phone talk time and re-charge coupons. I realized handsets get damaged and there is a steadily growing market for repairing these. There was also a simultaneous demand for used mobile phones when people came to me to offer old phones for rock bottom prices when they upgraded to new ones…. I have a nice rotating base of clients who repair sell and buy used phones... I try to get phone parts from the markets in town it’s not easy to get mobile phone spare parts… dealers over there keep a stockpile of functioning/healthy parts taken out of dead phones beyond repair…”. 
The ecology for used mobile phones, repair and maintenance markets appear to be structured as follows. Suppliers of phone parts develop the know-how and resources to fetch used phones and healthy parts from social networks in their neighborhoods and specific markets in downtown. The need to be vigilant about grey market demand and supply motivates regular contact between suppliers and customers. Sunil and Mudassar maintain constant and personal relationships with business partners and customers. Such a system economizes greatly on costs since a phone’s life-span is stretched to meet end-users demand for cheap and timely services. These Markets may be grey or even clandestine business but extremely invaluable for its clientele. As Mudassar quips, “…a multitude of shops across the city having undertaken these businesses … Of course this trade is not strictly above board, licensed or even legal … But there is so much demand … and we design our business strategies to meet these at unbeatable costs …”

4.3 Grey Markets and the Formal Economy
Grey markets survive, thrive and sustain over time through linkages with formal structures of economy. The vast grey markets in India are related to the various channels of economic activity governing trade and commerce in the country. Socio-business networks and communication nodes supporting business transactions have to deal with formal economic structures and dip into their resources to run businesses. From importing mobile phones and associated products to servicing dysfunctional devices, grey markets need goods, skill and personnel to procure, liaison and meet a growing client demand. A small businessman dealing with mobile phones and other ICTs encounters the formal economic machinery from the very beginning in acquiring a government license to import and trade. At every stage there are tie-ups with formal channels to procure hardware, human skills to assemble, repair and trouble shoot computers and above all to target and retain prospective customers. Let us take the example of a mobile phone repair and maintenance person, Kamlesh, managing a small shop in the Mumbai slum area: he firstly needs shop space and related skills to start-up the business; he then would need to procure hardware, used phones, spare parts and skills to repair; finally, a loyal and moving clientele complete his trade loop. At every stage in his business loop the businessman is seeking, cajoling and deriving trade benefits from a variety of formal and informal resources. The businessman needs both branded and grey wares depending on client demand and phone specifications. His sources for hardware, phones, parts and other accessories, depend on the nature of these demands. Another vital tie-up is to ferret good apprentices to help him repair and build phones. Kamlesh sources skills either from other repair shops, trains neighborhood buddies or others by attaching them to his shop and sometimes even a semi-formal tie-up with a training repair institute that may outsource repairing tasks.
More of the formal/informal mix is evidenced in the buying, selling of new and used mobile handsets. Mom and pop mobile stores buy handsets in bulk from wholesale shops or dealers in the grey markets of downtown Mumbai. The small shop owner usually develops a single point of contact with the wholesale shop owner or dealer over a period of time, evolving a business relationship of trust, friendship and enjoys good deals on bulk orders. Though branded Nokia, Samsung and LG phones are very popular, equally popular are the so-called China-sets, imported from Chinese manufacturers that are cheap, of low quality, and less durable. The latter comes with no formal bills or guarantee cards and negotiable price tags. We spoke to Faizan, a wholesale hardware dealer, in the downtown district. I mainly supply dongles to my clients... a small metal port with 100-130 cables to connect a mobile phone to a computer) widely used for re-formatting, flushing, flashing (all various ways to repair and upgrade mobile software). Dongles directly manufactured by mobile manufacturing companies like Nokia, Sony Ericson, Motorola, etc., they are known as JAF, UFS etc. cost around US$600-700 while the china made ones are half of that. There are several types branded ones like with in JAF or UFS... UFS-1 is used for basic Nokia models and UFS-12 is used for all types of Nokia high-end models. ... We charge the clients according to the model and value of the phone. There is also this very expensive dongle, US $1500, expensive dongle and it can be also attached to the mobile phone while correcting faults through the other dongles. They are called as Universal or Infinity... no matter what it will never make a handset dead or kill the mobile phone hardware. These are is warranted and procured with proper bills...” Even branded showrooms are happy to mix business channels to ‘sweeten the deals’ on phones and price tags. We also spoke to one authorized Nokia showroom in Bangalore which offered a ‘starter pack’ of downloaded multimedia content (videos, songs, games, etc.) on newly purchased handsets—a clear mingling of legally procured and sold handsets with illegally obtained content. A clerk at the shop described the competitive pressure her shop felt from other, less legitimate businesses. If her shop refused to offer downloaded content, “Customers will think oh, this shop is not giving these services, why we have to come here? The customer wants some offer … for that purposes we are offering them the downloading thing.” The clerk also described that formal arrangements also can restrict the shop’s pricing strategies. Free downloaded content was thus sometimes used to ‘sweeten the deal’, “…Sometimes a discount will not be possible from our side, because as a company showroom, we have given the best price. So that then we will offer downloading. Then they will be happy.”

It is clear from this narrative that the grey market governed by informal economic practices has to tie-up and use the formal economic structures at various stages in their business-cycle. If it is procuring hardware like parts of a PC or mobile devices or sourcing skilled persons for assembling, the shop owner has to use both economic sectors in the service of his business.
The content downloaders and street hawkers join the loop at the far end but are nevertheless important players in extending the market to the nooks of urban habitats. They are dependent on the more expansive grey markets for sourcing products and content. Transactions are usually through a peer to peer network. Mobile shops bring grey market content together with formally procured devices to form an attractive bundle.

5. Conclusion

In India, plenty and scarcity co-exist side by side. A largely international market-driven approach or a state-driven developmental scheme have shown serious limitations in distributing advantages of information technologies to huge sections of the populace. Between the two approaches to ICT adoption, the vast gamut of small businesses exists in both formal and informal sectors of economy. These bring affordable, relevant and demand driven ICTs to populations experiencing little impact of the global ICT boom or the out-reach of development agencies. These businesses are organic within their socio-economic context. They evolve locally, require small capital and a ‘little more’ than modest entrepreneurial skills. We explore two related issues on mobile phone greyware business configurations in urban India: 1. Context specific, innovative and commercial localization of services in hitherto underserved contexts. 2. Key persons managing business as critical in turning everyday instances of survival and organizational strategies to more consumer-oriented, service offerings for a local market.

We built our discussion around the organisation of grey market economy in the metropolitan Indian cities of Mumbai and Bangalore. We sum-up by pointing to the widely networked mélange of urban spaces, economic relations and human agents as the following: Firstly, persisting through a flexible yet durable mechanisms adjusting to threats and demands of informal economic relations; Secondly, creating market infrastructures via internal negotiation and adjustments to competition, demand and supply loops; Thirdly, by meeting a large demand for affordable mobile phone and ICT products, unmet by the formal economy; Fourthly, building steady service infrastructures by creating routes of access to the latest branded and unbranded mobile phone and ICT products, maintaining a negotiable pricing structures and evolving the market to meet new demands. The central theme in this essay has been survival and the consequent security measures to sustain grey markets: this is probably not surprising given the illegal or quasi-legal nature of the business being reported on. But it is the various strategies and techniques that actors employ to secure the market that are our focus of interest. Underpinning the business process of grey markets are the various human agents who procure, deal, buy, sell and service products. The singularity of these markets is the availability of products and services at unmatched prices. This unique selling point is maintained through multiple networks of social and communication channels through carefully cultivated routes and human relationships.
of trust. These networks in the course of time display patterns in their organizational features to improve efficient channelization of goods and maintain competitive pricing for the end-user or consumer of the product. These informal grey markets align themselves to formal structures for access and exchange of business know-how for a range of infrastructures, products and services critically supporting trade. Thus, our research is original in some aspects. It contributes to a growing yet limited body of knowledge about grey ICT markets, especially in developing economies like India. It summarizes the happenings across a diverse range of grey markets, from established structures to the perilous street hawking variety and the middle range actors, the small shop keeper and the freelancer. These findings indicate that it is not so much the quantity or even quality of ICT but rather, the contextual allocation of business resources that succeed.

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A Software Business Incubation Model for Sustainable Economic Development in Uganda

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Abstract—In low-income countries, a recurring challenge in the use of mobile and web-based services to foster development is to ensure the economic sustainability of those new services after their initial launch. The Makerere University Software Business Incubation programme tests a novel approach to this challenge, by applying a venture-capital-like management discipline to ICT innovations created by students, recent graduates and staff of the College of Computing and Information Sciences. The incubation process, which has been refined over the past 3 years, has already resulted in 6 new business start-ups. Scaling up is in progress. Partly because of the very low capital funding needs of the programme, most of the new enterprises start up with no debt. This paper describes the programme’s structure and operational processes and gives several examples of the new services created, along with a discussion of the challenges faced and solved by the programme’s management.

1. INTRODUCTION

A recurring challenge in the development of low-income countries is to invest the human capital that is created by improving public health and education. Too often, development stalls because increases in human capital are not productively invested – to the point where rural parents even become sceptical about the value of secondary school education for their children. However, investment in new ICT-based services and products generates many of the highest returns in developing economies, so encouraging such investment is a readily acknowledged policy for all stakeholders.

A specific challenge for new mobile applications that aim to foster development in these countries (M4D) is to ensure the economic sustainability of those new services after their launch.

Governments, NGOs and private corporations collectively solicit thousands of proposals for worthy new mobile and web applications in sub-Saharan Africa each year, via competitions for research grants, prize money, Millennium Development Goal programmes, innovation centres, job creation schemes, rural poverty eradication programmes, emergency aid support, health and education surveys, and private-sector software development jobs.

Many millions of dollars are awarded each year and hundreds of new applications are trialled. Most of the trials terminate within a year or two, for lack of funds to scale up, or for lack of sufficiently motivated users.

The net results are a few popular and self-sustaining services such as Mobile Money or Frontline SMS, an enduring cadre of NGO programme managers and consultants, and thousands of engineering and ICT graduates.
with experience in making demonstrations or proposals but rather few jobs.

This paper reports on a different approach to fostering economic development through ICT services and applications, based on the premise that the venture capital management processes that have worked in North America, and are working now in Europe and Asia, can also work in sub-Saharan Africa.

2. BACKGROUND

We begin with a short summary of the prevailing economic conditions in sub-Saharan Africa, Uganda in particular. These conditions determine how the venture capital management process needs to be localised.

Like many west and east African countries, Uganda has experienced healthy economic growth in the past decade, averaging around 6% per year [1]. The export potential of natural resources and agriculture is attracting investment from Asia. Use of English as the universal language of education, government and business has facilitated trade and development. The Atlas of Economic Complexity [2] ranks Uganda favourably for future growth.

The political environment is still unpredictable, but its volatility is decreasing. Multi-party political systems have taken root and will gain strength in future elections, although the opposition parties in many areas still lack the organization and discipline – and the financial support – to outrace the incumbents.

Compared to wealthy countries, the scarcity of highly specialised financial and professional services is evident, as is the small variety of industrial and retail products for sale (and their all-too-frequent low quality). Also, local capital for investment is scarce – especially for locally managed investment – and interest rates are high.

Mobile telecoms and mobile applications are exploding; the spread of phones, internet and credit cards is being compressed into a decade or two, instead of over half a century as in Europe and North America. Over 95% of people in urban areas have access to phones (either their own, or through family / friends), as do about 75% in rural areas.

Unsurprisingly [3], people have migrated to the cities (especially Kampala) because their opportunities are better in the city and because they know relatives who have become relatively prosperous there, even though the cost of living is higher than in the country. Many people hold two or more jobs in order to meet daily expenses.

Potholes, traffic jams, paper records, queues, power outages and stock-outs are universal. City dwellers of all economic levels lose many hours to the resulting inefficiencies; hence are chronically short of time. Patience has become less of a virtue than a coping mechanism.
Local software developers and clerical staff are abundantly available, but usually need on-the-job training and coaching. Experience in business planning, modelling and operations management is scarce. Formal qualifications and credentials are highly respected but do not imply practical experience or initiative, so (deservedly) carry less weight than a first-hand knowledge of local conditions and practices. The strong oral tradition in Africa fosters discussion and seat-of-the-pants management at the expense of writing and regular meetings.

On the other hand, the concentration of raw talent and learning ability among university students is formidable. The public educational system is highly competitive, so about half of all university students are selected from the top 5% of 20-year-olds. In Uganda, most of these go to Makerere University, which is the oldest, largest and has the best reputation. The great majority of Makerere graduates stay around Kampala and do their social networking face-to-face at government round-tables and workshops, industry associations, boards, Rotary clubs and the like. The physical proximity facilitates contacts and introductions among faculty members, government officials, business owners and executives, consultants and NGO representatives.

Overall, a self-reinforcing combination of widespread inefficiencies, reported obstacles to business [4], lack of standard input data for industry research or financial assessments, shortage and high cost (>20%) of local investment capital, has led to an abundance of unexploited commercial opportunities – despite the availability of technical and business university graduates and the government’s ardent desire to put them to productive work. Most of these opportunities are unknown to foreign investors because information about them is unpublished and uncirculated outside the local word-of-mouth networks [5].

Figure 1 summarizes these principal dynamics of Uganda’s current social and economic development.

Fig. 1: Current Socio-Economic Development Dynamics in Uganda
3. System Description

With the rapid growth of Uganda’s economy, the many and obvious inefficiencies represent opportunities for new enterprises to create jobs and wealth. The burgeoning of interactive SMS and mobile money services has illustrated this. In the coming decade, as computing and software become pervasive in government, industry and education, there will be many, many more software business opportunities.

A mechanism is needed for bringing together the owners of problems, the creators of solutions, experienced managers and sales people, and financial backers or investors. Out of this confluence, new businesses can be created.

An early-stage venture capital scheme is a proven way to do this. Compared to general business investment, venture capital long term financial returns are good [6]; and compared to international development finance programmes, they are outstanding [7].

Rather than proceeding (as in most contests and incubation centres) directly to software development on projects that appear original to the entrepreneurs, the Makerere programme requires its applicants to function as follows.

1. Working from suggestions of students, college partners or faculty members,
   a) Identify a problem in an existing enterprise that prevents it from carrying out its business more effectively, or causes it some undesired expense; or
   b) Identify an opportunity for the enterprise to sell an additional service or product to its existing customers.
2. Engage the enterprise, to understand this problem or opportunity intimately, from the viewpoint of its owner.
3. Conceive a cost-effective solution through discussion with the enterprise. Illustrate with a prototype if needed.
4. Make a business proposal, to seek financial backing.
5. Contract with the enterprise to deliver the solution.
6. Implement the solution and deploy it.

The key difference is—sell before you build—so that only what a client is paying for gets built. The college facilities and the available mentors are limited—and any stakeholders want to be sure these resources are marshalled to deliver commercial value. Otherwise the mentors can lose motivation.

The first 4 steps here may take several months to accomplish. But the process avoids the building of solutions to the wrong problem, or to a problem that turns out not to exist for the intended clients.

The management checkpoints from conception to viable business are summarized as follows:

1. First meeting: review and screening of verbal proposals are done on request from any applicant to the programme. Accepted projects will proceed to ...
2. Stage 0: Project team formation and exploratory research leading to
description of the new business concept, concluding with a business model and written business plan. No funding is offered to the entrepreneurs in the project team during this exploratory stage. As soon as a project team prepares its business proposal, its members can request a hearing by the Incubation Review Board.

3. **Stage 1**: Business plan approved by the Incubation Review Board. Seed money is advanced to project team to work toward a contract with a lead customer, and an experienced business mentor begins working regularly with the group.

4. **Stage 2**: For B2B projects, contract signed with first customer; for B2C projects, prototype built and agreement signed with any key supplier(s). The new start-up is incorporated and additional funding advanced to the project team to work toward implementation.

5. **Stage 3**: For B2B projects, the lead customer has implemented the new product or service and begun using it; for B2C projects, the new service has gone live – giving the start-up its first revenue. The business mentor continues with frequent coaching and some additional funding is advanced to the project team.

6. **Stage 4**: For B2B projects, lead customer has formally reviewed the performance of the new product or service, and has declared it to be satisfactory; thus is ready to recommend the new product or service to other clients. For B2C projects, sales have increased steadily for 3 months and a high-confidence date is known for positive operational cash flow. At this point the start-up should have a sales funnel of additional clients and will be able to tap conventional funding sources.

As in the management of venture capital, incremental funding for each stage depends on passing the checkpoint at the end of the preceding stage, according to plan. Figure 2 summarizes the progress of a successful project from proposal to established, growing business.

The purposes of this process are (i) to provide frequent checkpoints for assessing the viability and progress of each start-up; and (ii) to weed out incipient failures early, so that the available funds can be focussed on those start-ups (and teams) most likely to repay investment. Originality of the entrepreneurs’ idea is not the key factor: *success depends mainly on execution*. The process is more important than any particular business concept it incubates.

In contrast to existing African venture capital firms and NGOs like Kiva.org and BidNetwork that target operational businesses needing cash for expansion [8], our investment focuses on the seeding and early-stage phases of their start-up businesses.
Ownership and management structure of the Software Business Incubation (SBI) programme are similar to that of venture capital firms, as Figure 3 shows.

The investment funds are limited partnerships managed by the Uganda Business Labs corporation. They are set up to manage groups of related start-up projects and capitalized with cash contributions from Makerere University (via the College) plus college partners, faculty members and other external investors. Their capital can be raised in repeated rounds.
The investment funds pay for facilities for their start-ups. Each fund doles out its capital by stages to its start-ups, like a conventional venture capital fund. When an investment fund reaches its capacity of start-ups to manage, Uganda Business Labs may open a new fund.

The Uganda Business Labs management controls the allocation of resources: technical and business mentors, facilities, computers, software development environment and support, legal services, etc. Money from a UBL venture fund or directly from Uganda Business Labs Ltd may be advanced to pay for these resources.

Following a successful business proposal review, college partners or other investors may also take a stake in the start-up by advancing funds to it.

When a project succeeds in contracting its first sale, the new start-up can be formally launched and incorporated. Its founders (the project team) receive a majority share of the new company; and the UBL venture fund also takes a share representing its investment to date in the project plus the incremental investment required to support the software development and implementation. The project team is paid a larger stipend from this time forward. Additionally, other investors in the start-up may raise their stake at this point, or may make a loan to the start-up.

The overall aim here, on a smaller scale, is to copy the American experience.

As a part of Makerere University, the College of Computing and IS offers several tangible assets of value to software start-ups:

- Office space, computers, network and communications infrastructure, software development environment and support for project teams
- The OpenXdata applications platform (a tool set for structured data collection using mobile phones) and varied application experience with it
- Technical experts and programming coaches and for software development groups
- A constant and renewable supply of the country’s top software development graduates (about 1200 per year)
- An e-commerce website where entrepreneurs can advertise their products and services, and sell with transaction charges that are low compared to mobile money or traditional banking.

To minimize the start-ups’ requirement for cash, the college provides these assets (through the venture funds) as in-kind contributions to the start-ups’ equity. Other contributions of expertise—for example in accounting, business modelling, financial planning, coaching in sales and operations management— are credited as in-kind equity contributions wherever this can
reduce the need for cash. In all of these other areas, experienced mentors are locally available.

An issue with equity compensation is that even given the most sophisticated business models, accurate valuation of start-up businesses is virtually impossible. Hence using valuations to gauge shares for start-up supporters like business mentors is unfeasible. To avoid such conundrums, the equity shares of both the UBL venture fund and the business mentors in the start-ups are thus flat-rated.

The college’s intangible assets are also valuable in the local Ugandan setting, namely:

- Existing satisfied customers of past software development contracts
- Reputation of success in delivering software and IT services
- Connections with Uganda’s political and business leaders
- Some access to private financial capital

The programme’s focus on software business opportunities is not only because the programme originated in an ICT faculty. Software and IT enterprises have long been the most fertile area for venture capitalists. Compared to other businesses, their start-up capital costs are also lower.

7. Discussion

The setting of the SBI programme differs in several respects from typical western university business incubators, most notably in the human and financial capital available. In consequence, the programme differs in the low emphasis it places on technological innovation – there are many market gaps in Uganda, and addressing them is often a question of applying existing mobile technology with innovative pricing and strong branding.

Table 1 compares the SBI programme’s setting and orientation with that of other business incubators that operate in developed countries with sophisticated and highly segmented markets.

The Makerere SBI programme encountered several operational challenges in the Ugandan setting. These needed to be mitigated or resolved.

First, seed funding from within the university has been quite limited, and is also subject to the accounting rules for public institutions. The SBI programme therefore minimized its cash requirements by negotiating in-kind compensation for business mentors and other contributors; and diversified its funding sources through private placements and continuing applications to NGOs.

One such success in this vein was the recent establishment of a Microsoft Innovation Center within the College, so that Microsoft’s generous teaching
materials, training and marketing support are extended to all of the SBI entrepreneurs.

<table>
<thead>
<tr>
<th>Success Factor</th>
<th>Typical University Business Incubator</th>
<th>High-performance Business lab [10]</th>
<th>SBI-Makerere</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client ICT environment</td>
<td>unconstrained</td>
<td>unconstrained</td>
<td>mobile only</td>
</tr>
<tr>
<td>Relative infrastructure costs</td>
<td>low-medium</td>
<td>low</td>
<td>medium-high</td>
</tr>
<tr>
<td>Access to finance</td>
<td>medium-good</td>
<td>good</td>
<td>medium-poor</td>
</tr>
<tr>
<td>Founders’ personal capital</td>
<td>wealthy, variable</td>
<td>wealthy, fairly equal</td>
<td>poor, unequal</td>
</tr>
<tr>
<td>Founders’ education and business skills</td>
<td>medium-high</td>
<td>high</td>
<td>medium-low</td>
</tr>
<tr>
<td>Coach/mentor availability</td>
<td>medium</td>
<td>high</td>
<td>low-medium</td>
</tr>
<tr>
<td>Assumed founder intensity</td>
<td>variable</td>
<td>full time</td>
<td>part time</td>
</tr>
<tr>
<td>Business opportunity focus</td>
<td>technology based service or product / licensing</td>
<td>solution for a problem or market failure</td>
<td>solution for a problem or market gap</td>
</tr>
<tr>
<td>Business concept differentiation</td>
<td>technology</td>
<td>market segment, pricing, channel</td>
<td>end user cost, delay, pricing</td>
</tr>
<tr>
<td>Intellectual property focus</td>
<td>patents</td>
<td>branding</td>
<td>branding</td>
</tr>
<tr>
<td>Business model</td>
<td>required</td>
<td>required</td>
<td>required</td>
</tr>
<tr>
<td>Concept time to market</td>
<td>12-24 months</td>
<td>3-5 months</td>
<td>3-12 months</td>
</tr>
</tbody>
</table>

Second, the programme’s cash flow is irregular and somewhat unpredictable—both for income and expenses. Given these vagaries, a separately managed account became necessary to shield the programme from other demands on college funds.

To fit the natural rhythm of the academic year, the main intake for the programme was scheduled in October, when final-year ICT students are choosing their major hands-on software projects. For the minority of those students who prefer to pursue a project with commercial potential, this timing allows them to apply to the SBI programme with the same project. (However, any aspiring individual or group of entrepreneurs can apply to the programme at any time.)

In the university setting, many would-be entrepreneurs lack business maturity and often have idealized preconceptions about mass market services, or desire to solve global problems. There is also a tendency (not limited to Africa) to place excessive value on intellectual property and to focus more on technology than on barriers to uptake. All aspiring entrepreneurs in the programme hence attend a non-credit lecture series on business creation and management.

A related challenge is the lack of financial modelling experience among almost all of the start-up groups. Spreadsheet business models are a crucial tool for exploring product pricing options, determining criteria for profitability and building pro-forma financial statements. To date this has been addressed with individual group tutorials; but a more scalable approach involving visiting or local business-school interns is now being explored.
To maintain its clarity and distinctiveness in its African setting, the SBI programme also maintains a clear operating philosophy...

- No explicit emphasis on poverty eradication or job creation: the start-ups’ goal is sustainable sales. In fact, if some of the start-ups destroy jobs for taxi and boda-boda drivers by reducing the demand for them, this is laudable.
- Not just social entrepreneurship: business plans must not depend on charity. The Bangladesh mobile ladies’ business is sustainable because they charge for their services [11] in order to pay off their loans. Also, customers tend to perceive value when they pay for it.
- No contests, no hackathons: one does not start a business in order to win 48 hours of fame or a trip to San Francisco. Any experience thus gained in software prototyping and making elevator pitches is valuable, but the odds of winning are very slim.
- Sell before you build: too many hopeful start-up build solutions for problems that nobody has. The SBI programme cannot afford the “build it and they will buy” approach.
- Constant contact and coaching: programme alumni say the monthly or more frequent meetings and feedback are much more valuable than the formal training or access to computers and internet.
- Support for full execution, not simply for the front-end innovation: making the first sale is primordial – and satisfying clients to gain repeat orders is the key to sustainability.
- Stipends for active founders: like most Africans, the SBI entrepreneurs need income every month to survive. Without a regular income, they necessarily take any opportunity to earn cash. Yet starting a business is a full-time job. Stipends from the venture fund to cover essential living expenses enable this.

As examples of the SBI programme’s results, some of the current start-up businesses in operation are:

- Sales/fulfilment and reporting system for booking and playing of radio adverts for radio stations and their clients.
- Web based skills-jobs matching service for job seekers and employers/recruiters
- Travel saving service for patients needing laboratory tests. (The innovation is in technology and channel to market.)
- Targeted local-proximity marketing service for small-medium enterprises that find traditional media unsuited for advertising their products.
- System for sports fans and other bettors to place bets and collect winnings from their mobile phones.
- Service to allow bus companies and their passengers to query, reserve and pay for intercity travel by mobile phone.
One such SBI programme start-up recently raised UGX 400m in private financing – equivalent to about $5m in North America or Europe.

Even when their start-ups fail, the founders have been disproportionately successful at finding jobs in Uganda. As elsewhere, entrepreneurial experience is an attractive addition to a job-seeker’s CV.

In sum, by capitalizing on the existing features and dynamics of Ugandan society, this scheme creates some new positive feedback loops, as diagrammed in Figure 4—and its investment of money and time can thus have disproportionate leverage.

**Fig. 4: Effect of new Early Stage Venture Funding and Management in Uganda**

5. **CONCLUSION**

This approach to software business incubation is a novelty in Africa. While aiming to emulate the role of universities in North America and Europe, it is adapted for the on-the-ground realities of Uganda’s current society and economy, with all its constraints and opportunities. As such, it addresses a gap in current domestic investment and NGO activity in Uganda, by catalysing investment of the increasing quantity and quality of Uganda’s human capital.

The funds needed to test this approach have been within the capacity of local investors for the small-scale pilot that was begun in the spring of 2010 and for its expansion in 2011. In absolute terms, they were significantly smaller than the 2008 foundation grant that equipped and launched the College’s National Software Incubation Lab.
The cost of the SBI programme is small in comparison to foreign-funded education and public health programmes in Uganda, and its potential benefits are disproportionate. At minimum, the programme results in an annual human capacity creation of about 100 people with business venturing experience. Even when their start-ups fail, these individuals are unusually successful at finding jobs in Uganda.

At maximum, the programme will have over time a multiplier effect throughout the local economy and provide a handsome return for all the cash and in-kind investors involved. As a success, it can certainly be adapted for application in other African countries with similar local conditions.

The Makerere University College of Computing and IS has developed this software business incubation programme as a part of its local mission; but, of course, the college would be delighted to collaborate through it with academic and professional partner organizations outside Uganda.

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Three Methods for Evaluating Mobile Phone Applications Aimed Users in a Developing Environment: A Comparative Case Study

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Abstract—As mobile phones become increasingly prevalent within the computing paradigm, greater emphasis needs to be placed on the value of usability evaluations for mobile applications. The proliferation of mobile phones into all socio-economic sectors has the effect that a mobile application may be used by people with vastly different demographic profiles. This creates an impact directly on the choice of evaluation method. Contemporary views on mobile evaluation suggest an assortment of usability evaluation approaches that vary in terms of user involvement and evaluation context. In this paper we present a discussion on three usability evaluation methods that were used to evaluate a mobile web application aimed at users in the rural areas of South Africa. Recommendations are made which describe how the three methods could be used to complement one another in order to produce a comprehensive set of usability results.

1. Introduction

The ISO definition of usability states that usability is ‘the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use’ [1]. The context of use (COU) is characterised by four variables, namely user, task, environment and products.

Usability evaluation typically aim to determine whether the target user groups are able to use an application to perform real tasks [2]. Inspection and analytical usability evaluation methods involve usability experts apply their knowledge of typical users and tasks, guided by heuristics, to identify usability problems. Mobile phone usability studies that use these methods do not take sufficient cognisance of the COU (i.e. a specific combination of user, task, product, and the environment) during the interaction process [3]. Such evaluations lead to products that are suitable for users with characteristics that reflect the demographics and abilities of the heuristic evaluators [4].

Since we affirm that the usability of mobile phone applications should not only be evaluated by analytic methods, the three evaluation methods discussed in this paper all involve human participants performing tasks on the system under evaluation. This is particularly important when the demographics of the intended users are vastly different from that of the designers.
We follow Baber’s [3] view of usability which implies that changing any one of the (COU) of use variables (user, activity, device, environment) may have an impact on usability. Due to the mobility of mobile phones, applications running on them will be used in a variety of situations – many of them unpredictable. Real usage is therefore impossible to simulate in a lab environment, which leads to the belief that mobile applications and services can be tested much more successfully in the field [5]. In our study, a mobile web application aimed at users in the rural areas in South Africa, was evaluated in three different ways, namely:

1. In a human-computer interaction (HCI) laboratory, using eye tracking on a PC based emulation of the mobile application’s interface, with participants who reflect the profile of the real users.
2. In an HCI laboratory, using the system on a mobile phone, with participants who reflect the profile of the real users.
3. In the field, with real users.

The aim of this paper is to compare the contributions made by these three methods to the evaluation. In a similar study, Betiol and Cybis [6] have shown that, in terms of usability testing results, the methods yield more similarities than differences. Building on this, we do not want to characterise any method as ‘the best’ or ‘the worst’, but rather demonstrate how the different evaluation methods complement one another. Our study differs from that of Betiol and Cybis in that our users are computer illiterate, we used eye tracking with the emulator, our lab setup allowed for natural movement with the mobile phone, and in the field we relied more on feedback through interviews and questionnaires than on video recording.

The paper is organised as follows: Section 2 provides some background on the evaluation of mobile applications. Section 3 gives a description of the case (the mobile application) chosen for this study. Section 4 describes the methodology used in each of the three evaluations. In section 5 we discuss the results of the three methods. Based on the results, we draw some conclusions regarding the combination of evaluation methods in section 6.

2. BACKGROUND AND RATIONALE

Existing literature on the usability evaluation of mobile devices reports mixed opinions and results regarding the most suitable evaluation method for mobile phone applications. In general, field studies are regarded more favourably [5]. Ballard [7] believes that the diversity of device models, the changeability of the environment of use, and the interruptions associated with the use of mobile applications, makes laboratory testing ‘almost meaningless’ (p.166). Specific studies support this view, for example, Nielsen, et al. [8]. However, a study by Kjeldskov, et al. [9] found laboratory testing superior to field testing. Research by Kaikkonen, et al. [10] and Betiol
and Cybis [6] showed little difference between the two methods in terms of evaluation results.

The problems associated with laboratory testing, when compared to field testing, mostly relate to the fact that participants use the device in a controlled environment that does not replicate the interruptions, lighting problems and movement associated with real-life mobile phone usage. Realising the benefits from the laboratory recording equipment requires that the mobile device be held still and that users may be required to hold their heads, hands and bodies at angles different from what they would naturally do.

A further problem is that the mobile screen cannot be recorded as easily as a computer screen. One way to overcome this is to use an emulator – an application that runs the code meant for the mobile device, on a computer [7]. This obstructs modelling of the real COU, since users cannot hold the device as they would hold a mobile phone, and it requires mouse interaction. If the participant accurately represents the user, three of the COU variables (activity, device, and environment) are still severely affected. When an emulator of a touch screen phone is run on a touch screen computer the problem diminishes, because the interaction better reflects the user’s activity during interaction. Despite the problems, testing with an emulator can reveal certain usability issues, such as those relating to labelling, the amount of information on screen, and the screen language [7].

Another way to obtain screen recordings is to position the device on a sled with two cameras – one pointing at the device and the other at the user’s face [7]. The problem here is that the camera may obstruct the user’s view of the device. The prominence of the recording equipment may also increase the Hawthorne effect – users will have a constant, visible reminder that their actions and facial expressions are being recorded. Again, at least three of the four COU variables are hampered.

The main issue with field testing is that it is generally more time consuming [10]. Kaikkonen et al. [10] found that more things can go wrong in a field study due to the unpredictable environment and the inability to prepare for unexpected events. Testing in the field supposedly allows evaluators to ensure a good reflection of the real user, the activities, the device, and environment. In other words, the testing reflects real usage in terms of all four COU variables. We question this. Does the presence of the evaluators and most probably video and/or audio recording equipment not influence the environment or the users’ activities? Furthermore, while the users may be in their natural environment of use, the evaluators may be out of their comfort zone. Can this not also influence the environment and the user activity? If the participant is not using his or her own mobile phone during the field test, the ‘device’ variable is also manipulated.
The inconsistent results with regard to the success of field testing versus laboratory testing are understandable. In the laboratory, the accuracy with which the COU can be simulated can be described as an abstract ‘value’ on a continuum that is determined by how well each of the four COU variables reflect real usage. The continuum goes from ‘COU not reflected at all’ to ‘COU accurately reflected’. In the field, the accuracy with which the COU can be simulated also lies somewhere on this continuum. In a study that compares these methods, there are at least eight variables that may influence the outcome. The skill level and experience of the evaluators with the different methods may further affect the outcome. This leads us to the motivation for this paper: Depending on where an application will be deployed and who designed it, laboratories with the necessary equipment may not be available, designers may not be trained to use available laboratory equipment, there may be too little time to conduct field evaluations, or it may be dangerous for evaluators to go into the field. The ‘context of evaluation’ thus also affects which evaluation methods are viable.

The thesis that we investigate here is then: as long as real end users, or participants that mirror real users, are involved, any method of evaluating mobile applications is worthwhile, and any combination of more than one method even more so. We will not prove or disprove this statement here. Instead we will provide support for it through a description of our experience with three different evaluation methods on one specific web-based application developed for use by a narrowly defined group of computer-illiterate mobile phone users.

In the next section we describe the application evaluated, the context within which it was developed and the context within which it will be used.

3. THE CASE: PROJECT RUSTICA

Small convenience shops in rural communities in South Africa, called Spaza shops, sell essential goods to the community, but they do not have access to global supply chains [11]. These shops are located in remote areas where road conditions are poor. The owners do not always have access to transport and have limited stock and cash flow available. These are just some of the difficulties rural entrepreneurs face while trying to make a living.

In a collaborative effort between SAP (Africa) and the Council for Scientific and Industrial Research in South Africa (CSIR), a project was launched in 2006 in the Kgautswana area to support rural entrepreneurs. This area has a population of 120 000 people and consists of 19 villages. The pilot project involved two infopreneurs (self-employed people who deliver ICT services to the community) and one supplier — Sasko Bakeries (Pioneer Food). It allowed Spaza owners to order bread by sending a SMS to an infopreneur who then bundle and submit the orders to the supplier.

Project Rustica was later developed by SAP/Meraka’s Unit for
Technological Development, to overcome the limitations identified in the pilot project. Rustica moved away from the SMS ordering system to number of ICT solutions, one of which is a web based procurement system that can be used on multiple mobile platforms. It involves more suppliers and more infoentrepreneurs. It mainly allows users to order stock, view the current status of a previous order, view previous orders and manage their eWallet (i.e. their account balance). This application was evaluated using the three methods described in the next section.

4. Research Methodology

Below we give separate descriptions of the three evaluation methods used to evaluate the Rustica solution. For each we describe the application interface, the participants, and the data collection and analysis methods.

4.1 Evaluation Method 1: Usability Lab Evaluation using Eye Tracking on an Emulator

This evaluation was conducted in the HCI laboratory of the University of South Africa that is equipped with a 17" TFT monitor with resolution of 1280x1024 and a Tobii 1750 eye tracker on which the Opera Mobile 10 emulator of the system was run. The emulator has exactly the same functionality and behaviour as the application running on a mobile phone, although the user’s actions during usage are different. Although the Rustica application is designed for use on a touch screen phone, participants interacted with the emulator using a mouse, and in rare cases also the keyboard. Figure 1 shows the interface of the emulator screen.
The Spaza owners who are the real users of this system could not be brought to the laboratory. Participants that fit the user profile were recruited from the staff at the university where the laboratory is situated. The profile prescribed black, African adults whose level of schooling range from grade 5 to Grade 12, had never or very seldom used a computer, but may have used a mobile phone, and who is not very proficient in English. More women than men own Spaza shops. Five people with the demographics given in Table 1 participated in this part of the study.

Table 1: Participants in the Lab Based Usability Study with Eye Tracking

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Home Language</th>
<th>Grade Passed</th>
<th>Used Computer?</th>
<th>Cell Phone use?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>Tswana</td>
<td>Grade 12</td>
<td>Never</td>
<td>2-5 x a day</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>Tsonga</td>
<td>Grade 12</td>
<td>3-10 times</td>
<td>More than 5x a day</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>Ndebele</td>
<td>Grade 11</td>
<td>Never</td>
<td>More than 5x a day</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>Tswana</td>
<td>Grade 8</td>
<td>Never</td>
<td>2-5 x a day</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>Tsonga</td>
<td>Grade 12</td>
<td>Never</td>
<td>2-5 x a day</td>
</tr>
</tbody>
</table>

The fact that the participants were computer illiterate meant they had to be taught basic mouse skills before testing could start. They had to be taught how to hold a mouse, how the movements of the mouse on the table correspond to the movement of the cursor on the screen, and how to carry out a drag action with the mouse.

Table 2: Scripts for the Tasks that were Used by the Facilitator

<table>
<thead>
<tr>
<th>Task 1</th>
<th>Task 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>- On the screen you will see a few images. These images represent a list of options from which you can choose. You are going to order some stock for your Spaza shop, so click on the place that will let you order new stock.</td>
<td>- Let’s place another order, this time for 10 cans of Coca Cola.</td>
</tr>
<tr>
<td>- Wait for participant to complete the action.</td>
<td>- Wait for participant to complete the action.</td>
</tr>
<tr>
<td>- While doing stock taking, you notice that you are low on Vodacom and MTN recharge vouchers. Place an order for three R10.99 Vodacom recharge vouchers and two R4.79 MTN recharge vouchers.</td>
<td>- When you see the list of items you are going to order, you decide that you want to change the order. Change the order form 10 cans of Coca Cola to 20 cans of Coca Cola.</td>
</tr>
<tr>
<td>- Wait for participant to complete the action.</td>
<td>- Wait for participant to complete the action.</td>
</tr>
<tr>
<td>- Now confirm the order.</td>
<td>- Now order the items and go back to the menu.</td>
</tr>
<tr>
<td>- You will see the list of the items you want to order. Order these items then go to the menu.</td>
<td></td>
</tr>
</tbody>
</table>

The usability test included two stock ordering tasks, so that we could also evaluate the learnability of the interface by comparing how long they took to complete the two tasks. Table 2 gives the facilitator script that describes the two tasks.
For the eye tracking component of data collection, the fixation radius was set at 35 pixels and a 9-point eye tracking calibration was used. Eye tracking video recordings overlay a moving red circle on the screen recording, so that participant’s eye movements can be played back for data analysis. The size of the circle reflects the length of the fixation on any point.

Eye tracking analysis of interactive applications has limitations. When a dynamic interface is evaluated, progression through the on-screen events are different for each user. The evaluator needs to identify periods where screen elements remain in a consistent position across participants. For example, for each participant in this study we generated fixation graphs and heat maps from the moment they first clicked on the Order Stock button up to the moment they first clicked on the edit box next to the Vodacom airtime voucher.

We also used the eye tracking videos to record the time taken to complete certain aspects of the tasks, so that we could determine whether they fared better during the second task.

Additional data were collected through a post-test, informal interview.

### 4.2 Evaluation Method 2: Usability Lab Evaluation using an HTC Touch Screen Cell Phone and Capturing Video Data of the Screen and User Actions Style

This evaluation was done in the same HCI lab as method 1, but with the application running on a mobile phone. Table 3 shows the demographic profile of the five participants involved.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Home Language</th>
<th>Grade Passed</th>
<th>Used Computer?</th>
<th>Cell Phone Use?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>Sepedi</td>
<td>Grade 12</td>
<td>More than 10 times</td>
<td>More than 5x a day</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>Tswana</td>
<td>Grade 11</td>
<td>More than 10 times</td>
<td>More than 5x a day</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>Tswana</td>
<td>Grade 8</td>
<td>Never</td>
<td>More than 5x a day</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>Ndebele</td>
<td>Grade 11</td>
<td>Twice</td>
<td>2-5x a day</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>Tsonga</td>
<td>Matric</td>
<td>More than 10 times</td>
<td>More than 5x a day</td>
</tr>
</tbody>
</table>

Although some of these participants were computer literate, none of them had used a touch screen phone before. They first had to be trained how to perform basic actions such as selecting and dragging with the touch screen interface.

The same tasks and facilitator script were used in methods 1 and 2. Data were collected as follows: Initially two fixed cameras were set up to capture the participant’s face and body, and the cell phone’s screen respectively. An area on the table was designated as the area within which
a participant was allowed to move the phone around. Soon after we started recording the first participant we realised that it was going to be impossible to restrict their movements in this way – the participant kept moving out of the recording area.

Deviating from the planned procedure, one of the observers took a portable video camera into the participant room and stood behind the participant in such a way that the screen and the participant’s hand and finger movements could be captured. This proved to be very successful and data for the rest of the participants were recorded in this way. Although it sounds intrusive, this approach did not have a notable effect on the participants’ behaviour. They were engrossed in performing the actions required by the tasks and the person recording was outside of their line of sight. A problem with this method was the physical strain of holding the camera at the correct height for extended periods of time. To solve this, the researchers switched roles between sessions.

Additional data were collected through informal, post-test interviews. Data analysis involved repeated viewing of the video material, relating it to the data from the interviews.

### 4.3 Evaluation Method 3: Field Study Conducted at a Living Lab

The field study was conducted in several Spaza shops in the Kgaustwane area. Nine users who participated in the evaluation are currently involved in the Living Lab development in the area. Living Labs are innovation environments that allow cooperation between enterprises, users, public agencies and research organisations and provide platforms for creating, prototyping and using new products and services in real-life environments [12]. Table 4 depicts some of the characteristics of the participants.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Handset</th>
<th>Cell Phone Use?</th>
<th>Can Read Screen?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>HTC</td>
<td>More than 5x a day</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>Nokia</td>
<td>Less than 5x a day</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>Nokia</td>
<td>More than 5x a day</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>HTC</td>
<td>More than 5x a day</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>Nokia</td>
<td>2-5x a day</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>Nokia</td>
<td>2-5x a day</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>Nokia</td>
<td>More than 5x a day</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>HTC</td>
<td>More than 5x a day</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>Nokia</td>
<td>More than 5x a day</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The Rustica application was accessed through the browser of the mobile phones provided to the participants in the Living Lab. The users already knew how to operate the device and had previously used the Rustica application, so no training was required.
For the evaluation, a video camera was used with Morae software to record each session. The video recording was used for later analysis and referencing. Two moderators were present; one took notes and the other managed the recording.

One objective of the field study was to determine the intuitive nature of the application. Users were given a simple task to complete without additional guidance unless requested by the user. The task required that the users order two types of products (10 bags of maize meal and 5 cans of beans). To complete this task the user had to navigate to the Order Stock menu, go to the correct category, enter the order amount for each product, navigate to the Confirm Order page, check that the correct products were ordered, and, lastly, order the products.

Once the users completed the task, they completed a questionnaire with the help of the moderators. The questionnaire was compiled in English for reporting purposes. Many of the participants are not proficient in English, and the moderator translated the questions into their home language. The process of completing the questionnaire thus resembled a structured interview. A further informal interview provided additional feedback from participants.

5. Analysis and Findings

Here we briefly discuss the outcomes of each of the evaluation methods.

5.1 Findings Based on Evaluation Method 1 (Eye Tracking)

Figure 3 shows examples of the heat maps generated for some participants on a specific aspect of the tasks. Here the maps illustrate their fixation patterns from when they first entered this screen until they clicked on the required edit box (the top one). For most of the participants the edit box appears on the periphery of the heat blobs.

The fact that none of these participants fixated on the required edit box shows that they did not understand its purpose on the screen. The heat maps also indicate that they regarded the 1 and 2 tabs as important for this task. To these users, the edit box is just a rectangle drawn on the screen – they have no mental model that would lead them to think that this rectangle is for typing into. They know they have to provide a number, and therefore fixate on the labels of the tabs. Heat maps were created for various intervals during interaction, presenting similar evidence where users missed the significance of crucial interface elements.
We also compared the time it took participants to complete aspects of the tasks. Tables 4 and 5 illustrate the times taken to complete the first and second attempts at ordering stock respectively. The minimum time taken to complete the order was 5:31 and the maximum 10:41. Given that they only had to order two items and that some help was available, they clearly struggled with this task. On the second order the time taken to complete ranged from 2:03 to 7:14 which shows an improvement from the first order, but they still found it difficult.

The findings from this evaluation method can be summarised as follows: The user interface should support the user’s home language. Many terms and phrases were misunderstood, for example: Clear order (some used this to confirm the order); Confirm order; Confectionary; Exceeds (understood as exists); Status (interpreted as Stationary).

The users are clearly not familiar with the concept of an edit box, and they do not clearly distinguish when an object is clickable and when not. The Confirm order, Clear order and Menu buttons should preferably be
Three Methods for Evaluating Mobile Phone Applications Aimed Users visible all the time. Alternative captions for the Confirm order button are: Send the order now, Done with order, Continue with order and the Clear order button should rather say Delete order or Cancel order. The headings Product, Price, Total that appear at the top were interpreted as clickable options. On the Main Menu, the whole button should be clickable – not only the icon. When searching for a button to click on (e.g. Confirm Order) the users searched from left to right, so the Confirm Order button should appear to the left of the Clear button. The large white arrows at the bottom seem to some users as a way out of their confusion – they often looked at or clicked on these when they were unsure of what to do next.

<table>
<thead>
<tr>
<th>Participant</th>
<th>From Clicking on 'Order Stock' to Clicking on 'Beverages-Cold'</th>
<th>From Clicking on 'Beverages-Cold' to Clicking the Edit Box</th>
<th>From Clicking on the Edit Box to Clicking Done after Entering the no of Cokes</th>
<th>From First Clicking on 'Order Stock' to Clicking on 'Confirm Order'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.28</td>
<td>1.34</td>
<td>0.50</td>
<td>7.14</td>
</tr>
<tr>
<td>2</td>
<td>0.12</td>
<td>0.05</td>
<td>0.10</td>
<td>2.05</td>
</tr>
<tr>
<td>3</td>
<td>1.53</td>
<td>0.14</td>
<td>0.44</td>
<td>3.38</td>
</tr>
<tr>
<td>4</td>
<td>2.59</td>
<td>0.15</td>
<td>1.32</td>
<td>5.32</td>
</tr>
<tr>
<td>5</td>
<td>2.05</td>
<td>0.55</td>
<td>0.21</td>
<td>4.07</td>
</tr>
</tbody>
</table>

5.2 Findings Based on Evaluation Method 2 (Video Recording)

The analysis of the video recordings revealed that completing the required tasks on a physical mobile device was complex and challenging. The initial coaching on how to use the system proved to be insignificant as the users could not transfer the skills when attempting to complete the required tasks. This however, could be attributed to the limited exposure of the users to both the application and to touch screen smart phones.

Task completion times ranged from 10 to 25 minutes. These times however, were impacted by disruptions such as pop-up boxes which related to the loss of cellular network connectivity and a decline in the battery life of the mobile device. Constant requests for guidance also extended the task completion times. Users regularly required verbal confirmation that they were on the right track. The last factor which contributed to the long task completion times was the small size of the controls on the user interface. Users struggled to select controls and enter data due to the size of the controls and the on-screen keyboard.

Users were confused by the scrolling metaphor used on the touch screen. The idea of scrolling up to go further down the page did not agree with the mental model of the users. Lastly, as with the users of the emulator, the grouping of the products and the use of complex terminology confused the users to the extent where it impacted on task completion times and increased the total number of interaction steps required to complete the task.
5.3 Findings Based on Evaluation Method 3 (Field Study)

Figure 4 represents the results obtained from the questionnaire. An overview is given of each aspect covered by the questions. The dark sections of bars represent the percentage of positive responses, while the lighter part of the bar shows the percentage of responses that reflected negative perceptions or experiences.

Subjective satisfaction refers to how easy and pleasing it is to use the application. Consistency looks at uniformity between screens and attractiveness is based on the simplicity and the appropriate use of colours. Familiarity, predictability and system terminology questions how recognizable the system is, if it is understandable, conventional and if previous knowledge of mobile devices is helpful. Tolerance and feedback inspect if the system guides the users through tasks and if the system assists the users in making corrections if an error occurred. Control and freedom examine the navigation in the system and how easy or difficult it is to enter data is inspected through the question in the information entry section.

Figure 4 shows that the following sections require attention: attractiveness, tolerance, system terminology, and information entry.

The user feedback during the informal post-test interviews were analysed with close reference to the results of analysing the different questionnaire topics. This yielded more detailed findings: The negative results for ‘attractiveness’ mostly related to the use of colour in the screen design; with regard to ‘tolerance’, the interface lacks guidance on how to correct an error and the system lacks the ability to fix user errors automatically; users found the instructions difficult to understand as is reflected by the very low ‘system terminology’ score; and, lastly, the interview feedback confirmed the low score on ‘information entry’, as users found it difficult to provide input into the system.
The feedback from this evaluation is generalised and not specific to any of the pages or user interface objects. This evaluation method was more successful in gleaning information on user experience than it was at revealing specific usability problems. The method relied heavily on verbal feedback from the users, and the lack of specificity can be attributed to their lack of vocabulary to express opinions about specific interface objects and actions.

6. Conclusion

Usability evaluation methodologies present several advantages and disadvantages depending on their application and COU. The same applies when using these methodologies to evaluate the usability of mobile applications. This paper has presented the results of a usability evaluation conducted on a mobile web application using three different methods.

Despite being fundamentally different in their approach and analysis, the three evaluation methods revealed findings which complemented one another. Animated fixation paths and heat maps assisted in demonstrating the complexity of user interface for the intended user group. It exposed very specific design flaws and drew attention to the value (or lack thereof) that users attributed to individual controls. To support these findings the second method revealed that users found it hard to re-apply a mental model when completing the second task. With this method, design problems that relate to the physical attributes of the mobile phone were highlighted (e.g. the size of controls and scrolling up and down on a page) that would have been missed if only methods 1 and 3 were used. The third method provided more general results and yielded information on the users’ experience that the laboratory methods could not. There is thus clear evidence that each of the three methods reveal unique usability problems. The overlap in the results of the three methods is also valuable. For example, in three different ways the three methods revealed the difficulty users had with data entry, accentuating the severity of the problem. Another area of consistency in terms of problem identification was the user interface language. All three evaluation methods indicated that the terminology was complex and negatively impacted on task completion times.

The combination of the three methods used in study has proved beneficial in terms of evaluating the usability of a mobile application. Use of the eye tracking methodology has contributed to understanding how the user actually perceives the user interface elements while trying to complete a task. Evaluating the application on a mobile device in a controlled environment had the advantage of identifying specific usability issues without taking into account environmental factors and just concentrating on the core application. Lastly, conducting a field study with the actual users who have used the application over a period of time, provided an added dimension of realism incorporating factors that were excluded in the
first two methods such as environmental factors, tolerance towards using the application on a daily basis, problem resolution, and utility through actual usage.

7. ACKNOWLEDGEMENT

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REFERENCES


Mobile User Experience for Voice Services: A Theoretical Framework

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Abstract — The purpose of this paper is to provide a “Mobile User Experience Framework for Voice services.” The rapid spread of mobile cellular technology within Africa has made it a prime vehicle for accessing services and content. The challenge remains to provide these services and information on the technology that the user already owns and is proficient in using. To this end voice as service and distribution mechanism for information is, ahead of SMS and USSD, the most ubiquitous channel of access as it is available on all mobile phone handsets. User experience has been linked to the uptake and engagement with technology and services. As such it becomes imperative to acknowledge mobile user experiences for voice services in order to provide an optimal engagement opportunity that would facilitate participation by end users.

Keywords: Mobile User Experience, Voice services, Theoretical Framework

1. INTRODUCTION

The focus of this article is to provide a theoretical framework for mobile user experience (MEX) for the application of voice services. Before the framework can be presented it is imperative that we unpack a few concepts which are applied in this framework. Therefore an explanation of user experience (UX) will be followed by an explanation of mobile user experience with its specific components, as well as an explanation of what is meant by voice services in this context. The uniqueness of this framework is that it was adopted from a previously developed mobile UX framework and then applied to voice services specifically. This framework also forms part of an EU FP7 project (VOICES), initiated at the end of 2010.

User experience (UX), as a trans-discipline and emerging concept, has a multitude of definitions that are sympathetic to its origins, indicating its complexity and richness. Dix [1] observes that with the growth of the web, much software that traditionally sold as products have become services. He argues that where products allowed for one infrequent point of choice, services allow near continuous choice. As such, user experience becomes imperative to success. Pine and Gilmore [2] position experience as a unique offering of the emerging experience economy and argue that an experience occurs when an organisation intentionally uses services and goods to engage individuals in such a way as to create a memorable event.
With more consideration being paid to finding ways to reach the “bottom of the pyramid” [3] improved mobile access presents a unique opportunity for new voice services and voice service models. These are increasingly being facilitated by access to mobile cellular technology for individuals lacking large or predictable incomes [4]. User experience (UX) is an acknowledged factor in the successful uptake and use of technology [5-7], though it has received less attention for individuals in this category. Although user experience research informs practice on not only functional, but also hedonistic needs [8], limited empirical research is available to reflect this [9]. This is exaggerated when considering mobile user experience and even more so for voice services [10]. However, with the greater involvement of enterprises in developing countries in the provision of ICT related innovations [11] it becomes imperative to provide guidelines or frameworks that would, if not enable, increase the likelihood of uptake.

Practitioners and interaction designers cannot design, and much less control, a successful user experience. They can, however, design for one. As such, a framework for the mobile user experience for, in this case specifically voice services, becomes a 360° view of the mobile end user’s interaction with the mobile technology and the voice service.

2. Toward a Mobile User Experience

2.1 Focussing the User Experience

In order to understand user experience, Roto [8] argues that the term ‘experience’ encompasses many variables and that a focus on the interaction and experiences of the user with an interactive system is desirable. She states that: “[m]aking this distinction would help us to understand what is meant by experience or UX, to identify the factors affecting user experience, and also to evaluate user experience in a systematic way [8]. She views user experience as a special case of experience that involves a service or product, relating to an interaction with the system, where the system does not need to be interactive. This paper will build on this understanding, and focus on a user experience as opposed to an experience.

Hassenzahl [12], referring to the end user mode of interaction with mobile technology, distinguishes between goal mode and action mode. Goal mode is characterised by the user wanting to achieve a goal. Action mode, on the other hand, is where the user is focused on entertainment. Entertainment activities include such interaction as browsing or gaming. The interactions that were considered for this paper are limited to goal-orientated interactions as opposed to general browsing or recreational interactions [12-15], mainly because a user will interact with a voice service on a mobile device to reach a specific goal.
2.2 The User Experience

There is little consensus in literature on either the definition or characteristics of a ‘user experience’. Literature does, however, generally agree that a UX would include subjective attributes and social aspects. These subjective attributes and social aspects would be additional considerations in a space that has previously concerned itself mainly with ease-of-use and implies considerations that are beyond the task-related [1, 9, 16, 17]. Preece et al. shape the HCI concern and state that: “The dominant framework that has characterized HCI has been cognitive. In general, cognition refers to the processes by which we become acquainted with things or, in other words, how we gain knowledge. These include understanding, remembering, reasoning, attending, being aware, acquiring skills and creating new ideas” [18]. Hassenzal and Tractinsky reiterate this stating: “Since its early days, HCI research focused almost exclusively on the achievement of behavioural goals in work settings. The task became the pivotal point of user-centred analysis and evaluation techniques (e.g. usability testing). To ensure the interactive product’s instrumental value became the major endeavour of the field” [9].

There are several reasons for the illusiveness of a universal definition of UX. The first can be ascribed to the broad range of vague and dynamic concepts on which there is little consensus regarding the inclusion or exclusion of attributes. The second reason concerns the unit of analysis for UX, which ranges from a single aspect of an individual user with a standalone application, to all aspects of multiple users with many and diverse services and applications across domains. The third has to do with the fragmented research focus [19]. The various definitions articulated in literature [8, 20-27] all directly or indirectly reflect the findings of the review done by Hassenzahl and Tractinsky [9]. They identify three high-level components that affect the user experience, namely the user, the system, and the context.

Although the identified elements of the UX remain for mobile interactions, there are added complications and dimensions due to the mobility of the interaction and the personal nature of the technology [25]. These are reflected on in the following section.

2.3 The Mobile User Experience (MEX)

The literature that reflects on the mobile user experience is mostly limited to expert opinions and insights gained from solution-driven interventions. Ledfort [28] argues that the mobile user experience is not monolithic as it is dependent on a number of factors. Elements of context, networks, and the business-related issues such as cost, and unique affordances of mobile users and use have been suggested as additional considerations [15, 29-35]. Planning for a mobile user experience would imply the optimal consideration of additional components that impact on the MEX from the
MHCI considerations and from the voice interaction considerations. The components that would frame the MHCI are identified as mobile users, mobile devices, mobile networks, mobile business processes and mobile use.

An overview of each of these focus areas is beyond the scope of this paper and limits the outline to conclude that there are many challenges and potential solutions for effective interaction with mobile devices and services. However, these solutions are underpinned by common components that make up the interaction as outlined in the structure for MHCI.

The components of a user experience, outlined in section 2.2 as the user, the system and the context can now be expanded on to include additional considerations towards a Mobile User Experience as:

**User:** The mobile user; Mobile use.

**System:** Mobile device; Mobile business practices; Network affordances; Mobile Applications; Mobile Interaction

**Context:** Mobile Context

From these considerations a comprehensive Framework was presented by Botha to outline the factors or each of the components and their impact. These were adapted to incorporate specifics related to voice services. The next section investigates voice services focussing on goal driven interactions towards presenting a framework for mobile user experience for voice services specifically.

### 3. Voice Services

In recent years there has been a significant body of work generated in the voice-based services area such as to name a few, which covers various domains such as education, health, agriculture, finance, etc. Voice-based services are often referred to as spoken dialogue systems (SDS) or interactive voice response (IVR) systems in literature. Both allow a user to access information or a service via the voice channel of their mobile phone, by navigating through voice menus where input by the user is through speech (for SDS) or dual tone multi frequency (DTMF) (for IVR). The user typically interacts with the service through the means of a simple telephone call to the service’s phone number or more recently as proposed by Google through a voice-based search using the data channel of their mobile phone.

Numerous communities in developing world regions face barriers to information/service access, including infrastructure, distance, language and literacy. Many government entities and non-profit institutions need to deliver services and provide timely, accurate and relevant information to their communities of interest, which can be a challenging task due to these barriers. Voice-based services can play an important role in addressing these barriers and bridging the information gap as mobile phones are by far
the most widespread form of ICTs in developing world regions [11], [10]. Being independent of mobile phone device type and operator is an added advantage of voice-based services [10]. Barriers of language and literacy are also addressed as the service’s content can easily be made available in local languages and most users are comfortable with the concept of making a telephone call as opposed to operating a PC or interacting with a mobile interface. Voice-based services also have the further advantage that they do not require any computer infrastructure from the user end and can be used from anywhere, alleviating transport-related costs and delays.

Plauche et al. [44] developed one of the first voice-based services for low literacy users in the agriculture domain. It was found that low literacy users were able to navigate a SDS but with differences in task completion for low literate and illiterate users. The topic of input modality in voice-based services has also been explored by Grover et al. [37], Sherwani et al. [38], Patel et al. [39, 45], and Lerer et al. [46]. Results have varied in terms of user performance (task success) and user preference for any particular modality. Sherwani et al. and Lerer et al. [46], found speech input provided a significantly higher task success rate than DTMF. Conversely Patel et al. [45] found that user performance was better with DTMF input, whilst Grover et al. [37], report no significant difference in user performance between speech and DTMF input. For user preference, both Grover et al. [37] and Patel et al. [45] report that users preferred DTMF over speech input, whilst Sherwani et al. [38] report no significant difference in user preference, and Lerer et al. [46] although not explicitly reporting user preference suggest that users did not like the DTMF aspects of the system. Its noteworthy to mention that though all these studies targeted developing world users, they were conducted in different domains and contexts with different types of users; HIV info (Grover et al.), agriculture info (Patel et al.), general health info (Sherwani et al.) and an audio survey (Lerer et al.).

A language learning service by the BBC, termed “BBC Janala” [47] provides English language lessons via an IVR in Bangladesh. The user ‘dial[s] up a series of three-minute-long English lessons for 3 taka (2.5 pence) [USD 0.04] each, which is less than the cost of a cup of tea at a roadside stall in Dhaka” [47]. The service received over 750 000 calls in the first month [47] and to our knowledge is one of the rare successful examples of a ‘user-paid’ voice-based service in the developing world. Another notable example of a ‘user-paid’ voice-based service is that of “Lifelines India” [42] which provides a question-answering service in the agriculture and education domains. Through the assistance of a community field worker, the user calls the IVR, records their query and obtains a unique query ID number. On the back-end, within 24 hours a knowledge worker posts the response to the query using expert opinion and a knowledge database of similar FAQs. Later, the user retrieves the query’s response by dialling into the IVR again, with the cost of the call being 5 rupees (USD 0.11).
Patnaik et al. [48], Medhi et al. [49], and Kote et al. [50] compare a range of mobile user interfaces (UI) which include voice-based services. In [48], it was found that error rates for data collection through a live operator (voice) were significantly lower as compared to SMS, and electronic forms (via mobile phone). Medhi et al. [49], compare text-based interfaces such as electronic forms, SMS and USSD with text-free interfaces such as an SDS, graphical UI and a live operator. They report that “textual interfaces were unusable by low literacy users and difficult to use by novice users”. In the case of text-free interfaces, the live operator (voice) was found to be the most effective, with varying results for voice and graphical UIs respectively. In particular for voice UIs, Medhi et al. suggest that users, who are somewhat familiar with the concept and the general terminology (prompts) of the voice UI, were faster and more independent in their task execution. However, overall, graphical UIs had a higher task completion rate but users took significantly more time to complete the task and required more prompting and encouragement during the study. In a similar vein, Kote et al. found that users preferred an IVR over SMS for a service that crowd sources water availability information India.

Agarwal et al. [41] discuss the adoption of four different pilot deployments of voice-based services for general community information and agriculture in India. The authors highlight that, choosing a local partner organisation within the user community to act as an intermediary and ensuring content is relevant and moderated where required, are important factors that play a role in the adoption of voice-based services. Similar findings on content and adoption were reported by Grover et al. [51] for “Lwazi” which piloted a voice-based community information service for managers of government community centres, in six areas across South Africa. In [51] it is reported that the availability of information sources which provide content for the service was a crucial factor, and in terms of multilingualism in developing world environments, a dominant language or two usually prevails in an area with most users tending to be multilingual and conversant in the dominant language(s).

Across the various studies described above, numerous significant findings have been reported and several recommendations on design and deployment have been made. However, to date an overarching framework that explicates the space of user experience for voice-based services in the context of a mobile phone user has not emerged. Some noteworthy studies that provide an overview of a number of salient factors to be considered and recommendations for the development of voice-based services include those of Barnard et al. [52] and Grover et al. [40, 53]. In this paper we further expound on these recommendations and those of the numerous voice-based based services mentioned above and present a consolidated framework on mobile user experience for voice-based services.
4. FRAMEWORK FOR MOBILE USER EXPERIENCE IN VOICE SERVICES

This framework, which was adapted from Botha [36-38], consists of components of mobile UX or MEX which were outlined in section 2.3 as well as MEX factors and how these impact on mobile and voice contexts of use. Colour is used to reflect the following contexts:

- * Impact mainly in mobile context
- # Impact mainly in voice context
- + Impact in mobile and voice contexts

Evidence of relevant literature for each impact factor is then provided to develop the theoretical framework and a discussion or interpretation of the influences of mobile, voice and both mobile and voice is then provided.

Table 1: Theoretical Framework for MEX for Voice-based Services

<table>
<thead>
<tr>
<th>Component</th>
<th>Mobile User Experience Factor</th>
<th>Impact in Mobile And Voice Contexts Of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile User</td>
<td>Mobile Users have unique characteristics [8, 15, 35]</td>
<td>+The user occupies multiple social spaces simultaneously; [33, 54-60]</td>
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<td></td>
<td></td>
<td>+The user is distracted (short attention span) [34, 35, 55, 56]</td>
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<td></td>
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<td>+The user multitasks [35, 54, 55, 61]</td>
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<td></td>
<td></td>
<td>+The user is available or considered as connected [55, 56]</td>
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<td></td>
<td></td>
<td>+The user is contextual and the environment affects device use. [33, 34, 54-56, 58, 59]</td>
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<td></td>
<td></td>
<td>+The user personalises the device [34, 55, 56, 61]</td>
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<tr>
<td></td>
<td></td>
<td>+The user multitasks with mobile technology and considers the mobile device as familiar [34, 35, 55, 56, 61]</td>
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<td></td>
<td></td>
<td>+The users skill level [34, 35, 55, 56]</td>
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<tr>
<td></td>
<td></td>
<td>+The user's experience with voice-based services [37, 40, 46, 51, 52]</td>
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<td></td>
<td></td>
<td>+The user's literacy (functional and/or numerical) level(s) affects the interaction with the technology [37, 40, 42, 43, 49, 52, 53, 62, 63]</td>
</tr>
<tr>
<td>Mobile Use</td>
<td>User appropriation of the technology-in-use is facilitated [61]</td>
<td>#Openness of the user community; membership to the user community with concomitant implications for user training [40, 52]</td>
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<tr>
<td></td>
<td></td>
<td>+Personal characteristics of user. The users internal state, motivation, mood and expectations [8, 25, 35, 40, 47, 51, 55]</td>
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<td></td>
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<td>+The technology is convenient to use (available) [61]</td>
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<td>+The user is in control of the mobile device (shared and multiple usage) and the speech application [52, 61, 62]</td>
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<td></td>
<td>+The user considers the device fashionable [25, 33, 61, 62]</td>
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<tr>
<td></td>
<td></td>
<td>+The user considers the technology fashionable as a status symbol [39]</td>
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<td></td>
<td></td>
<td>+The user can identify with the technology-in-use as “our stuff” [61]</td>
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<td></td>
<td></td>
<td>+The user is exposed to long-term engagement with the application [40, 51]</td>
</tr>
<tr>
<td>Hedonic experience of use is facilitated [9, 32-34, 64]</td>
<td>+The user enjoys using the mobile device, [9, 55, 56]</td>
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<td></td>
<td></td>
<td>+The user will use the mobile device again. [9, 22]</td>
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<td></td>
<td></td>
<td>+The user does not experience frustration [64]</td>
</tr>
<tr>
<td>Component</td>
<td>Mobile User Experience Factor</td>
<td>Impact in Mobile And Voice Contexts Of Use</td>
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<tr>
<td>Mobile Device</td>
<td>Device capabilities support the interaction adequately performance issues (Hardware) [10, 65-67]</td>
<td>*The display is clear and visible and accessible during the interaction (e.g. sunlight) [66-68]</td>
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<tr>
<td></td>
<td></td>
<td>*Display is capable of rendering content for interaction [69]</td>
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<td></td>
<td></td>
<td>*Battery life is adequate to support the required mobility [66-68]</td>
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<td></td>
<td></td>
<td>+The memory capacity is sufficient. There is sufficient capability to extend the memory if needed [66-68]</td>
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<tr>
<td></td>
<td></td>
<td>+The device processing power supports the interaction sufficiently [66-68]</td>
</tr>
<tr>
<td>The imbedded software support the</td>
<td>+Functionalities adequately enable the interaction [68, 70]</td>
<td></td>
</tr>
<tr>
<td>interaction adequately</td>
<td>+Functionalities of the device are usable for the interaction, [56, 68]</td>
<td></td>
</tr>
<tr>
<td>(Software) [10, 55, 68]</td>
<td>+Operating system supports installation of application used in the interaction [56, 68, 71]</td>
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<tr>
<td></td>
<td>+Functionality feedback is understood [56]</td>
<td></td>
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<tr>
<td>Software is usable in use [14, 64, 72]</td>
<td>+The software embedded in the device is error free [64, 72]</td>
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<tr>
<td></td>
<td>+The interaction with the software embedded in the device is easy to remember [62, 64, 72]</td>
<td></td>
</tr>
<tr>
<td>Mobile Business Practices [10, 15, 35, 55, 56, 74-76]</td>
<td>+The pricing structure of the service provider is understood [64, 77]</td>
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<tr>
<td></td>
<td>+The cost of the interaction is disclosed [64]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+The interaction provides value for money [37, 39, 40, 42, 47, 51, 52, 62, 64]</td>
<td></td>
</tr>
<tr>
<td>Deployment of voice-based services [37, 40, 47, 51, 52]</td>
<td>+Stakeholders understand practical roles they play in success of application [40, 51]</td>
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</tr>
<tr>
<td></td>
<td>+Application is aligned with/supplements existing information/services channels [37, 40, 42, 51, 52, 62]</td>
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<tr>
<td></td>
<td>+Deployment of application is sustainable [40, 47]</td>
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</tr>
<tr>
<td>Mobile Networks Mobile</td>
<td>Network is available [10, 15, 35, 55, 56, 78-82]</td>
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</tr>
<tr>
<td>Interaction Mobile Application</td>
<td>+There is network coverage [36, 62]</td>
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</tr>
<tr>
<td></td>
<td>+The interaction does not need network coverage [34, 55, 56]</td>
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<tr>
<td></td>
<td>+Can perform the expected service dependably, accurately and consistently [35, 75, 83]</td>
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<td></td>
<td>+Network facilitates interaction [35, 75]</td>
<td></td>
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<tr>
<td></td>
<td>+Network services are sufficient to support interaction [35, 55, 56, 75]</td>
<td></td>
</tr>
<tr>
<td>Mobile Interaction supported by</td>
<td>+Usability of application [55, 56]</td>
<td></td>
</tr>
<tr>
<td>usability of application. [15, 55,</td>
<td>+Service or product is simple and easy to use (ease of use) [15, 62]</td>
<td></td>
</tr>
<tr>
<td>56, 64, 84]</td>
<td>+Important functionalities are easy to find (fluency of navigation) [15]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+Interaction needed in application is learnable [62, 64]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+Interaction is safe and secure [64, 84]</td>
<td></td>
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<tr>
<td></td>
<td>+Interactions are suited to mobility e.g. One hand information input on the move [77, 85]</td>
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<tr>
<td>Component</td>
<td>Mobile User Experience Factor</td>
<td>Impact in Mobile And Voice Contexts Of Use</td>
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</tr>
<tr>
<td>The Mobile Application supports the interaction [10, 34, 55, 56, 86, 87]</td>
<td>+Mobile Application accesses the interactions that are native to the phone [10, 34]</td>
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<tr>
<td></td>
<td>+Provides service and content to user when needed [15, 34, 55, 56]</td>
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</tr>
<tr>
<td></td>
<td>+Provide services and content to user where needed [15, 34, 40, 55, 56]</td>
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<tr>
<td></td>
<td>+Mobile Application makes task easier [15, 34, 40, 62]</td>
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<td></td>
<td>+Application provides only useful information during interaction [15, 56]</td>
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<tr>
<td></td>
<td>+Application provides appropriate functions for interaction [34, 40, 55, 64]</td>
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<td></td>
<td>+Application is reliable and performs service dependable, accurately and consistently [34, 55, 56]</td>
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<td></td>
<td>+Application provides timely responses [15, 34, 55, 56]</td>
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<tr>
<td></td>
<td>+Application supports multiple users [36, 42, 51, 62]</td>
<td></td>
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<tr>
<td></td>
<td>#Application provides appropriately generated content (user vs designer-generated) [40, 62]</td>
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<tr>
<td></td>
<td>#Application provides up-to-date content [40]</td>
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<tr>
<td></td>
<td>#Application provides content in local language/accents [37, 40, 42, 46, 52, 62]</td>
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<tr>
<td></td>
<td>#Content source is reliable and trustworthy [39, 40, 62, 85]</td>
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<tr>
<td></td>
<td>#Application's content source is sustainable [51]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>#Application content source matches sensitivity of content [37, 40]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>#Speech technology is ready to cope with the complexity of the application (NLP vs human-in-the-loop) [40, 46, 51]</td>
<td></td>
</tr>
<tr>
<td>Application complexity (technology readiness)</td>
<td>#Speech resources with which to build speech technologies are available [62]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>#Speech technology is able to cater for the nature of the task (restrictiveness of the task domain, linearity of the interaction, range of choices available) [46, 52]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>#Speech technology appropriately caters for code-switching, -mixing and dialectal variation [53, 62]</td>
<td></td>
</tr>
<tr>
<td>Technology capability (accuracy, speed, robustness)</td>
<td>#Speech technology can cope with the environment (noise, non-standard speech) [46, 52, 53, 62]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>#Speech technology is usable [40]</td>
<td></td>
</tr>
<tr>
<td>Voice user interface design [37-39, 52, 53]</td>
<td>#Application dialog strategy matches the nature of the task domain [46, 52, 53, 62]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>#Application’s input modality matches the task required [46, 52]</td>
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<tr>
<td></td>
<td>#Application’s input modality takes into account user preference [37-39]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>#Input modality matches user’s privacy needs [37, 53]</td>
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</tbody>
</table>
The critical reflection on the impact factors is provided in the next section.

5. CRITICAL IMPACT FACTORS

Based on the overview of impact factors relating to mobile user experience for voice-based applications presented in Table 1, this section discusses selected impact factors we deem to be critical to this user experience.

The first of these relate to the mobile user. The user’s experience with mobile and voice technology, as well as varying degrees of literacy pose challenges for user interface designs and deployment strategies for mobile voice services, particularly in developing world contexts. Medhi et al. [49] discuss these issues in detail and indicate that human mediation by means of a live operator can dramatically improve task completion rates in applications in such contexts. The user’s motivation to use the service and his/her expectation relating to potential benefit also impact the user experience and have implications for the sustainability of the service. The BBC Janala service discussed in section 3 is a good example of this. The fact that the calls to the system cost 3 taka each (albeit a minimal amount) and 750,000 calls were received during the first month after the launch, indicates the users’ level of interest in improving their English language skills.

The differentiating factors for UX in any mobile speech application are its voice user interface design as well as the capability and readiness of the speech technology. Barnard et al. [52] indicate that application complexity and user ability are major determinants of spoken dialog systems in the developing world. Lerner et al. [46] describe variation in task success rates based on careful VUI design choices involving changes in modality of input (touch-tone vs speech), changes in the structuring of the prompts, and changes to the accent of the recorded voice used in the prompts. The mobile speech application must also provide a service and content to the user that is relevant, reliable,
timely and trustworthy for a positive user experience to occur. A critical success factor in developing world contexts is the provision of content in the local language (and accent), as well as involvement of local users in the design of the application [62].

As mentioned in section 3, developments in deploying voice-based services such as voice search on mobile devices are resulting in the data channel on the mobile device becoming an impact factor in voice services. Functionalities and operating systems on the mobile device which enable interaction with the application and are usable for the interaction, are therefore becoming critical to the success of such services and the user’s experience of such services. Barnard et al. [43] discuss voice-search systems for development in more detail.

Mobile network infrastructure is also a critical impact factor for mobile voice services UX, with the emphasis on a reliable network with sufficient network services to support the interaction.

Finally, particularly in developing world contexts, the costs relating to voice services and the implications for mobile business practices have an impact on UX of mobile voice services, with value for money being critical. The charges (five Rupees) described in section 3 for the LifeLines India Agriculture service, serve a dual purpose: the users value and respect the information because it is not totally free; and it enables the creation of a sustainable business model. Lall [42] reports caller satisfaction levels of 96%, profit increases of between 25% and 150% and a rise in call volumes from "1 100 calls per month at launch, to an average of 350 calls daily". A sustainable business model further relies on stakeholders understanding their roles in the deployment of the service, and the service being aligned with or supplementing existing information or services channels [42].

Acknowledging the above factors as being critical to mobile user experience for voice-based services, enables their use as a starting point for developing a set of metrics to measure user experience of these services.

6. Conclusion

In this paper we give an overview of user experience in using mobile technology to interact with voice-based services. We indicate that a theoretical framework developed for mobile user experience can be adapted and applied to voice-based services. This adaptation indicates that in most instances, there is an overlap in factors that impact on user experience of mobile technologies and of speech technologies. The framework is expanded when impact factors pertaining specifically to speech-driven services are added.

Our future research will involve applying this theoretical framework to real-world applications. First, using the critical factors described above, we will distil from the theoretical framework,
metrics for measuring mobile user experience for voice services. These metrics will then be used to measure user experience in two speech applications as case studies. We will report on the findings of this research in future papers.

7. ACKNOWLEDGEMENT

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Financial Inclusion in India: An Empirical Study on Penetration of Mobile Banking

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Abstract—Some important dimensions of financial inclusion are that all sections of the society should have timely and adequate availability of financial services to ensure access at affordable cost. In India, there has been a lot of policy discourse in the recent times on financial inclusion. This study attempts to measure and understand financial inclusion by looking at supply of and demand for financial services. Separate composite Financial Inclusion Indices (FIIs) using both the data sets are calculated for the year 2010-11 (as the most recent household level data available is for this year) for all the States/Union Territories of India. In both the cases, a lot of variation across states, even within a state between rural and urban regions is being observed. Thus, from a policy perspective, two things are relevant. One is to widen the ambit of policy initiatives under financial inclusion, which will reduce the dependency on informal source of financial services, particularly credit. Second, is to provide greater focus on vulnerable states/regions in providing access to financial services on which they are lagging.

Keyword: Financial inclusion, Mobile banking, policy disclosure

1. INTRODUCTION

Finance has become an integral part of an economy. Developed financial system drives real growth, while the growing economy’s demand leads to advancing the financial sector. Banking system/institutions play a vital role in facilitating the development of financial system.

As early as eighteenth century Adam Smith (1776) expressed the view about significant and crucial contribution of high density of banks for stimulating the development of the economy. In the early twentieth century Joseph Schumpeter (1912) contends that technological innovation and their successful implementation is promoted and stimulated by well-functioning banks. Finance can also play a positive role in poverty reduction. A well developed financial system accessible to all reduces information and transaction costs, influence saving rates, investment decisions, technological innovation, and long-run growth rates.

The chief mode of providing access to finance to poor strata of society that has emerged over the recent years is micro-finance, whose success is evidenced through the rich experiences of application of Yunus’ model of ‘micro-credit’ across sixty countries—both rich and poor. The idea behind the Grameen Bank in Bangladesh was to “extend credit to poor people and they will help themselves.” Further, as Yunus (1999) says, “Micro-credit is not a miracle cure that can eliminate poverty in one fell swoop. But it can end poverty for many and reduce its severity for other. Combined with other innovative programs that unleash people’s potential, micro-credit is
an essential tool in the search for poverty free world,” The role of micro-
finance extends beyond providing loans and becomes an important tool for
providing financial support to masses.

The denial of financial services and the conditions that lead to depriving
an individual or a group from the benefits of these services of any type like
access-exclusion, condition-exclusion, price-exclusion, marketing exclusion
or self-exclusion, also social deprivation or social standing comes under
financial exclusion. It can be due to many social and economic factors viz.
low household incomes, expensive source of credit, no savings and no
insurance coverage. This takes us to the issue of ‘financial inclusion’.

Report of the Committee on Financial Inclusion in India (Government
of India 2008) defines financial inclusion “as the process of ensuring access
to financial services and timely and adequate credit where needed by
vulnerable groups such as weaker sections and low income groups at an
affordable cost”. The World Bank (2008) considers financial inclusion as
access to financial services. It “implies an absence of obstacles to the use
of these services, whether the obstacles are price or non-price barriers to
finance”.

**Mobile Banking Penetration:** To ensure the financial inclusion in India
mobile banking creates new and convenient financial transactional channels for
mobile users which is accessible from anywhere, anytime. Recent report by Celent
says India has around 400 mn mobile subscribers, out of which 20 mn to 25 mn
are registered users of mobile banking. The penetration of India’s active mobile
banking user base is predicted to reach 2% (25 mn) by 2012, up from the current
0.2% (2.5 mn)."

India as a country becomes quite favorable to this kind of technology which
will not only benefit the masses, but will also take the country’s development to the
next level. What has been followed now is customization of this technology keeping
in mind the complexities which it faced for its growth. So, the eco-system of telcos,
banks, and small enterprises to make mobile banking beneficial and successful in
India, is the next big step in mobile banking.

1.1 Objective

In recent years, financial inclusion has assumed public policy relevance.
Many countries like India (Government of India 2008), United Kingdom
(UK) (2006) and International organizations like the United Nations (2006),
World Bank (2008, 2009) have set up committees to understand financial
inclusion and to improve its scope. However, the measurement aspect of
financial inclusion has, so far, not extensively been covered by these reports.
For India, being a very well diversified economy and society, it is imperative
to give adequate attention to measurement of financial inclusion (which
implies to evaluate the extent of accessibility, availability and usage of
financial services like saving, credit, insurance, remittance facilities among
many other such services) by policy makers and researchers.
There are few scholars who have attempted to measure some aspects of financial inclusion. Honohan (2007) estimated the fraction of the adult population using formal financial intermediaries using the information on number of banking and MFI accounts for more than 160 countries, and then correlated with inequality (Gini Coefficient) and poverty. Mehrotra (2009) also built up an index for financial inclusion using similar kind of aggregate indicators like number of rural offices, number of rural deposit accounts, volume of rural deposit and credit from banking data for sixteen major states of India. While World Bank (2009) analyzed the association between access to banking services, as measured by the number of bank accounts per thousand adults in each country, and several other factors like transactions offered at banks, or required by banks, and regulations adopted by country authorities and discusses about the availability of copious amount of data on many aspects of the financial system. But, systematic indicators of inclusiveness of financial sector are lacking.

Most of the studies discussed above used the financial depth measures (how much finance) rather than actual penetration or access measures (how many users). This set of information can be termed as supply side information, which presents only one side of the overall picture and is partial in nature. It has its own shortcomings; it does not distinguish between business and individual accounts, or between individual having multi-accounts, or on the adequacy and timeliness of loan amount, or information about informal service.

It is very important to look at the user’s side of financial inclusion too. This paper attempts to fill this gap by analyzing both supply and demand side information and providing a comprehensive picture of financial inclusion in India by mobile banking penetration. It attempts to measure and understand financial inclusion by looking at supply of and demand for financial services.

2. Indices for Financial Inclusion

In discussing, financial inclusion we are referring to the formal financial system. In the Indian context, the formal system comprises Scheduled Commercial Banks, Regional Rural Banks, Co-operatives, Post Offices, Insurance companies and their associates. Separate composite Financial Inclusion Indices (FIIs) using both the data sets for 20010-11 (the latest year for which demand side data are available) are calculated for all the States/Union Territories of India and used as complementary to each other to get a comprehensive picture. Using the household level data, it also analyzes the role of informal sector vis-à-vis formal sector, particularly, with regard to credit.
2.1 FII Based on Banking Penetration

For banking penetration indicators like the number of bank accounts per 100 adult persons, number of bank branches per million people (as availability of banking services or as coverage), number of ATMs per million people (as coverage), amount of bank credit and amount of bank deposit (as use/output of the banking system) have been used to indicate the extent of financial inclusion. These indicators are largely from banking sector; they do not cover other institutional sources like post-offices, Micro-Finance Institutions and co-operatives.

The present study proposes to use six indicators1. These are:

1. Number of deposit accounts per person (as access or penetration)
2. Number of credit accounts per person (as access or penetration)
3. Number of bank offices per person (as availability)
4. Average saving amount per deposit account (as usage/depth of the financial system)
5. Average credit amount per credit account (as usage/depth of the financial system)
6. Proportion of credit utilized to credit sanctioned in the state (as usage)2

The FII index for banking penetration uses distance-from-average method. First, for each indicator, the actual value is divided by the overall average of that indicator,

\[ I_q^t = \frac{X_q^t}{X_q^{\*}} \]

where

\[ X_q^t \] is the value of indicator \( q \) for the state \( s \) at time \( t \),

\[ X_q^{\*} \] is the mean value of indicator \( q \) for all the states at time \( t \).

\( q = 1, 2... 6 \)

Subsequently, the average of all the indicators gives us the proposed supply side composite index – FII,6

\[ \text{FII}^B = \frac{\sum_{q=1}^{6} I_q^t}{6} \]

2.2 FII Based on Household Level Access

The discussion on supply side indicators gives us a picture of financial system penetration. To contextualize this with the demand for financial services, the current chapter proposes to measure financial inclusion at

1Due to unavailability of Insurance data of the State level in the public domain, this index does not include the insurance component.

2In the above six indicators, the first three indicators have been normalized by population size, and the next two are normalized by the respective number of accounts. In addition, a sixth indicator has been added, which will indicate the flow of credit in a particular state.
household level by using information on saving, credit and insurance. The penetration of informal sources is also discussed in this section. Measures of household level inclusion, as a proxy of demand for financial services, give us a comparative picture across states, separately for rural and urban India.

The following sets of variables have been used for developing the indices for measurement of financial inclusion at the household level:

1. Formal Saving includes share and debentures owned by the household in cooperative societies & companies, government certificates, RBI bonds, deposit in post office, co-operative society/bank, Non-banking Company and other financial assets.
2. Formal Insurance includes insurance premium, annuity certificates and provident fund.
3. Formal Credit includes cash loans payable by the households to institutional agencies.
4. Informal Saving includes chit contribution, deposit with individuals, cash in hand, promissory note, mortgage of real estate, pledge of bullion & ornaments/other moveable property, receivable unsecured loan, receivable professional dues, trade credit and kind loans and others.
5. Informal Credit includes cash loans payable by the households to non-institutional agencies.
6. Informal Insurance (there is no variable which provides information on informal insurance).

As the indicators are all in percentages, they are normalized with a minimum of zero and maximum of hundred. Equal weighted averages of the indicators have been used to calculate composite financial inclusion index for the demand side. The index is the average of these three components (in case of formal sources) and average of two components – Saving and Credit only3-(in case of informal sources), which indicates the status of availed financial services.

\[ FIIFH = \frac{\sum q X_{tq s}}{3} \]

where,

\[ X_{tq s} \text{ is the value of indicator } q \text{ for the state } s \text{ at time } t \]

\[ q = \text{Formal saving, credit and insurance} \]

\[ FIIIH = \frac{\sum q X_{tq s}}{2} \]

where,

\[ X_{tq s} \text{ is the value of indicator } q \text{ for the state } s \text{ at time } t \]

\[ q = \text{Informal saving and Informal credit} \]

3At a household level, pledging/mortgaging of assets/property is a coping strategy to tide over some difficulties. Thus, investments in assets/property also have an insurance role. In any case, informal insurance have not been covered in AIDIS.
2.3 Data
This study has used the data from Reserve Bank of India’s publication titled Basic Statistical Returns of Schedule Commercial Banks in India (earlier known as Banking Statistics) for the year 2010-11. The data are collected through the annual statistical surveys, Basic Statistical Returns (BSR)-1 & 2, from the scheduled commercial banks in India including Regional Rural Banks.

BSR defined the population groups as follows:
1. ‘Rural’ group includes all centers with population of less than 10,000.
2. ‘Semi-urban’ group includes center with population of 10,000 and above but less than 1 lac.
3. ‘Urban’ group includes center with population of 1 lacs and above but less than 10 lacs.
4. ‘Metropolitan’ group includes centre with population of 10 lakh and more.

In the current chapter, rural group is the same whereas urban includes the latter three groups. For normalization of indicators like number of deposit accounts per person we have used census 2001.

For household level information, NSS unit level data from the 59th round has been used, which is All India Debt and Investment Survey (AIDIS) for 2002-03. The survey gives basic quantitative information on assets, liabilities and capital expenditure in the household sector of the economy during July 1, 2002 to June 30, 2003. For calculating an index, the data on saving, credit and insurance has been used.

3. Results and Analysis
3.1 Analysis and Findings of Supply Side Index- Banking Penetration
To address the inherent limitation of availability of institutions (bank branches) at the state level, even after normalizing for population, efforts have been made in this part to analyze the penetration of the financial services at rural and urban level separately, apart from the overall state level analysis. Thus, the distance method has been used to build an index (Table 1). The analysis reveals a fragmented development of financial system within India. This is evident from the fact that the supply side financial inclusion index of banking penetration (FIIB)
Table I: FII Across States (Overall, Rural and Urban) and Their Ranks using Six Indicators of Banking Stretch

<table>
<thead>
<tr>
<th>States/Regions</th>
<th>Index State</th>
<th>Rank State</th>
<th>Index Rural</th>
<th>Rank Rural</th>
<th>Index Urban</th>
<th>Rank Urban</th>
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<tr>
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<td>0.88</td>
<td>14</td>
<td>0.99</td>
<td>12</td>
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<td>1.43</td>
<td>4</td>
<td>1.27</td>
<td>7</td>
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<td>0.86</td>
<td>17</td>
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<td>5</td>
<td>1.11</td>
<td>8</td>
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<td>0.79</td>
<td>23</td>
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<td>1.88</td>
<td>3</td>
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<td>1</td>
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<td>3.32</td>
<td>1</td>
<td>1.67</td>
<td>3</td>
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<td>5</td>
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<td>24</td>
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<td>11</td>
<td>1.29</td>
<td>6</td>
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<td>7</td>
<td>1.24</td>
<td>7</td>
<td>0.85</td>
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</tbody>
</table>

Source: Calculated from Basic Statistical Returns of Schedule Commercial Banks in India, 2010-2011

Value of the top state (Chandigarh) is more than six times that of the bottom state (Manipur). In rural areas the difference between the top (Delhi) and bottom (Manipur) is close to eight times and in urban areas the difference between the top (Chandigarh) and bottom (Manipur) is nearly four times. While comparing the economic development of the state (in terms of per capita income) vis-à-vis the penetration of the banking services, it is observed that states like Goa, Delhi, Chandigarh, Pondicherry, Maharashtra, Kerala and Karnataka have performed better in both the parameters. This reflects a larger spread of services among people in the states which are better developed. In some situations, it has been observed that the penetration of financial service is concentrated among a smaller
segment of population. This is evident from the number of deposit and credit accounts being very low than the average, but the average deposit and credit amount per account being substantially higher than the average, (Mizoram and Rajasthan, respectively)

The above analysis does provide us an insight into the performances of the states with respect to penetration of the financial services from banks. The supply side indicators of financial inclusion provide information about capturing availability and to some extent accessibility and usage dimensions of financial inclusion. But, fail to provide information about its users with regard to their social groups, wealth (asset size) and any other relevant aspects and certain other dimensions like affordability and timeliness

A weakness with this kind of data is its availability at aggregated form or with very less number of classifications. In such kind of representations, it is difficult to have information about inequality in quantum of credit allocation within the borrowers. Another important drawback using supply side indicators is the unavailability of data or information pertaining to financial services provided by informal sector. In order to have a comprehensive measurement, it is imperative to look into the demand for financial services.

3.2 Demand for Financial Services in India- Household Access

The household level analysis gives an alternative picture. At the aggregate all India level, access to formal sources is about one out of every three households for savings, less than one out of five households with regard to credit, and one out of eight for insurance. Combining all the sector, the value of FIIFH is 0.208 (Table III).

In case of rural India, access to saving and insurance facilities’ from formal sources is relatively low. The proportion of population who do not have access to any kind of saving and insurance facility from formal institutions is three-fourth and four-fifth respectively. Credit access is relatively better in the rural areas.

Whereas, a better position of access to saving and insurance have been observed in urban India but credit services are not that much striking as savings and insurance are. Less than one household out of seven has credit access in urban India. Overall, financial inclusion index from formal sources for households, FII, is better for urban (with a value of 0.29) compared to rural (with a value of 0.18).

---

7For example, in the case of BSR there are two categories of borrowers - small (less than Rs. 2 lacs) and others. With regard to saving accounts, there are no classifications as per amount.

8Informal sectors are defined as all other non-institutional sources, like chit fund, money lender or friends and relatives.
### Table II: Indicators of Banking Stretch and Their Ranks Across States (Overall)

<table>
<thead>
<tr>
<th>States/UTs/Regions</th>
<th>Deposit a/c per</th>
<th>Rank</th>
<th>Credit a/c per</th>
<th>Rank</th>
<th>Branches per person</th>
<th>Rank</th>
<th>Avg. Rs per deposits a/c</th>
<th>Rank</th>
<th>Avg. Rs per Credit a/c</th>
<th>Rank</th>
<th>Credit utilized</th>
<th>Rank</th>
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<td>9</td>
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<td>13</td>
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<td>17</td>
<td>376.5</td>
<td>23</td>
<td>990.9</td>
<td>0.99</td>
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<tr>
<td>Haryana</td>
<td>0.335</td>
<td>9</td>
<td>0.048</td>
<td>12</td>
<td>0.076</td>
<td>16</td>
<td>240.6</td>
<td>21</td>
<td>1324.7</td>
<td>7</td>
<td>1.32</td>
<td>5</td>
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<td>0.057</td>
<td>17</td>
<td>0.131</td>
<td>3</td>
<td>239.9</td>
<td>23</td>
<td>1522.7</td>
<td>19</td>
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<td>3</td>
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<td>13</td>
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<td>262.7</td>
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<td>Credit a/c per Rank</td>
<td>Branches per Rank</td>
<td>Avg. Rs per deposits a/c Rank</td>
<td>Avg. Rs per Credit a/c Rank</td>
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<td>0.051 7</td>
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<td>0.074 17</td>
<td>299.6 10</td>
<td>1249.3 6</td>
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<td>0.04 18</td>
<td>0.074 17</td>
<td>299.6 10</td>
<td>1249.3 6</td>
<td>1.25 6</td>
<td></td>
<td></td>
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<td>0.11 4</td>
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<td>All India</td>
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<td>0.066 28</td>
<td>296.1 1000</td>
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<td>1</td>
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</table>

Note: a/c denotes accounts, Avg. denotes average, Rs denotes Rupees. Credit utilized is as a ratio of credit sanctioned.

Source: As in Table 1

Table III: FII of Demand for Financial Services at All India using Household Level Access for Saving, Credit and Insurance by Source

<table>
<thead>
<tr>
<th>Sources</th>
<th>Total/Rural/Urban</th>
<th>Saving</th>
<th>Credit</th>
<th>Insurance</th>
<th>Index †</th>
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<td>Formal</td>
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<td>All India (Total)</td>
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<td>0.128</td>
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<tr>
<td>All India (Rural)</td>
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<td>0.081</td>
<td>0.178</td>
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<td>All India (Urban)</td>
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<td>0.138</td>
<td>0.552</td>
<td>0.288</td>
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<td>Informal</td>
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<td></td>
</tr>
<tr>
<td>All India (Total)</td>
<td>0.037</td>
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<td>-</td>
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<td>All India (Rural)</td>
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<td>0.475</td>
<td>-</td>
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<td>All India (Urban)</td>
<td>0.058</td>
<td>0.182</td>
<td>-</td>
<td>0.12</td>
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<tr>
<td>Combined</td>
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<td>(Formal and Informal) #</td>
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<tr>
<td>All India (Total)</td>
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<td>0.496</td>
<td>0.296</td>
<td>0.252</td>
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</table>

Note: FII denotes Financial Inclusion Index, it lies between zero (no inclusion) and unity (full inclusion). Saving, Credit and Insurance are incidences that also lie between zero and unity.

†The calculation of the Index (FII) is a simple average of the incidences given for Saving, Credit and Insurance. For Informal sources, the Index has been calculated by taking the average of saving and Credit.

#Formal and informal do not add up to combined, as they are not mutually exclusive.
A state-wise analysis of demand for financial services shows huge disparity across states. A careful examination of the regional disparity in the level of financial inclusion shows that southern states perform better than states of other region. The next best performers are western and northern states, while the index value for eastern and north eastern states are below the average. Some states/union territories with good ranking are Kerala, Andaman, Chandigarh, Himachal Pradesh, Pondicherry, Maharashtra, Lakshadweep, Tamil Nadu, Daman, Punjab, Gujarat, and Goa. Across the three better-off regions, saving and insurance coverage has been relatively higher for states of Punjab, Himachal Pradesh, Kerala, Tamil Nadu and

Maharashtra as also in all the union territories. All north-eastern and eastern states rank at the bottom heap, with Sikkim being an exception with its index value close to the all India average. Nagaland (with a relatively good insurance coverage) and Tripura are better covered by the formal sources as compared to their neighboring states. Relatively poorer states like Bihar, Jharkhand, Chhattisgarh, Orissa, Rajasthan, Uttar Pradesh, and Madhya Pradesh are well below than average. However, some states like Orissa, Chhattisgarh, and Madhya Pradesh have relatively better access to formal sources. As discussed earlier, FII constitutes the three components of savings, credit and insurance. However, a good access to one of these components does not imply good access to another component, nor does a better average value imply good access to each of these three components. Some states like Andaman, Chandigarh and Himachal Pradesh rank high on the composite index due to good saving and insurance coverage, whereas Pondicherry has good credit and insurance but does not have a good coverage in the formal sector. The examination reveals that almost all the major states of India showed high dependence on informal sources for credit. However, the states like Himachal Pradesh, Goa, Maharashtra and Chandigarh, where formal financial system is well penetrated, had low demand for informal sources.

To have clear picture with regard to both sources of credit, the access to credit has been further evaluated at composite level of credit sources viz. formal, informal and both in a mutually exclusive manner. The above categorization enables us to understand the dimensional aspects in financial inclusion. Access to formal sources of credit by household indicates availability and accessibility of credit, whereas dependence on informal sources points out that credit is either not available or not accessible, but at the same time being affordable. The combined category of access to credit from both sources reveals the possibility of either inadequate or untimely credit access from formal sources.

\[\text{In this section, the term formal and informal classify the section of households who have exclusively availed credit only from formal and informal sources respectively. The term both is intended to refer to the households who have availed credit both these sources.}\]
3.3 What is Overall Status of Financial Inclusion?

It is very difficult to measure the actual situation of financial inclusion either based only on banking outreach or only household level access. Both the data sources have their own limitations. The former information was limited because data from formal sources like co-operatives and post-offices could not be used. By design, it also excluded data from informal sources. The latter data source looked into household level information on access or usage for saving, credit and insurance from formal sources and saving and credit from informal sources. Reliance on informal sources of credit also indirectly raises the questions of affordability, inadequacy and timeliness of the formal sources.

4. Concluding Remarks

This study attempts to measure and understand financial inclusion by looking at supply of and demand for financial services. Separate composite Financial Inclusion Indices (FIIs) using both the data sets are calculated for the year 2010-11 for all the States/Union Territories of India and used as complementary to each other to get a comprehensive picture. In both the cases, even within a state, differences are clearly evident between rural and urban areas for the different indicators considered. The presence of informal sector in providing financial services is significant, especially in rural areas. Thus, from a policy perspective, two things are relevant. One is to widen the ambit of policy initiatives under financial inclusion, which will reduce the dependency on informal source of financial services, particularly credit. Second, is to provide greater focus on vulnerable states/regions in providing access to financial services on which they are lagging. Truly, there is need for A Hundred Small Steps, but without losing sight of the most vulnerable groups, regions or states.

Table IV: Incidence of Household Access to Credit Across States (Overall) and Its Share by Source (Percent)

<table>
<thead>
<tr>
<th>States/UTs/Regions</th>
<th>Share Household Access</th>
<th>Household Access</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Formal Only</td>
<td>Informal Only</td>
</tr>
<tr>
<td>Northern Region</td>
<td>32.59</td>
<td>56.53</td>
</tr>
<tr>
<td>Haryana</td>
<td>36.94</td>
<td>44.94</td>
</tr>
<tr>
<td>Himachal</td>
<td>52.53</td>
<td>38.15</td>
</tr>
<tr>
<td>Jammu and Kashmir</td>
<td>53.56</td>
<td>42.48</td>
</tr>
<tr>
<td>Punjab</td>
<td>54.19</td>
<td>54.92</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>28.23</td>
<td>63.73</td>
</tr>
<tr>
<td>Chandigarh</td>
<td>66.88</td>
<td>29.05</td>
</tr>
<tr>
<td>Delhi</td>
<td>18.97</td>
<td>78.93</td>
</tr>
<tr>
<td>North-Eastern Region</td>
<td>20.58</td>
<td>78.64</td>
</tr>
<tr>
<td>Arunachal Pradesh</td>
<td>33.75</td>
<td>60.1</td>
</tr>
<tr>
<td>Assam</td>
<td>14.07</td>
<td>84.96</td>
</tr>
<tr>
<td>Manipur</td>
<td>3.96</td>
<td>95.36</td>
</tr>
<tr>
<td>Meghalaya</td>
<td>26.34</td>
<td>73.66</td>
</tr>
<tr>
<td>Mizoram</td>
<td>42.06</td>
<td>57.43</td>
</tr>
<tr>
<td>Nagaland</td>
<td>29.48</td>
<td>70.4</td>
</tr>
</tbody>
</table>
## Table V: Overall Comparative Status of Financial Inclusion Across States/UTs from both Supply and Demand Sides

<table>
<thead>
<tr>
<th>States/UTs/Regions</th>
<th>Share Access</th>
<th>Household Access</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Formal Only</td>
<td>Informal Only</td>
</tr>
<tr>
<td>Tripura</td>
<td>50.5</td>
<td>49.38</td>
</tr>
<tr>
<td>Eastern Region</td>
<td>34.03</td>
<td>60.32</td>
</tr>
<tr>
<td>Bihar</td>
<td>17.24</td>
<td>80.34</td>
</tr>
<tr>
<td>Jharkhand</td>
<td>46.62</td>
<td>51.87</td>
</tr>
<tr>
<td>Orissa</td>
<td>49.94</td>
<td>41.34</td>
</tr>
<tr>
<td>Sikkim</td>
<td>49.15</td>
<td>47.52</td>
</tr>
<tr>
<td>West Bengal</td>
<td>36.88</td>
<td>56.02</td>
</tr>
<tr>
<td>Andaman</td>
<td>59.23</td>
<td>34.67</td>
</tr>
<tr>
<td>Central Region</td>
<td>36.44</td>
<td>53.21</td>
</tr>
<tr>
<td>Chhattisgarh</td>
<td>54.52</td>
<td>33</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>41</td>
<td>42.64</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>31.64</td>
<td>60.98</td>
</tr>
<tr>
<td>Uttarakhand</td>
<td>54.36</td>
<td>40.81</td>
</tr>
<tr>
<td>Western Region</td>
<td>59.17</td>
<td>31.94</td>
</tr>
<tr>
<td>Goa</td>
<td>85.89</td>
<td>11.25</td>
</tr>
<tr>
<td>Gujarat</td>
<td>41.52</td>
<td>51.33</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>68.48</td>
<td>21.66</td>
</tr>
<tr>
<td>Dadra &amp; Nagar</td>
<td>24.09</td>
<td>73.89</td>
</tr>
<tr>
<td>Daman &amp; Diu</td>
<td>12.13</td>
<td>87.09</td>
</tr>
<tr>
<td>Southern Region</td>
<td>30.61</td>
<td>54.46</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>21.41</td>
<td>63.3</td>
</tr>
<tr>
<td>Karnataka</td>
<td>38.21</td>
<td>52.56</td>
</tr>
<tr>
<td>Kerala</td>
<td>59.35</td>
<td>17.49</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>26.36</td>
<td>59.8</td>
</tr>
<tr>
<td>Lakshadweep</td>
<td>48.85</td>
<td>47.66</td>
</tr>
<tr>
<td>Puducherry</td>
<td>24.95</td>
<td>63.65</td>
</tr>
<tr>
<td>All India</td>
<td>36.12</td>
<td>52.88</td>
</tr>
</tbody>
</table>

Source: As given in Table III.

### Table V: Overall Comparative Status of Financial Inclusion Across States/UTs from both Supply and Demand Sides

<table>
<thead>
<tr>
<th>Demand Side</th>
<th>Supply Side</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>CN, KE, MA and HP</td>
<td>NA</td>
</tr>
<tr>
<td>Medium</td>
<td>GO, SI and PU</td>
<td>KA, AP, UT, HR, TN and GU</td>
</tr>
<tr>
<td>Low</td>
<td>DE</td>
<td>WB</td>
</tr>
</tbody>
</table>

Source: Tables I and III.

Note: 1. High stands for >1.1 (supply side) and > 0.3 (demand side)
2. Medium is >0.9 but < 1.1 (supply side) and between 0.2 to 0.3 (demand side)
3. Low is less than 0.9 (supply side) and less than 0.2 (demand side)
4. All India average is 1 (supply side) and 0.208 (demand side)
5. NA = Not applicable
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[8] Reserve Bank of India (RBI) 2008, 13 May circular on technology


An Appraisal of the Transformational Potential of the M-Banking Model

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Abstract—This short paper presents a preliminary insight into the transformational potential of the Mobile Banking model in serving as a platform to connect to the larger formal financial landscape. To this end, a preliminary prototype of M-Banking as a physical and electronic link was tested in Western Uganda, and the customer feedback noted through demographic surveys, informal and semi-structured interviews. In presenting a sub-set of the larger research data during this three month pilot, this paper situates the transformational potential of the M-Banking model through its ability to serve unbanked as well as underbanked population(s), to transform access into usage, to achieve scale, and to include a host of financial options and (potentially) service providers.

1. OVERVIEW OF TRANSFORMATIONAL M-BANKING MODELS

Mobile Banking is a type of branchless banking that can bring financial instruments to populations that are not served by brick and mortar branches. Indeed, the elements of mobile banking can be situated within the elements of branchless banking; in that branchless banking, and therefore m-banking, can be characterized by the technology platform that can authorize unique customer access and complete electronic transactions (mobile phone); the structural facilities to trade against electronically valued currency (mobile money); the classification of non-bank third-party outlets that can handle cash-in and cash-outs (typically retail outlets constituting a part of a larger agent network); basic cash-in-cash-out services provided by government-authorized deposit-taking institutions, and the accessibility to substitute for a physical bank branch at the customer end [1]. As Porteous first articulated [2], mobile banking models can be either additive, where the model provides an supplementary platform for conducting financial transactions, or transformational, where the model makes an entry into unserved regions as the exclusive platform for conducting financial transactions.

The concept of transformational m-banking models is compelling, as it presents the capacity to transform the financial landscapes of hitherto unserved regions. Porteous went on to operationalize transformational impact using the access frontier methodology that separates usage of a product from access to it, based on prevailing terms and conditions [3]. Porteous further concludes [4] that the transformational potential of M-banking ventures can be characterized by the capacity to bring financial services to unbanked populations at sufficient scale. Such scale may be achieved by addressing the specific needs of unbanked populations, while striving not to homogenize these needs. Therefore, a transformational M-banking model may need to include a complete suite of financial services that go beyond the current facilities of remittances, micropayments, and micro-transfers. Further, to emulate the principles of financial inclusion,
transformational M-banking models may need to encourage competitive options from multiple financial services providers [5].

Interestingly, there has been some speculation that mobile banking may be evolutionary rather than transformational, in that the underbanked populations may be the first to create an identifiable and quantifiable demand for such services and thus, start using them immediately [6]. Clearly, underbanked populations are invested in some form of financial services and the underutilization of these may be a result of a lack of knowledge, a lack of interest, a lack of engaged participation by financial service providers, and expensive accessibility [6, 7]. Therefore, M-banking as an additive platform may indeed transform access into usage if the alternative solutions are able to address some of the aforementioned issues. Further, an additive platform may encourage potential users to diversify their financial portfolios that may help distribute risk across different financial instruments. Having manifold options reduces the dependency on, and possibly the underutilization of, an exclusive solution in an underserved landscape. As the literature is observing, the poor are capable of managing their own financial decisions, and thus choosing their financial services accordingly, as long as multiple, suitable options are available [8].

This note demonstrates the findings from a three month pilot that was conducted in Western Uganda to test an M-Banking solution that extended access to formal bank accounts in unserved regions by leveraging a non-traditional service provider (bank on wheels) on the mobile backbone. By reaching out to unbanked populations, the pilot model aimed to be transformational. However, in providing multiple services within the solution, the model was able to address some of the many diverse needs of the target population.

2. Introduction to the FinLit Project
The FinLit model was designed to enable the forward flow of money from informal savings devices (such as from under the mattress) and semi-formal savings devices (such as village savings groups) into the local M-Banking product, and then finally into a formal bank account. This was realized through a physical link between the potential customer and the M-Banking product, where customers took money out of their homes and deposited it into their M-Banking accounts, and then between the M-Banking product and the formal bank account where customers withdrew money from the former and deposited it into their bank accounts. Since, the FinLit model was tested in regions that did not have physical bank branches, a partnership was forged with PostBank, a national bank, as it had recently started a mobile bank-on-wheels which serviced the pilot sites on a weekly basis. Thus, the FinLit model combined the weekly access that the PostBank van provided with the constant access that the local M-Banking product and agent network provided. To illustrate, if a customer needed to find a safe place
to store his money on a day that did not coincide with the PostBank van’s weekly schedule, he could store it in his M-Banking account temporarily, and transfer the amount immediately to the bank account when the van visited next, or when enough had been accumulated (for instance, when it could earn interest) to warrant this move. Customers were also encouraged to leave some amount in their M-Banking accounts which they could access on days other than the one that was serviced by the PostBank van. In this way, the M-Banking wallet was conceptualized as a temporary storage wallet, while serving as a physical link to a formal bank account.

The pilot also tested a restricted and human-enabled electronic link to facilitate constant access to the PostBank accounts, a facility that the van was unable to provide on its weekly schedule. Due to resource constraints, a human-enabled link was conceptualized and implemented in the latter stages of the pilot. Theoretically, the link connected customers directly to their bank accounts on the M-Banking platform. In practice, the customer transferred cash directly to a dedicated PostBank staff using the local M-Banking service. This dedicated staff member was responsible for then transferring this cash into the customer’s bank account. The transaction was authenticated at the M-Banking end by the matching of the customer phone number and unique PIN, and at the PostBank end by the matching of the signature initials of the customer and the account number (details that the customer provided during the M-Banking transaction) to his/her phone number. An SMS receipt was sent to the customer as soon as the transaction completed.

3. Methods & Findings

Demographic surveys were conducted with 92 informants who had opened an account with PostBank. 55 new customers or 60% of these were previously unbanked. The sample was also investing in assets such as livestock (17 or 19%) and keeping money at home (29 or 32%). Thus, 50% of the sample was already using informal instruments prior to signing up for a PostBank account. 958277274960% of the sample was earning variable incomes, in that they did not take home a fixed amount at the end of each month. 30% of the sample was earning a monthly salary of upto US $46.20, or less than $2 a day. The demographic survey findings are summarized below:

However, it was observed in the preliminary stages of the pilot that FinLit customers were transacting directly with either their M-Banking accounts or the PostBank van. 16 informal interviews were conducted to clarify these observations. 13 informants responded that they were unable to understand the value of their M-Banking accounts in serving as a physical link to their bank accounts. Since, this link on the M-Banking platform was conceived to impart temporal continuity to the FinLit model, 30 semi-structured interviews were conducted with PostBank customers to understand their reaction to the weekly schedule of the PostBank van.
Fig. 1: Nature of Income Flows

Fig. 2: Monthly Income Range

Fig. 3: Banked Population
23 or 77% of the informants stated that they were satisfied with the weekly frequency of the van. 21 informants articulated the various reasons for this:

Table 1: Reasons for Satisfaction with Weekly Frequency of PostBank Van

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Number of Informants</th>
<th>Vignettes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly Savings Behaviour</td>
<td>8 informants</td>
<td>Informants said that the weekly schedule of the van helped structure their savings behaviour. They saved small amounts throughout the week, and deposited the accumulated amount into their accounts when the van came to their site(s).</td>
</tr>
<tr>
<td>Diversified financial Portfolios</td>
<td>6 informants</td>
<td>Informants said that the money that they deposited into their bank accounts was one part of their larger financial portfolio. Thus, the weekly access did not inhibit them as they could access other resources in emergency events.</td>
</tr>
<tr>
<td>Temptation to withdraw</td>
<td>3 informants</td>
<td>Informants observed that the weekly access to their bank accounts imposed a trivial barrier between them and their money, and therefore reduced the temptation to withdraw unnecessarily.</td>
</tr>
<tr>
<td>Distance</td>
<td>2 informants</td>
<td>Informants said that they could not undertake the considerable distance (between 1-7 kms across the pilot sites) to the PostBank van stop more frequently than once a week and therefore, the schedule suited them.</td>
</tr>
<tr>
<td>Rigid Timings</td>
<td>2 informants</td>
<td>Informants observed that the rigid schedule helped impart some discipline in their financial behaviour. Since the cost of missing the van was relatively high, informants who wanted to transact on that particular day had to ensure that they made the time for it.</td>
</tr>
</tbody>
</table>

In contrast, 7 or 23% of the informants said that they would prefer to have access to their bank accounts more frequently. The reasons given for this were:

3.1.1 Rigid Timings
Interestingly, 5 informants observed that the rigid timings in fact limited access to their money, and that they would prefer a more round-the-clock schedule.

3.1.2 More Frequent Transactions
2 informants said that they wanted the PostBank van to service their site(s) more frequently as they wanted to increase their transactions with their bank accounts.

Further, 24 electronic link users were surveyed to record their feedback to the shift onto the link. 88% or 21 informants had used the van before moving to the electronic link, while the remainder accessed the nearest physical branch. 92% of those surveyed responded that they chose to transact with the link because it was more convenient, sparing them both time and the trouble of commuting to the PostBank van during their restricted schedule.
4. Conclusion

This note presents the findings from a three month pilot in Uganda that positioned the M-Banking platform as a physical and electronic link between unserved regions and formal bank accounts. In providing an exclusive platform over which to connect with the formal financial landscape, the FinLit model served the fundamental stipulation of a transformational service. This is demonstrated through the demographic findings, where it is seen that 60% of the informants who had recently signed up for a PostBank account had previously possessed no formal bank account. 50% of the sample was already saving in informal devices. At this stage during the pilot however, it was difficult to ascertain if this segment of the sample would have discontinued the reliance on informal financial devices and instead, steadily increased their usage of formal savings instruments in a bid to diversify their financial behaviours.

The physical link positioned the M-Banking wallet as an interim storage device in the larger connection to formal bank accounts, in a bid to provide an integrated financial model (daily access of M-Banking combined with the weekly access of the PostBank van) that was available to customers on all days of the week. However, as the findings show, most informants were satisfied with the weekly service of the mobile van, and this rendered the function of the M-Banking wallet as a physical link to provide constant accessibility as trivial. Interestingly, the subsequent reaction to the electronic link and the convenience (and constant access) it afforded showed a marked preference for the same, although informants had previously noted their satisfaction with the weekly service of the PostBank van. Therefore, the electronic link as an additive platform may have been instrumental in a) transforming access into usage of formal bank accounts by including those segments of the population(s) that were not transacting with the PostBank van and in b) moderating the underutilization of the formal bank accounts by alleviating the access costs to the PostBank accounts through the PostBank van. Indeed, there is an interplay between the concepts of transformational and additive financial systems, and they need not be as disconnected as had previously been imagined.

Of course, achieving scale remains an important factor before a financial landscape can be said to have truly transformed. Leveraging the M-banking model as a committed connection to formal financial services for unserved regions remains a promising solution given the scale at which mobile phones have diffused in the developing world. Further, positioning the M-Banking backbone as a platform to link to formal financial services opens up access to areas with little or no presence for multiple formal financial service providers. This short paper provides a preliminary insight into the transformational potential of the M-Banking model as both a physical and electronic link to the larger financial landscape, and thus provides direction for similar future studies.
5. ACKNOWLEDGMENT

The author thanks AppLab at the Grameen Foundation, Post Bank and the Mobile service provider without whose active support the Fin Lit pilot (or this paper) would not have been possible. The author also thanks Dr. Olga Morawczynski and Julius Matovu of AppLab for their guidance and support during the FinLit tenure, as well as for their invaluable comments towards this paper.

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Challenges and Opportunities: 
A Case Study of Nokia

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Abstract—Over the last two decades, there has been an exponential growth in 
the number of mobile phone users. Worldwide mobile phone subscriptions grew 
from 12.4 million to over 4.6 billion, penetrating the developing economies. 
According to research firm International Data Corporation (IDC), the global 
mobile phone market ballooned in the first quarter of 2011, growing 19.8 percent 
year-over-year, especially in emerging markets. According to the firm’s Worldwide, 
Mobile Phone Tracker, vendors shipped 371.8 million units in first quarter 2011 
compared to 310.5 million units in the first quarter of 2010. Nokia remains the 
world’s largest mobile phone maker by volume, although its market share dropped 
from 34.7 percent to 29.2 percent year-over-year. The focus of this case study is 
the business strategy adopted and performance by Nokia in the Mobile devices 
market. Nokia has proven itself as one of the most recognized brands in the past 
two decade. This case also examines how the Nokia brand has emerged through 
all challenges and opportunity.

Keywords: Exponential Growth, Emerging Markets, Nokia
The Role and Impact of ICT in Microfinance

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Abstract—Microfinance services available to the poorest people, especially investment loans for micro-business development, are recognized as an important part of poverty reduction strategies. As the industry matures, MFIs face a competitive environment, forcing them to balance the goals of outreach and sustainability. However, in spite of its successes, microfinance has not been able to reach to the poorest of the poor particularly in the low density population areas of Madhya Pradesh, Orissa, Bihar, Uttar Pradesh etc. in India. The main reason behind this gap is the cost of credit delivery. Information and communication technology (ICT) is an important driver and the great hope, although it brings with it fundamental changes to the microfinance delivery mechanisms that have become almost sacred for the microfinance sector. This research is at the intersection of inquiry on ICT for development and the digital divide, the impact of microfinance, and the use of ICT in the financial services industry. We discuss the role and impact of ICT on outreach and sustainability at the industry levels

Keywords: Information and Communication Technology, Microfinance, Outreach, Sustainability
Intermediaries on the Move: A Research-in-Progress on the Impact of Mobile Technology on the Intermediary Role

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Abstract—The overwhelming majority of people living in underdeveloped countries do not have the technological resources to physically connect to the Internet. Even when they do, e.g. through public access points such as telecenters or cybercafés, they do not know what information is available or how to access them. The high illiteracy rate further exacerbates this problem.

Two developments have promises to ease this problem. The first is the emergence of intermediaries who are entities, individuals or organizations that bring the Internet to the users in developing countries by providing a variety of services including physical connectivity and informational access to those who do not have such access. Examples of such intermediation include service access points for eGovernment services, supporting health care, activism on behalf of slum dwellers, and participation in democratic discourse. While they have had some success in bridging the digital divide, their sustainability remains a concern.

The second development, the advent and spread of mobile technology has possibilities to ease this concern. More than any other technology, mobile phone penetration has increased at a breathtaking rate in developing countries. For example, in Tanzania between 2000 and 2010, mobile phone subscriptions have skyrocketed from 110,000 to 21 million and a full 47% of the population own mobile phones. In all likelihood, a larger percentage of the population has access to a mobile phone since often the same phone is used by several users. The immense potential that mobile technology has for development cannot be overemphasized: this conference itself is a testimony for that. It remains for research and practice to examine in-depth how specifically and in what ways, nuanced perhaps, mobile technology can impact development. In the specific problem formulation of our research project, the question is:

How does mobile technology impact the intermediation process in bringing the Internet to users who do not have resources or capabilities of their own?

From a study on the potential impact of mobile technology on poverty reductions, we have seen that people of higher economic status and engaged in business activities believed that mobile phone use had benefitted them. By contrast, those of lower income and status did not believe that they will gain any benefit. This is the precise group who has little knowledge about Internet as a resource and the information available on it. In other words, these are the very people whom require intermediaries. It is therefore important to study how mobile technology can affect the intermediation process. This is the aim of our project, and we are gathering data in two developing countries, Tanzania and Indonesia. We have been conducting research in these two countries for almost 2 decades now, specifically focusing on the spread and use of the Internet, and we have already identified intermediaries. We are using a qualitative approach and we are interviewing intermediaries, users and other stakeholders in the sites we have visited a number of times. We will continually analyze the data during our project and present and discuss the preliminary results at the conference.
Digital Technologies and the Imaginary of Uses in the Developing World: Mobile Phone Inroads in the Côte d’Ivoire’s Social Fabric

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Abstract – The development of the mobile phone industry in Côte d’Ivoire has been largely boosted by the people’s resourcefulness. Meaningful discourses around this technology started to emerge in the country when its uses became widespread. This article claims that there is an imaginary of uses, and considers the digital imaginary as consecutive to digital innovation. Lundby (2009) discusses the concept of “mediatization” which refers to how mediating technologies shape social life. This paper argues that the mobile phone, as a digital technology, has contributed to shape the way Ivorian perceive and speak of their day-to-day lives, that practices around the mobile phone have generated new narratives, new discourses, and new terminologies in social interactions.

1. Introduction

This paper is an attempt to retrace the process through which the mobile phone has succeeded in establishing itself as part of the Ivorian cultural life. It examines the emergence of digital imaginary in the Ivorian context. Charles Taylor refers to social imaginary as “the ways people imagine their social existence, how they fit together with others, how things go on between them and their fellows, the expectations that are normally met, and the deeper normative notions and images that underlie these expectations.” (Taylor, 2004: 23) Embedded in this conception is the notion of shared understanding, or what Stuart Hall (1997) calls a “shared conceptual map” in a given community. Drawing from this concept, I understand digital imaginary as an authentic mode of appropriation of a given digital technology, which becomes an integral part of social practices, generates new discourses and, provides new symbols for social interactions. McLuhan (2001: 20) suggests that popular language is an immediate barometer of the structural changes that a given innovation introduces in society. Subscribing to such notion, I claim the centrality of technologies in the social changes process, their capacity to transform social structures, the forms of human associations, as well as thinking processes. Close to this perspective is the concept of “mediatization” which, as Sonia Livingstone puts it, implies that “everyday practices and social relations are historically shaped by mediating technologies and media organizations.” (Lundby, 2009: x) I discuss how the mobile phone, as a digital technology, has contributed to how Ivorians perceive and speak of their day-to-day lives, how practices around the mobile phone have generated new narratives, new discourses and new expressions in social interactions.
2. The Mobile Phone in Côte d’Ivoire: Growth and New Practices

Introduced in Côte d’Ivoire in 1996, wireless phone uptake grew exponentially. In 2011, the mobile penetration rate in the country reached 59%, with 5 mobile operators sharing a market of 15 million customers. Shortly after the introduction of mobile telephony in the country, mobile booths, namely the use of one’s mobile phone as a public phone booth, made their appearance. Soon after, they became a legitimate income-generating activity for a respectable size of the population. Mobile phone operators fed the mobile booth practices, despite their illegal status, by developing prepaid cards and establishing structures that insure their wide availability. Thanks to its affordability and its accessibility, the mobile booth practice has indeed become central to the network of social communications, fully integrated into the socioeconomic life of the Ivorian people. (See Kamga, 2005) It has become part of the many informal activities upon which the Ivorian economy rests.

In 2009, a new phenomenon appeared and grew: more and more booth owners are now transferring money with the mobile phone, without having to appeal to any financial institutions. The concept is based on the use of airtime as a monetary value. Mobile booth managers have succeeded in showing that money transfer has its place in the Côte d’Ivoire mobile phone industry. Just as for the mobile booth itself, there is no legal framework for mobile phone money transfer. However, the affordability and the availability of this service attract more and more people, especially those out of the banking system. This type of operation works well with booth owners who have enough cash on hand to meet customers’ needs. Clearly, it is a practice that consists of “poaching” (de Certeau, 1990) the mobile phone industry. This form of money transfer became highly acceptable in 2010 when the World Food Program (WFP) launched a pilot project to reach Ivorian affected by the civil war. The project partnered with MTN, a mobile operator, to facilitate money transfers to 54,000 people in poor Abidjan communes, to help them buy some food. The WFP Director in Côte d’Ivoire, Alain Cordeil, noted that “this innovative method of payment” was “particularly suitable for households with low purchasing power.” A total of 1.6 million dollars was made available for the project, with the last instalment expected in late October 2011.

To take advantage of this innovative use of their network, operators are now studying to develop a business model that would allow them to grasp their share of the money transfer practice. An inspiring avenue is the Smart Money model introduced in the Philippines in 2000 by Smart

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1Http://news.abidjan.net/h/352349.html (Consulted on November 24, 2011)
As noted by Sharon Smith (2004:1), “Smart Money enables users to transfer money from a bank account to a Smart Money account. Subscribers can then use a Smart Money card like a debit card to pay for a variety of goods and services at a network of retail stores and restaurants.”
Communications, Inc., a model that requires a partnership with the banking system. However, Côte d’Ivoire is not there yet.

3. **THE MOBILE PHONE IN CÔTE D’IVOIRE: NEW DISCOURSES**

From the beginning, there was a legitimate debate over the pertinence of investing in mobile telephony which was then considered a luxury inaccessible to common people. In fact, the early adopters among the lower class of the population were mocked, people asking them ironically who they were about to call with their phones. When the industry took off, thanks to mobile booths, the social debate shifted toward how to frame this practice or whether it should be allowed to continue. Public authorities juggled with this idea, pressed by Côte d’Ivoire Télécom, the only legal operator of the “publiphony”, who saw the development of mobile booths as a threat. Today, the debate revolves around public health and exploitation of the poor. Cissé Sindou’s article, “Côte d’Ivoire: ‘Affaire «Antennes mortelles» aux II Plateaux’ - Nord-Sud Abidjan”, is symptomatic of the ongoing debate about the impact of the mobile telephone on public health. The author reports an investigation that took place in the district of Plateau, where radiations from the cell phone antennas are suspected of having detrimental effects on people’s health and lives in the vicinity. As to the exploitation of the poor, the article “Orange-CI exploite les Gérants de cabine: Le Synacotel menace...” [“Orange-CI Is Exploiting the Booth Managers: The Synacotel threatens...”] indicates the tone of the debate: what should the margin of profit be for mobile booth managers and how should it be established? These controversies reveal that mobile phones have made their way into the vast field of social discourse. As well, there is the growing interest among researchers. Ivorian mobile telephony has been studied from various angles. For instance, Guy Gnamien (2002) devoted his thesis to the geographical deployment of the mobile booth in the city of Abidjan, showing that the anarchical character of this deployment led to a city development that goes against established models. My own Ph.D. dissertation analyzed the various modes of mobile phone appropriation in Côte d’Ivoire, and the insertion of mobile phones into its socioeconomic life.

4. **THE MOBILE PHONE IN CÔTE D’IVOIRE: SYMBOLIC APPROPRIATION**

The most striking development of the mobile phone in Côte d’Ivoire is its symbolic appropriation. By symbolic appropriation, I mean the provision by the mobile phone of symbolic codes for day-to-day exchanges, how terms denoting aspects of the mobile phone experience came to be exploited in broader social interactions or exchanges. One example is the term “beeping,” which refers to calling a correspondent and hanging up before he has the time to pick up the phone. A ‘beep’ call is a request for the mobile phone owner to return the call. Social conversation has adopted the term “to beep”...

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4It consists of the operation of a public phone booth.
5See also the article “Télécommunications: Doit-on supprimer le téléphone portable?” http://news.abidjan.net/article/index.asp?n=328463
with this particular meaning. For instance, in conversations, if someone intervenes without being invited, he would be asked: “Who beeped you?” It has also become a way to tell someone that his opinion is unwelcome. Thus the expression “tell him that nobody beeped him” has become commonplace. The term “to beep” has escaped the realm of mobile communication to be exploited in other communication settings where the phone is not involved at all. The term works by means of its invitational connotation as well as the participants’ awareness that “to beep” in various contexts is unlikely to refer to a phone call. In other words, there is a “shared conceptual map”. (Hall, 1997)

Another typical example is the term “booth,” lent to the common language by mobile booth practices. It is used for its meaning as public place, a place where anyone can stop whenever he wants. Thus, when someone goes where he is not welcomed, he might be asked: “Do you think this is a booth?” The parameters of the uses of mobile phone have become the symbol through which meaning circulates in social interactions. Though a study remains to be done to establish the widespread symbolic appropriation of mobile phones in Côte d’Ivoire, the preceding examples indicate that the mobile phone practice is sinking into people’s thinking. As Knut Lundby (2009: 2) notes, “people’s lives are shaped as they relate to their media environments and include a variety of media in their daily practices.”

Conclusion The sociology of technology has given a great deal of consideration to how new technologies emerge. Socio-constructivists have generally operated in this playground, where the notion of technical imaginary is largely understood as the engineering spirit as well as the utopías, dreams, and various representations that have in some way contributed to the emergence of a new technology. Within such a perspective, Patrice Flichy, in his paper “The Imaginary of Internet” writes: “Now, imagination has been involved not only in the diffusion of this new technology, but also in its conception. It is one of the elements of a common culture binding designers and users.” (2000: 156) However, the assumption in this paper is that there is an imaginary of use. The framework is that of the sociology of uses, which, as Chambat (1994), suggests, involves both the sociology of technology and the sociology of communication, as well as ways of life. The adoption process of the mobile phone in Côte d’Ivoire shows how the imaginary is put in motion once a given innovative technology is introduced, since people’s first quest is to imagine the forms of uses that might be more beneficial. In the Ivorian case, mobile booth practices have sparked the take-off of the country’s mobile phone industry and have transformed social life.

Unanticipated uses constrained the mobile industry to make strategic adjustments. Though unregulated practices, mobile booths have been granted a sufficient level of legitimacy, while discourses and debates around the phone have shifted from a simple for-or-against attitude to a
whole range of social concerns and theoretical questions. New practices have provided new symbols for social interactions. Thus, digital imaginary emerges. As Krotz (2008: 24) suggests, the process of mediatization “changes communication and so the core of human action.”

REFERENCES


Mobile Communication for Development? 
Formulating Critical Research Questions

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Abstract—In this paper we take a look at the field of M4D from a perspective 
embedded in Media & Communication and Sociology. While acknowledging 
the contribution of mobile communication in improving the lives of people in 
developing countries, we pose some critical questions for discussion. Following 
Marshall McLuhan, we ask ourselves in which ways mobile communication per se 
-regardless of its content- is influencing society and culture. This discussion will 
lead us to heightening the importance of identity negotiation through practices of 
connected- and responsiveness increasingly afforded by mobile communication in 
so-called late modern societies. Finally, as we consider mobile communication in 
relation to its content, we conclude that such identity negotiation processes are a 
fertile ground for commercial companies to insert their messages and brands.

1. INTRODUCTION
The rise of mobile communication has been remarkable. By November 2010 
up to 90 per cent of the world population had access to mobile telephony, 
with 72 per cent of the total number of mobile subscriptions coming from 
the developing world (Svensson & Wicander, 2010). The proliferation of 
mobile telephony in developing countries has no doubt open up a range of 
possibilities and new avenues for aid agencies and NGOs, as well as it has 
empowered people in their everyday lives. Examples from previous M4D 
conferences range from using the mobile phone for telemedicine, to report 
and monitor malaria outbreaks, to reinforce literacy, as well as to monitor 
elections, fight corruption and mobilize support for social and political 
change (see Svensson & Wicander, 2010).

The improvements in the area of mobile telephony and its potential 
for development purposes are indeed encouraging. However, from an 
academic perspective, Duncombe called for a greater conceptual and 
methodological rigour in the conduct of research as well as theoretical and 
methodological development at the last M4D conference. Our contribution 
is on the theoretical part. Drawing on theories from Media and Sociology 
disciplines that the emerging field of M4D has not embraced to the same 
extent as, for example, Informatics and Computer Science) we wish to 
contribute with formulating some critical questions on the increase of mobile 
communication in developing countries. We argue that mobile telephony 
not only brings with it new and increasing opportunities for development, 
but gives commercial companies a cheap and direct access to communities 
which previously had been either left out or considered beyond reach.

The starting point of this short paper will be in Media Theory and 
Sociology, paying special attention to the way in which media and
technology are linked to society and culture. How is mobile communication shaping societies all over the world and particularly in the developing countries? We will then argue that most societies are deeply pervaded by a consumerist logic that has consequences for the development of communities in the globalised south. Out of this reasoning, we will formulate some critical questions for the study of mobile communication in developing countries.

2. Mobile Communication in Late Modernity

We can no longer deny the importance of the rise of mobile communication. In Media & Communication Studies we connect changes in communication patterns to societal changes at large. It can be argued, for instance, that the advent of the printing press was tied to the rise of mass society and mass culture. Horkheimer (1947) and the Frankfurt School were early to discuss cultural forms as part of a larger societal structure. Recently, many scholars made a similar argument, claiming that with the rise of mobile and digital communication we are leaving mass society behind (see Benkler, 2006; Bruns, 2008; Shirky, 2009). These technological changes are happening in tandem with us entering into what some sociologist label as late modernity (Giddens, 1991).

Dahlgren (2006) characterizes late modernity by identifying two interrelated cultural processes: dispersion of unifying cultural frameworks and individualization. Our focus will be on the latter. Individualization refers to lacking a sense of social belonging and a growing sense of personal autonomy, a process in which communities, personal relationships, social forms and commitments are less bound by history, place and tradition (Dahlgren, 2006; Miller, 2008). In other words, the collective and the traditional has faded in importance in favour of reflexive identity negotiation (Giddens, 1991).

How is mobile communication related to such processes of identity in late modernity? To answer this question we will first turn to media scholar McLuhan and to more recent research discussing how mobile communication is leading to a connected society. McLuhan (1968) famously argued that the medium is the message, claiming that the content transmitted was of secondary importance to the medium and the patterns of use attached to it. What message is the usage of mobile telephony transmitting and how does it impact on society at large? The connected society is the label used to describe a society in which mobile phones are the prime mode of communication, connecting friends, family, colleagues and like-minded people (van Dijk, 2006). Therefore, an increasingly important value in contemporary societies must be connectedness. The message mobile communication platforms are carrying with it should thus be to stay connected, as echoed in the well-known Nokia slogan Connecting people. In relation to this, we would like to underline responsiveness accompanying connectedness. In a connected world, relations themselves seem to be more important than the units
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and information they are conveying (van Dijk, 2006). Miller (2008) even proclaims that content is not king, but keeping in touch is. Connectedness and responsiveness are illustrated in a study where informants claimed that the mobile phone enriched their social life, furthering opportunities for self-expression at the same time as managing and remaking relationships with friends and family (Pröitz, 2007). Studies from Japan reveal that most of the messages sent consisted of the intimacy-maintaining thinking of you sort (Rheingold, 2002). These studies illustrate how mobile communication is connected to processes of identity negotiation in late modernity through values of connected- and responsiveness.

Here we would even argue that mobile telephony pushes people to identity negotiation. Foucault’s notion of disciplining helps us to understand how the mobile phone is not merely a “neutral” technology for people to use, but has embedded relations of power in the sense that there are certain preferred ways of interacting with the technological tool, inscribed both in its design and how others make use of it. According to Foucault (1994/1982) disciplining should be understood as increasingly controlled and rationalized processes of adjusting activities, communication practices and power relations. The question we then need to ask ourselves is what is the rationality of using the mobile phone for identity negotiation?

3. Capitalism and the Logic of Consumerism

The increasing affordance of individuality and identity negotiation in late modernity can indeed be deemed positive in how, for instance, marginalized people have been able to connect and develop their identities outside the realm of traditional institutions of modernity that they regard as oppressive (such as family, church et cetera). But identity is also tied to capitalism in ways that might not always be considered positive. Processes of identification have been incorporated to capitalism, as acts of consumption and advertising clearly exemplify, in which identity and lifestyle are tightly connected to brands that we are made believe we need to purchase in order for us to negotiate that particular identity or that particular lifestyle. Identity becomes a vehicle for how the capitalist system can penetrate the life-world and vice versa, since many identity positions are created by capitalist domination to begin with (Hands, 2011).

How does this relate to mobile communication? If we take a step back from McLuhan and consider mobile telephony in relation to its content, it becomes clear that mobile phones not only help us to connect with friends, family and like-minded but they are also a gate through which companies reach us, penetrating our life-world with consumer distractions and advertisement, hence capitalizing on our need for communication and identity. As first-time subscribers in India we contracted a mobile service in order to keep in touch with friends and family, but we were not aware of by doing so, we were also providing a channel through which a battery of
SMS and automated calls with all sorts of advertisements reaches us daily. We have similar experiences from East Africa. Hence it becomes obvious that mobile phones not only give us access to the world, they also give the world access to us and, in the current circumstances, this is a capitalist world at large.

The fact that mobile users might become the target of numerous advertisements, highlights another important feature of the mobile phone. As opposed to radio and TV, mobile phones are much more interactive and allow users to buy goods and services at the push of a button. This characteristic, together with the low cost of mobile communication infrastructure, has the potential to turn mobile phones into the ideal selling platform aimed at communities that, until recently, were left out of the market. Until the advent of mobile communication, the isolation and poverty of certain communities had made infrastructure too costly and profit margins too low as to motivate any effort to reach them on the part of consumer goods companies. Mobile communication, by providing a cheap technology that can function as an advertisement and selling platform, has the potential to change this picture significantly. In the context of lowering mobile costs and increasing competition for new markets, even communities that can hardly afford to buy anything might be attractive for large companies. As the cases of China and India proved in the last 50 years, the paupers of today might well become the consumers of tomorrow.

The questions posed so far in this paper suggest that, as critical scholars, we need to be aware of the potential hegemonic embrace of mobile communication into a larger consumerist logic. Such critical awareness is even more acute for understanding the impact of mobile telephony in the developing world. We need to ask ourselves what are the implications of the rapid growth of mobile telephone subscriptions in developing countries. In capitalist market economies we will rather be addressed as consumers than as citizens. It thus might be the case that the increase in mobile communication will come with a price; yes, we are globally connected to each other but not only as friends, family, colleagues and like-minded, but also as consumers. With consumerism potentially reaching into every corner of the world, identities are advertised to people that before were largely untouched by the logic of consumerism creating new needs that, in communities with scarce resources, might be hard to satisfy.

Instead of speculating, we need to critically study how such consumerism will affect communities in developing countries, for the better or worse. The crucial question thus becomes what is happening with people in rural areas of the developing countries that in less than ten years have become connected through mobile communication. What will be the impact on people’s livelihoods and everyday lives in communities left until recently on the margins of market capitalism, now gaining access to a vast array of products and services through their mobile phones? A foreseeable effect of
this process will be an increasing pressure to monetize the local economy. For rural communities that rely mostly on a self-subsistence economy -living on the produce of their land- this development can have potentially far-reaching consequences. On the other hand, it might well be the case that the benefits and new possibilities offered by mobile telephony will offset any eventual negative effects caused by the introduction of the new technology and its corporate ownership.

4. Conclusion

We believe that critical theories from Media & Communication Studies and Sociology should have a say in the emerging field of M4D. We should continue to celebrate the possibilities for change, empowerment, health and education that the increasing proliferation of mobile telephony enables. However, we should not forget that mobile telephone companies are commercial enterprises driven by profit-maximization and, hence, operating out of a consumerist logic, using heightened processes of identity in connected societies as a means to target subscribers as consumers.

We hope to have shown in this short paper that media and communication are in a dialectical relationship with society and culture. We have also underlined that mobile communication and its implications cannot be understood outside the context of capitalism. Does this imply that mobile telephony and its impact is inevitably commercial? Is this the message of the mobile phone? Or is it a tool for mobilization at the service of social and political movements, as we have seen in numerous cases during the Arab Spring? It remains a further question if mobile communication can serve several purposes, both commercial and socio-political, without any major disruptions or unsurmountable contradictions. To answer this we would need to conduct ethnographic field work in an area that has been reached by mobile telephony in the last ten years, to study the impact of mobile telephony on the local economy, personal interrelationships and political agency.

In this paper our aim has been to pose a few questions to the emerging field of M4D from the point of view of Media & Communication Studies and Sociology. In this way, we hope to enrich the discussion and to encourage new avenues for future research.

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Political Conflict, Microblogging and the Changing Role of the Citizens: Examples from Germany, Tunisia and China

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Abstract—Partly driven by social media, the mediatisation of society has spawned new forms of political communication in the public sphere, accompanied by high hopes for more participation by citizens, and a more democratic political structures, along the Habermasian model of deliberative democracy (Habermas, 1996). Critical voices, however, have categorized the internet as a means for the fragmentation of society, for a digital divide, and have shed doubt on the idea of the internet as a means for deliberative discourse. With the increasing number of smart phones, this negative perspective might, however, change. One of the most recent positive developments in terms of citizens’ participation is the microblogging system Twitter. Twitter is based on a 140-character exchange and has been publicly acclaimed for supporting the “Arab spring” revolution. It is this brief format and ist within functions, which make Twitter relevant for the global exchange. "Though the 140-character format is a constraint, it need not be seen as a limitation; while participants often shorten and otherwise modify tweets to fit into 140 characters, this characteristic of Twitter can also be seen as an advantage” (boyd/Golder/Lotan 2010:10).

This paper explores political participation through microblogging in three different countries on the basis of empirical research (Germany, Tunisia, China), and shows how patterns of interaction and argumentation in political discourse on twitter or other microblogging systems have changed political discursive practices.

1. Communication Model

We propose a communication model for Twitter, which focuses on six main functions of microblogging for political participation:

1. News Medium: Sharing Information on the level of simultaneous reporting of events (“eye-witness medium”)
2. Organisational Medium: Activating others (followers) to engage in real life activities
3. Publishing: Informing the world about political events
4. Discussing: Engaging in discussions with politicians, supporters or adversaries
5. Personal Sharing: Seeking comfort and support for private matters
6. Social Interaction: Keeping in touch with friends, family

These diverse functions are being realized by the semiotic structure of twitter as “discoursive universe”. We have developed a structural discourse model, which identifies four main communication strategies of interaction and participation in twitter (Thimm et al., 2011).
Microblogging Communication Strategies:

The communicative functions of

1. Addressing (@),
2. Tagging (#),
3. Linking (http://),
4. Republishing (RT)

Constitute a multi-referential system, in which tweets and their authors get related to one another. By addressing other users directly or by just mentioning them within a tweet (@-symbol + Username) twitter users can build contacts and initiate wide spread discussions with several participants who are either involved actively or just read along. The @-function helps establishing interactional “cross-turn coherence” (Honeycutt/Herring 2009: 2) and creates new options to participate in the political online discourse (e.g. @-initiated interaction between citizens and politicians).

The #-symbol is used to mark keywords or topics in a twitter message and helps categorizing tweets semantically. Twitter users can follow conversations regarding a certain topic more easily and get a better overview of what is being discussed within the certain field of interest (content mapping). This communicative function of hashtagging stands for discourse organization and content contextualization.

Hyperlinks (each string headed by http://) help expanding the 140 sign-limit of a tweet and sequence the content. The communicative function of linking allows users to substantiate their argumentation within a discussion by inserting multi-modal content, such as photos, videos, or other websites. They can link to online articles or blogpostings in order to provide some background information or context for their argumentation or give some “proof” of a claim by uploading a photo or video. Some of the visually stimulating hyperlinks like inserted photos are also used as narrative elements within a deliberative discourse in twitter.

The fourth main communicative strategy is retweeting (RT). A user can resend another user’s tweet by either clicking the retweet-button (automatic retweet) or by putting “RT”+@+username of the original sender at the beginning of the reposted tweet. The retweet function serves as a quick opportunity to share and distribute messages with a lot of people at the same time. Once retweeted, a tweet gets retweeted almost instantly on the 2nd, 3rd, and 4th hops away from the source, signifying fast diffusion of information after the 1st retweet. The more important a person on twitter is considered, the more often her messages get retweeted and referred to. This often also relates to a large number of followees. Huge interest is especially shown in tweets that suggest closeness to politicians or other decision makers. This „closeness-potential“ is becoming a strategic factor of personalizing election campaigns on twitter. The following table offers an overview over operational and functional levels:
Table 1: Operator Model Twitter

<table>
<thead>
<tr>
<th>Operational Level</th>
<th>Functional Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ addressing, mentioning</td>
<td>addressing</td>
</tr>
<tr>
<td></td>
<td>interaction</td>
</tr>
<tr>
<td></td>
<td>coherence</td>
</tr>
<tr>
<td></td>
<td>contacting</td>
</tr>
<tr>
<td># hashtagging</td>
<td>specification of topic</td>
</tr>
<tr>
<td></td>
<td>discourse organisation</td>
</tr>
<tr>
<td></td>
<td>contextualisation</td>
</tr>
<tr>
<td>http:// (Hyperlinking)</td>
<td>distribution of information</td>
</tr>
<tr>
<td></td>
<td>argumentation</td>
</tr>
<tr>
<td>RT (Redistribution)</td>
<td>diffusion</td>
</tr>
<tr>
<td></td>
<td>referencing</td>
</tr>
<tr>
<td></td>
<td>citation</td>
</tr>
</tbody>
</table>

The microblogging system is a complex, highly condensed platform for information diffusion, interpersonal exchange, argumentation and mobilisation (Kwak et al., 2010). These four functional signifiers offer new opportunities for citizens to participate in political discourse via twitter. Especially the diffusion function of micro blogging comes into focus when looking at its political impact. As Twitter’s structure disperses conversation throughout a network of interconnected actors rather than constraining conversation within bounded spaces or groups, many people may talk about a particular topic at once (boyd/Golder/Lotan 2010: 1). The stream of messages provided by Twitter allows individuals to be peripherally aware without directly participating.

To analyse the communicative effects, functions and impacts of Twitter for political discourse, three studies were carried out for comparative analysis. A quantitative study on political participation during state elections in Germany, a qualitative study on Twitter topics in Tunisia and a qualitative study about Sina Weibo in China.

5. Comparative Studies

To follow up the model and to include a global perspective, three countries were selected for analysis: Germany, Tunisia and China.

5.1 Twitter participation in German State Elections

The basis of analysis are tweets of local politicians, citizens, and news media portals, which were collected during state elections in Germany in 2010/2011. State elections form an important basis for governmental ruling, as a multi-level political system supports a situation of checks and balances between the local level, the state level and the national level. Therefore in state elections candidates are trying to get in touch with the citizens, in their constituency as well as statewide. A selected sample of the interactions on twitter was collected during four state elections during the years 2010 and 2011. These tweets include: (1) tweets by selected candidates of each party, (2) by print media twitter portals, and (3) by regular citizens posting about the election. Taking all studies into account, the following types of tweets were obtained:
Tab. 2: Twitter Participation German State Elections by Selected Social Groups

<table>
<thead>
<tr>
<th></th>
<th>North Rhine Westphalia</th>
<th>Baden-Württemberg</th>
<th>Rhineland-Palatinate</th>
<th>Saxony-Anhalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Election Day:</td>
<td>9.5.2010</td>
<td>Election Day:</td>
<td>Election Day:</td>
<td>Election Day:</td>
</tr>
<tr>
<td>Enquiry Period:</td>
<td>6.3.-3.4.2011</td>
<td>27.3.2011</td>
<td>6.3.-3.4.2010</td>
<td>27.2.-27.3.2010</td>
</tr>
<tr>
<td>Public Sphere</td>
<td>8,769</td>
<td>21,288</td>
<td>21,055</td>
<td>15,089</td>
</tr>
<tr>
<td>Politicians</td>
<td>3,080</td>
<td>981</td>
<td>1,610</td>
<td>1,883</td>
</tr>
<tr>
<td>Parties</td>
<td>1,316</td>
<td>1,829</td>
<td>1,682</td>
<td>1,109</td>
</tr>
<tr>
<td>Media</td>
<td>5,496</td>
<td>1,997</td>
<td>2,749</td>
<td>1,434</td>
</tr>
<tr>
<td>Total</td>
<td>18,661</td>
<td>26,095</td>
<td>27,096</td>
<td>19,465</td>
</tr>
</tbody>
</table>

The overall methodological process applied for the data analysis can be characterized as triangulation, combining qualitative measures (interpersonal interaction (@replies and @retweets), semantic analysis (#hashtags) and speech acts (e.g. meta communication) with quantitative measures (content analysis, frequency profiles, topic profiles).

The following methodological steps were taken:

1. Quantitative Analysis: Tweet-profiles according to the operator-model (types of activity, interactive styles)
2. Qualitative analysis, content analysis: speech act patterns and argumentation patterns as well as interaction structures (e.g. types of reference, topic management).

The multi method approach allows for a semantic, syntactic, and pragmatic analysis of the tweets to identify the social exchange between the participants.

Firstly, the hashtag based topic analysis shows the main topics discussed on twitter during the elections.

Fig. 1: Topics Discussed during the Elections in Baden-Württemberg (2011)
Whereas the high frequency of hashtags like LTWI1 or LTWBW, which both refer to the German abbreviation for the election in question, is not surprising, the high amounts of references to “Fukushima” and “Atom” give a clear indication to political issues at the time of the election. Even more interesting is the high frequency of the hashtag S21, which refers to billion dollar local traffic project, which was highly contested by local citizens’ groups. This group used Twitter for organizing local protests and demonstrations, watch police activities and recruit new supporters (see examples below).

In a second step of analysis, the individual twitter interactions of the politicians were analysed for personal style and political discourse with the public. Applying the operator model we can analyse types and styles of discourse by the individual politician:

The results show an unusual mix of private and political topics on the part of the politicians, a mix, which is only partly accepted by the wider public. Profile analysis revealed different strategies on the level of interaction and responsiveness - some politicians mainly went ahead with their personal agenda (“presentational type”), while others engaged directly and intently and used twitter as a dialogical tool (“interactive type”). The results show that politicians don’t interact a lot with their voters – they mainly use hashtags and links to refer to other or related topics. Only a minority refers directly to citizens and their comments or questions.

Citizens, however, use twitter quiet differently, especially during political conflict. The above mentioned highly contested local traffic project called “S21” (Stuttgart 21), generated thousands of tweets. When looking at the communication patterns used by the citizens in this context, some clear patterns evolved. The main strategies were being “documenting/
informing” (by videos and fotos”) and organizing. The Tweet below gives an example for a series of images (“tweetpics”), which document police activities at the construction site.

Apart from this “watchdog” function, which Twitter enables by its added functions, tweets are often used to call supports to join the demonstrators. A second tweet illustrates this function, this tweet calls for supports to join the gathering:

The results shows that Twitter is especially effective in political conflicts, as a means to share local informations and organize groups. Other than that it should be noted that German politicians have started to use Twitter for personal marketing purposes. Whether Twitter is a tool for deliberation online will be tested in upcoming studies.
5.2 Study 2: Twitter in Tunisia

The hypothesis of Twitter as a means of participation in conflict situations was followed up by a study on Twitter usage during the Arab Revolution, namely in Tunisia. The amount of tweets was impressively high: the total number of tweets with the hashtag “Tunisia” was 196 million, tweets with the hashtag #sidibouzid, the province where the unrests started, accounted for over 103 million.

The types of tweets differed from the German ones in some respects, most noteworthy was the global reach of tweets, see examples below:

@monaeltahawyMona Eltahawy Every #Arab leader is watching #Tunisia in fear. Every Arab citizen is watching Tunisia in hope and solidarity. #Sidibouzid. January 13, 2011 11:39 am via web

@alfarhan
Fouad Alfarhan الجزيرة تقول أن بن علي متجه لدولة خليجية! رتويت إذا كنت سوري وترفض تقدير وطننا #سيدة #تونس #بنت علي

January 14, 2011 1:40 pm via Twitter for iPad
Tweets with the hashtag “Tunesia” were collected from January to March 2011. Using Backtype, a service tool for twitter analyses, it could be shown, that the hashtag “Tunesia” reached its peak with 28 Tweets per second at the 14th of January 2011, at 9:27 local time in Tunesia, only a short time after first reports about Ben Ali trying to leave the country 9:21.

Fig. 3: Tweet Distribution Tunesia

Overall the functions of diffusion and organizing, which were found in the German data, could be confirmed for the Tunesian data.

5.3 Study 3: Sina Weiba in China

Sina Weibo is a Chinese microblogging site, which has started playing an important role in watching political conflict in China (Xia 2010). Technically being a hybrid of Twitter and Facebook, it is one of the most popular sites in China, in use by 90% of the market. With 9,588,870 fans, Yao Chen, a young actress, is the most popular ‘Weiborer’ in China and has third most followers next to Lady Gaga and Justin Bieber. Sina Weibo was launched by SINA Corporation in August 2009, and now has more than 140 million users (at the same time Twitter has 175 million users worldwide). While Weibo is essentially the same concept as Twitter, there are a few differences:

1. Blog-like comments.
2. Focus on verified accounts
3. The backing of a Chinese giant.
4. Embedded picture & video attachments.
5. Stringent self-censorship

Although the Chinese government employs strict censorship on internet media, it could not control Weibo totally. Especially the documentations of self immolations due to property evictions, child abductions and corruption are increasingly being reported through Weibo.

One of the most recent cases, which used Weibo for the publication of a political conflict, were the Shanghai train accidents. Thousands of users
posted images on Weibo, sharing their stories and calling out for better safety regulation. Many Chinese were outraged and voiced harsh criticism, like Li Fashi in the following post on Weibo:

![Critical Posts on Sina Weibo](image)

Overall the “eyewitness function” of Weibo is even more prominent in China as in other countries. It is this very function which leads to continuing efforts to suppress free speech on Sina Weibo. The company announced in the fall of 2011 that it is developing a credibility rating system to curb users who spread “false online information” that could pose “potential threats to social stability”. But with 200 million users and 75 million microblog posts a day, the service’s reviewers can only delete so many at a time, allowing embarrassing posts — such as those questioning the high-speed rail crash’s official death toll, wishing to overthrow the communist regime, or ridiculing the regime’s latest propaganda film — to roam around the service and attract much attention and support among fellow netizens.

6. SUMMARY AND OUTLOOK

More and more people worldwide use mobile phone applications to share informations and social meaning. It is the mobile phone, which enables citizens to watch their governments more closely by reporting news to the global public. Many are now using Twitter or its equivalents, employing the interactive functions to voice their interests and concerns. Overall, Twitter can be conceptualized as a “social news diffusion” medium, which not only has a control and information exchange function, but enables citizens to keep track of the political events, share and document them and thereby influence politics.
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Motivation, Mobilization, Participation: Are Mobile Phones Instrumental in Mobilizing the Public?

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Abstract — The paper proposes a methodological study of reception and follow-up action of specifically designed messages, delivered on SMS and Social Media, to mobilize public participation in a cleaning campaign in India. The messages will be geared towards empowering the recipients with a higher sense of civic responsibility. The empowerment here views the potential participants beyond their roles as mere citizens, which are bound in rights and duties. These customized messages are geared towards audiences with varying degree of commitment towards civic engagement. Appeals and Mobilizing Information (MI) combined would be designed towards audiences with minimal, optimal and elevated levels of commitment towards civic engagement. The findings of the project will be valuable both for future engagement of participants in India and elsewhere.

1. CLEAN INDIA CAMPAIGN (CIC)

Imagindia, a non-partisan, independent organization, uses democratic ideal of public participation, to further strengthen democracy, through ‘research, implementing projects, and where necessary shaping public opinion—within India, and globally.’ The organization also has a ‘proven distinction to mobilize grassroots opinion in other countries via its ability to harness the Indian Diasporas communities.’ (http://www.imagindia.org/)

India, the largest democracy in the world, is also known for faring low on civic sense, compared to other democracies. Civic sense in this paper is applied as an application of ‘do unto others’ in everyday life and etiquette, e.g. following traffic laws, and respecting public property. Unlike the concept of civic culture as defined by Dahlgren (1999, 2010), civic sense is not as much political as it is ethical. Here, civic sense focuses on how our everyday acts might influence the lives of others. However, the concept of civic sense, as used in this paper, could eventually contribute towards a civic culture. Generally, both an ongoing culture of neglect and a lack of responsibility towards shared property and oftentimes law, is held responsible for this attitude. This culture of neglect has also been a long time concern of organizations like Let’s do it Delhi Mountain Cleaners and Chennai Beach Cleaners have taken up initiatives that focus on cleanliness. However, none of these organizations are working on a scale as large as Clean India Campaign.

Although unconstitutional since India became a republic, caste system still defines division of labor in the country. Cleaning, often within the premises of one’s household is a job relegated to the low-class who have been doing it for generations (Shenoy 2008). Temporary, daily and live-in servants are common in urban India. However, there has been strong movement from civil society organization such as Center for Study of Society
Motivation, Mobilization, Participation: are Mobile Phones Instrumental to question and change such attitudes (http://www.csss-isla.com/index.htm). As a democracy, India cannot enforce practices that many consider should be taught at home. Furthermore, the ethical dilemmas of what is civic sense and who is responsible complicate the situation to the point where inaction becomes the default choice for the citizens. However, could a shift in attitude using various media technologies, especially the ever-growing mobile phones, be pursued?

CIC, mainly directed towards the elite, is a concrete step towards engaging the section Indian society is empowered and can foster change. Launched in February of 2011, CIC is a national movement executed by the Imagindia Institute that strategically, combines national sentiment with science and technology to encourage citizen participation. Apropos to its name, the institute applies a multilevel strategy by bringing cutting-edge research, and latest technology, to evoke a national sentiment of pride in creating a ‘new-Image’ for India.

The movement is Gandhian in its design, scientific & entrepreneurial in its approach. It is drawing support across a wide eco-system of citizens from all walks and regions of the country, & among Indian Diasporas. (http://www.imagindia.org/)

Clean India Campaign’s (CIP), use of ‘Cleanliness’ is different from the anti-corruption campaign. CIP, unlike the anti-corruption campaign that deals with eliminating corruption, is concerned with physical removal of garbage in public places. The campaign’s primary focus, so far has been on areas around hospitals (email correspondence Sachdev, President of ImagIndia). The emphasis on Gandhian principles, states Sachdev, is to prevent any confusion with anti-corruption campaign that also use the word ‘cleaning’ as metaphor.

‘The Gandhian principles are deep, & highlighted for 2-reasons. One, we want volunteers to come & either work, or just relax around—but not start discussing about various ills of the country,... Second, around the time we started our movement (jan. 2011), the anti-corruption movement was also starting. Our focus is on cleanliness, & the anti-corruption movement also focuses on “cleanliness” in governance. So there is logical overlap between both movements (as in, working towards a ‘clean’ India). But we don’t want to dilute the focus. Our focus is on physical cleanliness of the country. Therefore, to make the distinction clear, we emphasize Gandhian. Plus, of course, the dignity of labor, & removing mental barriers towards picking garbage.

E-mail correspondence, Nov. 29, 2011.

Capitalizing on the growing subscriptions of mobile phones¹ CIC uses SMS to disseminate information. The largest single mobile user in India is between 25-35 yrs. Students from the largest occupational group of mobile users, followed by self-employed. (IndiaTechOnline).

¹By August 2011, India was reported to have 865.71 million mobile subscriptions (Reuters, 2011)
1.1 An Uneven Consumer Pyramid

Interestingly, the ownership and use of mobile phone does not vary much across the five socio-economic classes, as identified in Indian economic system. The classes A to E, are identified on the basis of both educational level, occupational status and income, of the primary wage earner of the family, where A is the most literate & highest earning (Indiaretailbiz). Due to paucity of research, it is difficult to state the purposes for which the phones are being used other than the traditional telephony. Out of the 200 million Internet users in India, at least 40 million are said to be mobile phone users (Indiatechonline).

1.2 Civic Culture, Civic Engagement, And Civic Sense

At this juncture it is important to explain the three terms that remain intertwined in this discussion. Civic culture, a broad term, encompasses various levels of civic engagement. Our study strays from the most popular notion of civic culture, given to us by Dahlgreen (1999, 2010), which emphasizes a political angle and is linked to citizenship in a democracy. However, the study does borrow from Skocpol’s (2004), concern that democratic principles are threatened without support from a civic culture and Lee (2008) who insists that a ‘civic culture’ is supposed to reduce crime, and bring the society towards a pluralist liberal democracy. It is assumed as Tongreen (2005) suggests, that civic culture is deeply rooted in and should emerge from local traditions, kinship, and family systems. To which I would add ‘civic culture would also be a response to a local problem’, which India has with unaccounted-for garbage & littering. The use of Gandhian principles, which emerges from strategies used for earlier movements like Bhoodan (land donation), (Khandewale, 1973) & Sarvodaya (uplifting all) (Harris, 1998).

Creation of this civic culture would depend on engaging the public. Civic engagement according to Norris, (2001) involves three different dimensions—knowledge about public affairs, public’s trust in its political system, and public’s participation in influencing and altering laws and policies. However, civic sense, especially as described above, implies evoking a sense of oneness with one’s environment and fellow beings, without association with democratic rights or duties. Although, in this study, there is a focus on knowledge & participation, as a result of a) exposure to messages on the mobile phones, b) follow-up engagement in the campaign, if the latter does occur. Both knowledge and participation in this case are not politically or commercially motivated. Neither are they a formalized manner of learning. The use of mobile phones to encourage participation is intended to generate a ‘new attitude’ hopefully leading to a shift in public attitude, mainly through participation. The focus is also on the process of working in silence and if that influences future, more engaged involvement in the campaign. Mobile phones then are seen as a conduit for reaching the target population via specially designed messages.
The rise in the number of SmartPhones in India, especially among the target population of this study, 25-35 years, enhances the possibility of participation by being linked with websites, twitter and other new features. It is important to reiterate that this exploratory study, focuses on tracking the kind of participation that predesigned messages may initiate. Here, technology is considered a portal that carries and disseminates messages. The focus is on combining message-design with mobile technology, with a purpose to generate, over a period of time, trends and understanding of levels of information in a message, and a correlation with participation if any, including the role of mobile platform. While this initiative by CIC may turn into a full-fledged social movement, it certainly has started independent of any media or governmental organization. In that, here civic sense is not described in terms of political involvement or political statement. Earlier studies, that focused on news language’s ability to engage citizens have established that ‘words and appeals’ can either invite or inhibit public participation (Barton, 1991). Furthermore, messages must be created with a varying degree of invitational potential, to maximize public participation (Uppal, 2003). Combining these two concepts, the study will engage in data collection to explore the potential of ‘appeals’ and ‘mobilizing information’ provided on mobile phones to encourage citizen participation in Clean India Campaign.

The study does not claim to be charting a revolution, or following a trend, instead very deliberately creating a ripple of information and studying what follows. Rather than speculating what caused the response, if any to messages on mobile phones, the interest is in understanding the interaction between audience and the message on a mobile platform and how it may lead to an action, whether by participating or merely registering for a session.

Despite the democratizing potential of technology, some scholars have established that the Internet has not engaged the younger audiences, beyond the purposes of education and entertainment (Bakardjiera, 2010). However, internet still remains a meeting place for youngsters, whether via phones or on computers (Bakardjiera, 2010). So, this study is an attempt to combine an already existing campaign, which rests on public participation, and uses both mobile phones and social media to get the word out. However, before the movement gathers enough momentum to be self-sustainable, the first few rounds of information and encouragement is directed towards the section of society that both has free time and is freedom from financial responsibilities. That population usually is the student population in India, where culturally the young stay at home until they get married, and the culture of student loans is almost non-existent. Incidentally this is also the population that has the largest cell phone penetration (IndiatechOnline. Accessed November 25, 2011). Considering these factors, the target population for this study will be between 20-35 years of age.
2. Methodology

The research will be conducted in three rounds. The first round of this research will focus on:

- Creating messages based on ‘evoking a sense of social-conscience’ and ‘restoring an ideal social order’ (Barton, 1991). Barton (1991) based on potential of news language to initiate public discourse, has defined news as messages with specific appeals. These appeals, can be persuasive in engaging or inhibiting the public from participating. Although, originally this notion was applied to direct news, this study proposes to test the notion of appeals in abridged electronic format of mobile phone messages or information on social media. Of the six appeals suggested by Barton (1991) only appeals to an ideal social order (that point towards a disrupted social order), and to an individual conscience (made to individuals with a strong sense of conscience and a slightly above-average political orientation) will be tested.

- Creating messages with varying grades of mobilizing information (MI), (Motivational vs. Empowering) (Uppal, 2003). MI, first defined by Lemert, has not been given much attention in the public campaigns. Lemert, gave three basic kinds of MI: identificational, locational & tactical, that provided information on names of the people involved, addresses, and any ‘how-tos’ information, e.g. how to cast a ballot. However, different kinds of MI was revealed in a comparative analysis of environmental news from India and the US: Invitational and Empowering. For the purpose of this study, we will test only Invitational MI, that was identified at three different levels:
  a. **Motivational**: Directed towards those with least interest in public participation: Use of celebrities in the campaign. Gul Panag, a film actress, serves as CIC’s ambassador.
  b. **Informational**: directed towards those who are already aware of the initiative. Information on activities organized by various interest groups, both pro and anti a specific issue.
  c. **Purposive**: directed towards those who have already been involved in CIP’s activities. Detailed information on activities of a group, history of the issue, dates and venues of the activist strategies.

For all levels of messages created both as SMS and on social-media, there will be an interactivity feature, which will allow the receivers to send feedback. That data will be collected merely via the frequency of return response. The volunteers that do participate in the project will be requested to fill out questionnaires both before & after engaging in the cleaning campaign.
Motivation, Mobilization, Participation: are Mobile Phones Instrumental

1. Creating pre and post questionnaires.

2. Pre questionnaires will focus on questions related to use and facility of mobile technology, basic demographic information including level of education, and political interests, prior volunteer experience, and expectation for involvement.

3. Post questionnaires will include follow up questions based on the experience, ideas of future involvement, both temporary and long-term.

The second round of the research will involve two steps.

1. Sending the messages out (disseminating the information)

2. Administering a Pre and Post questionnaires on all the participants (according to CIP website, volunteering is schedule for 20 Sundays in one year).

The third round of the research will involve the following steps.

1. The third level of research will be analyze the data collected to examine:
   a. If mobile phones were in any manner influential in taking action.
   b. If there is a correlation between the kind of mobile phone and a follow up action (smart phone vs. Nokia phone)
   c. Is there a significant influence of buddy/friend in taking action
   d. What messages appealed to audiences of what level.

While this is an exploratory study, it has scope for expansion. We hope to work towards a model for public participation, which may be used in future citizen engagement projects, both in India and abroad.

REFERENCES


Abstract—We argue that low-income youth lead lives which are marked by transience, and that adjustments must be made to the M4D agenda to account for their specific needs. In 2010, we conducted an interview study involving 233 street, slum and ghetto youth of Nairobi, and we present their patterns of mobile phone ownership and use. We identify finding casual jobs as the primary need of our respondents, followed by coordination/communication needs specific to the fluid work and living conditions prevalent in our sample. We posit place creation as the primary task of future interventions. We identify the challenges provided by the transient nature of the living and work arrangements our respondents to effective mobile based interventions and suggest a preliminary approach to the same.

1. INTRODUCTION

The last decade has seen increasing penetration of mobile telephony in developing nations and a concordant rise in the expectations of development solutions based on these infrastructures. However, currently, we believe that extant Mobile Communication for Development (M4D) work has not adequately addressed the needs and specific preferences of the poorest of the poor. We present a section of our research work based in Nairobi which deals with the mobile phone usage of street, slum and ghetto youth (herein referred to as low-income youth). While the larger project dealt with the narratives of developmental subjects, in the current study we present results dealing with two aspects of mobile phone usage by low income usage, namely, (i) ownership versus borrowing of devices, and (ii) perceived utility of the mobile phone in earning a livelihood. We explore these two notions to present a design recommendation for future mobile based developmental interventions targeted at low-income youth.

Kenya provides an interesting case for the M4D community as it provides an intersection of a large population of low income youth (Aptekar 1994, Kilbride et al. 2000, & Suda 1997) and a large uptake of both mobile phones, as well as, mobile based services such as mPesa (Morawczynski et al. 2009). Our work is focused on street (residing primarily on the street), slum (residing in urban slums and other temporary urban residential clusters, such as Kibera) and ghettoes (residing in permanent and semi-permanent housing, including colonial estates such as Shauri Moyo). While the specifics of our sample are described in a subsequent section, an important underlying characteristic of our sample is their transience, a feature produced by and perpetuated due to the prevalence of the constraints of poverty and the marginalized and, often, illegal existence of our respondents. By transience, we hope to capture aspects such as locational transience (i.e. no fixed housing over time), and employment transience (i.e. a succession of casual jobs, or ‘hustling’ in the local parlance). We believe that the issue of transience is...
particularly relevant to M4D interventions, as the mobile phone appears to be crucial in the efforts of low-income youth to deal with the vagaries of a transient existence.

In terms of the larger discourse of the community, we believe we address three important threads, (i) delineating the specificities of a particular set of intended users (Donner et al. 2008), in our case, the bottom of the bottom of the pyramid, (ii) highlighting the perceived impact of mobiles on the livelihoods of respondents (Donner 2009, Donner 2006), and (iii) the design of solutions which adequately address the transient existence of low income urban youth (Kreutzer 2009). In a sense, we provide a view of the mobile phones situated in the specific context of the casual employment, transient residential status and, most poignantly, effective marginalization and illegality of the lives of our respondents.

2. METHODS AND SAMPLE

We utilized a fixed question, open response methodology (Mishler 1986) due to the narrative focus of our larger research project. In total, we interviewed 233 respondents in Nairobi, comprising of 193 males and 40 females. The median age of our respondents was 24.5, with the inclusion and exclusion range being 18-40 years. Our sample was constructed by an adapted snowball sampling methodology, with the initial set of respondents referred by our local partner organization. The snowballing was done at a group level, with each group of respondents asked to point to other groups of low income youth, and their places of congregation (‘bases’ in the local parlance). We also modified the sampling methodology to provide an adequate representation of women, which is skewed heavily towards men (Aptekar 1994). The transient nature of the housing scenario of our sample can be illustrated by the fact that 75% of the respondents reported having been homeless at some point or at the time of the survey, with the median period of homelessness being 6 years.

Respondents were asked two questions, (i) whether they owned or borrowed a mobile phone, and (ii) if and how the mobile phone had an impact on earning their livelihood. Due to the variety of our respondents, ranging from those who live in permanent housing to those who are permanently transient, encompassing those engaged in legal and long term employment to those engaged in short term engagements involving varying degrees of illegality such as prostitution, snatching, and peddling, we believed a simple two question approach was prudent. The open ended responses provided were recorded both in writing, as well as by audio recording to ensure accuracy and to prevent misrepresentation.

3. RESULTS

In terms of ownership and borrowing, approximately 40% of our sample reported owning a mobile phone, whereas approximately 38% reported
depending on a borrowed mobile device. The remainder reported neither owning nor borrowing a mobile phone. The non-users included those who depended on pay-phones, those who claimed that they did not know how to use a mobile phone and, finally, those who claimed they had no one to call.

![Graph showing device ownership distribution of sample](image)

In terms of the usefulness of the mobile device to earning a livelihood, approximately 33% of the respondents acknowledged a positive effect of owning or using a mobile phone. In addition, 15% of the respondents posited the use of the mPesa service to be instrumental to their livelihood needs. The use of the mPesa service was, as expected, dominated by remittances in times of need, however, additional uses were also observed, such as using the mPesa service as a bank account (“Because I don’t have bank account, so my bank account is mPesa”), and as a payment portal by small business owners (“Sometimes customer sends me money through mPesa”).

Of the respondents who felt that the phone was useful in earning a livelihood, 33% reported using their mobile to find casual jobs (“Some people call me to come and collect some phone for repair”), and 60% reported using the phone to communicate/coordinate with their employers, co-workers and clients (“If I have a customer for my art and I am at work at the car wash”). Both these dimensions bear importance with regards to the transience of low income youth in Nairobi. The task of finding a job, typically casual work, becomes considerably more arduous, if the job seekers home is transitory, their contact details are often dependent on the kindness of friends and strangers, and in cases where casual jobs are pursued in parallel. Similarly, coordinating (“So somebody can tell me about municipal council raids (on beggars) and that is why I bought the phone”) and communicating (“When a customer needs early car wash, he asks me to wake up early”) for work purposes produces similar challenges relating to the acute mobilities of the actors. These mobilities are further accentuated by the mobile nature of the jobs themselves, sometimes due to what the job entails (sign painting, collecting
scrap) and sometimes due to the legality of the job (prostitution, snatching, begging). As a side note, only one respondent cited mobile internet being useful for the purposes of a job search. We believe the lack of mobile internet usage is to be expected with the educational particulars of our sample population, limited ownership of devices, and lack of technical skills needed to utilize the medium.

Lastly, we also saw a variety of uses of the phone which were important to the earning of a livelihood, but could best be described under the under the umbrella category of barriers which the phone helped circumvent. These include, but are not limited to, following up on debtors, requesting help to be bailed out after an arrest, and as a source of money (“When I’m broke, I sell the phone for money”).

4. DISCUSSION

In terms of our discussion, we would like to explore the notion of place-creation, which we believe should be the goal of M4D interventions aimed at transient low-income youth. Tuan (1975) defines places at one level to be a unit in the hierarchy of space, but also frames it, at another level, as “meaning constructed by experience”. In its current form, mobile phones help users in our study to negotiate the inherent mobilities of their situations and their aspirations to provide a technology mediated place which tries to simulate stability in terms of both temporality and location. This instrumental use of the mobile phone when coupled with the specifics of actual use suggest interesting design challenges-finding casual jobs within reachable locations and in-time to, co-ordinating with other casual workers, and most crucially, assisting small business owners in navigating the challenges of communicating and collaborating with transient employees, and customers.

We believe our study provides an example of patterns of use (Alexander 1979), and that our work makes a case for a renewed examination of the needs of the poorest of the poor, who often have access to phones yet not to services which adequately address their exaggerated transience, and their specific place needs. In addition, we see scope for group based interventions, as the presence of shared ownership of the device itself, group living arrangements centred around the physical base, informal work collectives, and collective financial arrangements, all point towards group rather than individual level initiatives. For, as we saw with most of the youth bases, even though the membership of the base might change, the base persists. In a sense, the base might provide a physical site to situate interventions and to explore a variant of Burrell’s (2009) notion of a networked field site, incorporating the “physical, virtual, and imagined”. Even in terms of conducting the study, we gained access or lost access to respondents at a group level which we believe adds weight to the argument of group interventions. So, potentially, a mobile phone based casual-jobs recruitment service could operate by distributing a single phone to a youth group.
Lastly, a caveat must be placed to re-emphasize the narrative focus of our work. We took our respondents on their word, and were extremely grateful for their candour in describing not only the daily indignities that they faced, but also the variety of illegal activities that they engaged in the course of their everyday existence. However, in some instances, we were alerted to alleged misrepresentation by some of the respondents, an unavoidable hazard in narrative studies. We believe that these misrepresentations are not significant, in that, the larger sample makes similar points, and the specifics of individual cases, in our view, does not discredit the narratives of the whole.

5. Conclusion

We provide a study of mobile phone usage amongst low income youth in Nairobi. We explore device ownership patterns, as well as, the utility of the mobile in terms of earning a livelihood. Predominantly, phones were deemed useful by respondents useful in the search for casual jobs. In addition, respondents found the phones useful in communicating and coordinating the variety of casual jobs they engaged in, and, to a limited extent, in running their small businesses. Although these results were along expected lines, our major emphasis lies in highlight the transience of these low-income youth and how phones help in negating the mobilities of their life, work and pursuits. We argue for place-creation as the objective of M4D interventions aimed at this demographic and discuss the challenges of creating solutions which address the transient existence of these peoples.

6. Acknowledgement

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Mobile Participation? Crowdsourcing during the 2011 Uganda General Elections

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Abstract—This paper examines the challenges and opportunities in using mobile phones for political participation. In doing so, a study was conducted on the open crowdsourcing election monitoring platform UgandaWatch. SMS questionnaires were sent out to a) a randomised sample of Ugandan mobile phone users and to b) a sample of users of UgandaWatch. The key findings were; a) open crowdsourcing provides a useful channel in cases when citizens experience that there is nowhere else to turn, and when citizens need help; b) the major reasons for not using UgandaWatch was not having heard of the service and not having anything to report; c) the primary challenges in using UgandaWatch was fear of personal safety, the cost factor, and the perception of participation not having any effect; d) most users never visited the website but of those who did 75 per cent did so through their mobile browsers. Drawing on our findings, we recommend; 1) strategic and educational marketing: inform the public why the service should be used and how to use it; 2) closing the feedback-loop and decide how to use the crowdsourced data and communicate this to the users; 3) using multiple channels: combine a spectrum of traditional and ICT-enabled channels to increase accessibility and solidity.

Keywords: crowd, crowdsourcing, election monitoring, mobile, M4D, participation, SMS, SMS-questionnaire.

1. Introduction

Political participation is often discussed in quantitative terms, and this in relation to voter turnout. This discussion rests upon the assumption that it is the level of participation that has the democratic implications (Petersson 2006, p.233). However, increasing numeric participation is not necessarily the same matter as increasing the equality of the political participation. Enabling participation for groups that usually do not participate might not increase voter turnout, but may instead contribute to equality in political participation (Beckman 2009: p.14 ff.).

Numerous practitioners and academics believe that innovative use of information and communication technology (ICT) lead to increased political participation (Heacock 2009, Banks 2008, Schuler 2008, UNCTAD 2011). Heacock (2009, p.6) conclude in her comparative research that “digital media can empower and inform citizens in ways as yet unmatched by any other method, and the demand for participatory technology in Africa is high”, UN highlight that ICT “can facilitate democratic processes and increase participation by citizens” (UNCTAD, 2011 p.15). Banks (2008 p.25) writes that mobile phones “allow citizens to engage more actively in civil society by monitoring elections and helping keep governments accountable” and Schuler (2008, p.144) states that a “growing number of election-monitoring organizations around the world employ SMS technology to improve the effectiveness of their monitoring efforts”.

Mobile phones are the most widely spread ICT in sub-Saharan Africa (ITU 2010, Hellström 2010), and “the most important activist technology” of recent (Zuckerman 2007). In Uganda, where almost 100 percent of the population is covered by a mobile phone network and where almost half the population (theoretically) has a mobile phone subscription (i.e. 14.7 million active SIM-cards, which does not equal mobile phone ownership) (GSMA 2011), mobile technology opens immense opportunities for new modes of communication, interaction and political participation (Hellström 2010).

In the run up to the general elections in Uganda 2011, a number of SMS enabled tools were deployed to increase the political participation: Political campaigns using mass SMS broadcasts, SMS application to determine voter registration status, SMS news service subscription, voter education using bulk SMS, parallel voter tallying and crowdsourced election monitoring platforms.

Democracy Monitoring Group (DEMGroup), a coalition of four Ugandan civil society organisations, funded by the Deepening Democracy Programme with technical assistance from National Democratic Institute (NDI) and Mountbatten Ltd, developed an open crowdsourcing platform dubbed UgandaWatch. The purpose was to provide citizens with a way to share their observations via SMS on various issues such as vote buying, registration hiccups, inappropriate campaign conduct, cases of violence, general complaints or positive feedback. The initiative was preceded by a national marketing campaign where radio jingles, newspaper advertisements and flyers were used to promote UgandaWatch and the dedicated shortcode 6090. The initiative generated more than 10’000 reports via SMS sent by more than 3’000 unique users. The crowdsourced reports were manually verified and geo-tagged by a team of trained volunteers before it was published online (however, only 25 per cent of them were actually published, the rest were filtered due to reasons such as issues in regard to verification or that texts were considered as spam). The cost of sending a SMS had been negotiated to 100 Uganda Shillings, i.e. roughly the price of a normal peer-to-peer SMS.

A typical message sent to UgandaWatch could read “Youth elections in Kanara sub-county ended in failure. complaints due to chaos, mismatch between votes cast & registered voters” or “In Mugalu zone mpererwe, da ballot boxes are not yet reached at da polling station”. Every message was to generate an automatic reply stating: “Thanks for SMSing UgandaWatch. We are independent of any party. Your number remains private. Our volunteers will follow up. Find out more: ugandawatch2011.org”.

1.1 Mobiles, Crowdsourcing and Election Monitoring
Using mobile communication technology to crowdsource in order to monitor and observe elections has been used in a number of sub-Saharan African states. The basic idea is that ICTs allow “very small contributions to be
effectively aggregated. Coordination costs have historically outweighed the benefits of small contributions, but new ICTs can be used to lower the associated overhead” (Garrett 2006). Crowdsourcing enables distributed interaction (Donner 2010), i.e. many-to-many interaction between users and ICT, distributed across geographical space and in time. In this research context, the small contribution of a single SMS becomes part of something bigger through the use of a temporal and geospatial archive of events, usually tagged on a comprehensive data map (see Ushahidi, CitiVox or Drupal’s Managing News for example).

Election monitoring initiatives using crowdsourcing can be divided into two main categories:

- Bounded crowdsourcing where trained volunteers, workers or observers sending (coded) reports to a centralized server.
- Open crowdsourcing where general public is allowed to submit (unstructured) reports.

See Table 1 for some recent mobile election monitoring initiatives in sub-Saharan Africa through open and bounded crowdsourcing.

<table>
<thead>
<tr>
<th>Type</th>
<th>Country</th>
<th>Year</th>
<th>Initiative</th>
<th>Technology</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Benin</td>
<td>2011</td>
<td>FORS Elections monitoring</td>
<td>Citi Vox, Frontline SMS</td>
<td>300 organised election observers. 2,000 reports via SMS. Volume problems with FrontlineSMS.</td>
</tr>
<tr>
<td>1</td>
<td>Burundi</td>
<td>2010</td>
<td>Burundi Friends Observe initiative, African Great Lakes Initiative (AGLI)</td>
<td>FrontlineSMS</td>
<td>120 citizen reporters. 735 SMS’s sent in which were then re-distributed, sending out 7,449 SMS’s. No mapping.</td>
</tr>
<tr>
<td>2</td>
<td>Uganda</td>
<td>2011</td>
<td>UgandaWatch (DEM Group, NDI)</td>
<td>Drupal, shortcode</td>
<td>Crowdsourced monitoring. 10’000 reports, 2’500 published</td>
</tr>
<tr>
<td>2</td>
<td>Nigeria</td>
<td>2011</td>
<td>ReclaimNaija</td>
<td>Ushahidi, Frontline SMS</td>
<td>Crowdsourced monitoring. 8’153 reports, 0.16% verified.</td>
</tr>
</tbody>
</table>


Based on the cases listed in Table 1, the rationale for using mobile phones to monitor and to facilitate citizen participation are, but not limited to:

- Speed (real-time reporting)
- SMS format (ubiquitous)
- Privacy (in relation to other methods)
- Costs (low cost solution compared with other solutions)
- Interaction (mobile phone user can receive information, document, publish and network—from a passive recipient to an active user)
Identified challenges are:

- Speed (information overload caused by unverified data)
- SMS format (character limitations, takes time, put user to risk, hard to verify)
- Privacy (threats to citizens’ privacy and safety when reporting)
- Costs (airtime, register shortcode)
- Accuracy (inaccurate information)
- Control (government surveillance)
- Technical problems (volume problems, delays, network)
- Illiteracy and lack of training
- Demographics (young urban male versus elderly rural woman)

2. DATA AND SURVEY METHODOLOGY

A few weeks after the elections, two SMS questionnaires were sent out to more than 100’000 mobile phone subscribers, querying their awareness of UgandaWatch and aiming at; a) finding out the reason/s for this form of political participation and, b) understanding the challenges and opportunities in using mobile phones for political participation. Two different questionnaires were sent out to:

- general public, i.e. a randomized sample of 112’381 unique Ugandan mobile phone numbers resulting in 856 complete questionnaires.
- crowd, i.e. a sample of 1’500 users of UgandaWatch resulting in a total of 1’722 relevant answers.

Each question was sent in a separate SMS where the first one asked for an informed consent regarding participating in the survey free of cost. Only those giving their consent received the following SMSs. All questions were tested on a group Ugandans with differing socio-economic background and thereafter modified, before finalized and sent to the samples.

2.1 General Public

In March-April 2011, a structured questionnaire of six questions was sent out via SMS to 112’381 unique Ugandan mobile phone numbers (hereafter this sample will be referred to as the “general public”). It generated 856 complete questionnaires, i.e. understandable replies on all five questions asked, representing a response rate of 0.76 per cent. The survey design, where the system generated questions only after a reply on the previous had been given, led to a dropping response throughout the surveys (initial question for example generated a response rate of 2.78 per cent). To increase the response rate, a reminder was sent to 2’500 numbers within the initial sample. The reminder had a huge impact and increased the response rate from 122 completed questionnaires to 856.

We queried basic demographic information, but did not collect identifying information. Anonymous phone numbers were randomly selected from the subscriber database of Dmark Mobile (www.dmarkmobile.
Due to technical reasons associated to the dedicated shortcode used, the questionnaire could only be sent to MTN and Warid customers, i.e. only to two of Uganda’s seven mobile network operators. The fact that the population, from which the sample is drawn, is subscribers of SMS-services, such as daily bible quotes and sport news, indicate that the sample is not representative of the Ugandan population, but instead skewed in favour of young, urban men. Given the fact that 73 per cent of the respondents were men, the sample can not be said to represent the Ugandan population as a whole. Instead the sample may be viewed as a most-likely sample with a certain level of mobile literacy. “General public” in this case is thereby not representative of the average Ugandan, but rather of the average ICT-savvy Ugandan.

2.2 UgandaWatch Crowd

In early March 2011, about 3’000 unique numbers, representing users of UgandaWatch (hereafter referred to as the crowd), had sent reports to UgandaWatch. A randomised selection of 1’500 mobile numbers was made to which the first question of the questionnaire was sent via Text To Change’s (www.texttochange.org) shortcode 8282. To increase the response rate, we sent one reminder to close to 1000 of the numbers as well as offering an incentive to 500 numbers, in the shape of an opportunity to win 20’000 Uganda shillings worth of airtime, for participating in the survey.

The incentive brought an actual gain to participating in the survey but also meant there was a greater risk that people outside our population would respond, or that the same person would use different numbers to respond to the survey. To limit this problem, after the incentive-SMS was sent, we only kept the replies coming from the original randomised sample. This meant an increased data loss, but possibly a more qualitative sample.

The randomized sample of 1500 mobile numbers turned out to be an exceptionally dynamic one: only a fraction of the replies came from the original sample (i.e. rest came from numbers outside the original sample), and same number did not answer all questions (numbers were lost and new added throughout the 10-question survey). We identify two possible explanations of this. The first is that different SIM-cards were used. The respondents may have received a question to one SIM-card, but then used another to reply. The second explanation is that the persons in the sample shared the survey with friends, who then also participated in the survey. In this case, it is hard to know whether they had used UgandaWatch and thereby representative of the population of UgandaWatch users. However, the first half of the questionnaire required experience from UgandaWatch and a qualitative review of the replies rather support the first explanation. Therefore it is assumed that the sample is in fact representative for the UgandaWatch users.

The response rate for each and every question was about 10 per cent. However, only 29 numbers, less than 2 per cent, answered all survey
questions. Unfortunately, this makes bi- and multivariate analysis difficult and also illustrates the survey dynamic, with a very large amount of numbers entering and exiting the survey at various times.

2.3 Critique of Method

Running a SMS questionnaire had a number of limitations. The format of an SMS is one: formulating the question and reply alternatives using 160 characters is hard. It is also problematic to connect a number to an individual; same person can answer many times using different numbers, different persons can answer the questionnaire using the same number, different persons may have been answering different parts of the questionnaire etc.. The mobile phone is only the medium. It is therefore hard to establish correlation and to control the sample size (snow ball sample). The questionnaires were all free of charge for the respondent, i.e. the cost was on the receiver. Designing a questionnaire like this makes it hard to budget for and control the total cost since all incoming SMS are allowed and spammers are hard to stop.

3. RESULTS

3.1 Reaching Out

Despite the national marketing campaign and a relatively generous marketing budget, mainly used on radio jingles and newspaper advertisements, flyers and t-shirts, about 40 per cent of the sample general public had never heard of UgandaWatch. A majority of those who had learned about it had done so via radio (45 per cent), followed by newspapers and friends (17 per cent each).

The numbers were very similar among the sample crowd (radio 36 per cent, newspapers 17 per cent and friends 18 per cent). The flyers had a bigger impact among the crowd than among the general public (8 per cent as opposed to 2 per cent). It stands clear that radio promotion had the single largest impact for spreading the word about the SMS hotline, but that newspapers and social networks also constituted important channels. Initially bulk SMS was used to promote UgandaWatch, but due to the unclear legal status of unsolicited bulk SMS in the run-up for the election, this marketing method was abandoned.

3.2 Why (Not) Participate?

Among the general public, the top-two reasons for not using UgandaWatch were that they had not heard of it, as well as that they had nothing to report (22 per cent). 9 per cent reported that they felt it was too unsafe. It is however likely that those experiencing a high degree of unsafety using SMS for political participation would not at all respond to a SMS survey like this, the percentage may therefore indicate the minimum level of safety concerns. 4 per cent did not use UgandaWatch because of lack of time. Only a few
respondents of the general public (less than 1 per cent) found the service too expensive and indicated that money constituted an obstacle.

The single biggest reason for the crowd’s participation was to “Help my country” (72 per cent). The second biggest reason, constituting 14 per cent of the answers, was to “Get help” followed by 11 per cent of the answers stating they had nowhere else to turn. Only a few answered they wanted to test the service or stated other reasons.

The number one challenge using UgandaWatch among the crowd was the cost. Almost a third of the answers expressed that 100 Uganda shillings was an obstacle. Almost as many, 28 per cent, state as challenge that the SMS had no effect or that they did not receive a reply from UgandaWatch. 12 per cent of the crowd had network issues. The percentage among the crowd stating safety as a challenge for using UgandaWatch, was only slightly higher at 11 per cent, compared to the general public.

The two components of UgandaWatch was the SMS hotline and the public website where the reports were mapped. However, results from the survey show that many of the citizen reporters never used both components: almost half of the crowd (45 per cent) never visited www.ugandawatch2011.org and did thereby not see the bigger picture of the whole exercise. Of those in the crowd that did visit the website, 75 per cent did so using their browser in their mobile phones.

When asked about the best methods for democratic participation, a steady majority of 61 per cent of the general public and 46 per cent of the crowd expressed a preference for traditional means as public meetings.

Only 12 per cent of the general public’s answers mention SMS or Internet while among the crowd this figure was 32 per cent. It is possible that a skewness in favour of the traditional means has occurred, caused by the articulation of the question asking for the “Best way for democracy
participation?”, not giving room for the possibility of several methods being preferred. In spite of this, up to 10 per cent of the respondents did actually state several methods, and to limit the problem of skewness, all their stated alternatives were included in the results.

![Fig. 2: Best Methods for Democratic Participation According to General Public (Left) and the UgandaWatch Crowd (Right)](image)

Further, a vast majority, 61 per cent, of the crowd state that they are not involved in a civic organisation and 15 per cent state that they did not vote in any of the elections.

4. DISCUSSION

4.1 Marketing of UgandaWatch

Despite the national marketing campaign of UgandaWatch, roughly 40 per cent of the general public had never heard of it. This illustrates the challenge of marketing SMS-services, as well as the implications of non-existent meta-information on mobile applications and services. There is no way for a isolated user with a feature phone to find out what solutions are available, why and how to use them as opposed to a Internet user who can use a search engine.

As stated above, the initial idea was to promote UgandaWatch via bulk SMS, but since unsolicited SMS’s are a legal grey zone in Uganda, the idea was scalped. A major advantage in promoting the initiative via SMS would have been that the actual shortcode 6090 would automatically have entered people’s inboxes making it easier for people to remember and send reports to the platform.

Other similar projects seem to face marketing problems too. One of Ushahidi’s co-founder, Juliana Rotich, notes the limited impact the platform had within Kenya when the service was rolled out in 2007. Ushahidi had no communication campaign to help people learn about the platform and those who used it were mostly regular Internet users. She states, “we were not able to reach a critical mass of people in the country, partly because we did not
get much local awareness” (Essoungou 2010). Marketing of the platform has in fact been a challenge for many Ushahidi implementations.

Yet another example comes from Transparency International who carried out a random sample survey of individual knowledge about the anti-corruption hotline operated by Kenya’s anti-corruption commission. The study “revealed that only 33 per cent knew of the hotline’s existence despite a high public knowledge of corruption issues and government efforts to publicise the service” (Transparency International, 2009, p.2).

It is clear that radio was the single most important channel for marketing UgandaWatch. With as many hearing about it through friends, it is possible that the impact of the word of mouth, and social networks, was underestimated in the marketing plan. Related to this issue is the quality of the marketing campaign. Many of the messages sent were not very informative and required follow up and verification. 75 per cent of all the messages sent to UgandaWatch were never published.

4.2 Closing the Feedback Loop
Almost half of the UgandaWatch informants never accessed UgandaWatch’s website. This highlights one of the main challenges with crowdsourcing using low-end units designed for voice and SMS only: closing the feedback loop. This needs to be addressed if people are to continue feeding similar crowdsourcing platforms with information. Luckily, of those who did visit the website, 75 per cent did it through their mobile, again indicating the role mobile Internet do and will play in the future.

The fact that the third most frequent reason for participating through UgandaWatch was because there was nowhere else to turn indicates that a service like this fills an existing void. Simultaneously, 14 per cent turned to UgandaWatch to get help. It is however unclear if DEMGroup and their partners had the same intention with the service as the users. On one hand, UgandaWatch was promoted as a “Citizen’s Reporting SMS Hotline” indicating that UgandaWatch was not an emergency number providing help, but rather a number to call for passing on information. On the other hand, UgandaWatch also emphasized that they “investigate” as well as report to the police and the Electoral Commission. This implies that the service may actually provide help. The communication of the purpose of UgandaWatch was, in other words, unclear. This is also emphasised by the 21 per cent who experienced it as a challenge that their SMS had no effect or that they did not receive any response. A question, which arises, is what impact this ambiguity will have on future M4D-services. With UgandaWatch being one of the pioneering large-scale open crowdsourcing implementations in Uganda it is possible that those, whose expectations were not met, will reject future attempts.
4.3 Affordability

Discussions were held within DEMGroup to subsidise the service and even offer it for free but the fear was that this would generate a lot of unsolicited messages and abuse of the platform.

Surprisingly, in the shed of all the theories pointing to lack of resources as an obstacle for participation, only a small percentage of the general public reported they did not use UgandaWatch because of lack of money. Simultaneously, a third of the crowd stated cost as a challenge for using UgandaWatch. In other words, among those who were not using UgandaWatch cost was not a reason for avoiding the service, but among those participating the cost did constitute an obstacle. A way to understand this could be that the users of UgandaWatch may use the service several times, and that the accumulated cost thereby constitutes an obstacle for participation.

4.4 Political Participation through ICT

Both the general public and the UgandaWatch crowd preferred public meetings as method for democratic participation. Consequently, as a contribution to the discussion of new versus traditional methods for participation, it seems as if traditional ways for participation are still the most important, both for those already participating through ICT and for those who do not. Nevertheless, ICT-enabled methods appear to constitute a complement, especially SMS and radio. To nuance this finding, it is important to bear in mind that the question in the survey was in regard to democratic participation in general. When looking at participation in specific issues, it is possible that the results would differ. It is also worth noting that whereas only 3 per cent of the general public found SMS being a good method for democratic participation, as many as 22 percent of the UgandaWatch users preferred SMS. Thus, it seems as if when using a specific service for ICT-enabled participation, one’s preference and understanding for mobiles as a tool for participation in general, increases.

A vast majority of the UgandaWatch crowd stated that they were not involved in civic organisations. It is of course possible that those not being involved in a civic organisation use other means for participation. However, the term “civic organisation” is fairly inclusive including for example churches and community-based organisations. Conclusively, it seems as if this form of SMS-participation does attract also those who do not participate through the traditional channels. If SMS-enabled participation can offer a channel for participation also among those who normally do not participate, this is something that will affect political equality in a positive direction. The fact that 15 per cent of the crowd did use UgandaWatch, but did not vote, also shows that UgandaWatch provided an additional channel to voting, for participation in the electoral process.
4.5 Be Political, But not too Political!

An advantage using SMS to report incidents is the possibility of privacy and security:

“For example, if one is witnessing an event first-hand it may not be possible to inform others by a traditional cell-phone call since people in the vicinity might overhear and might misunderstand the reasons why other people are being alerted, putting the observer at risk.”

— (FrontlineSMS, 2010)

However, about 10 per cent reported that it was too unsafe to send a SMS to UgandaWatch. This figure is probably higher since the users with security concerns did probably not respond to the SMS survey either. Digital communications leave traces, SMS being no exception. SMS are permanent records, stored by the operator and can be accessed and tracked by outsiders (i.e. government) at any time. Even if the SIM card is changed the phone’s unique identifier (the underlying phone hardware, i.e. IMEI, International Mobile Equipment Identity) can be tracked and the sender exposed.

Human mobile technology activities generate a lot of spatio-temporal data constantly recorded by the operator for operational and billing purposes. The data could be used for a number of innovative, location-based applications like intelligent marketing and effective transportation systems. Authorities could also use the data for whatever purpose putting the individual privacy and health at risk. How many did not use the service because of reasons like this is impossible to tell, but self-censorship and privacy/security issues are to be taken seriously.

During the election day the regulator (under pressure from the government), ordered the operators to filter and block SMS traffic and specific words in messages (Biryabarema 2011). Filtered SMSs later on reached the platform but created a terrible backlog and the whole idea of publishing observations in near real-time was lost. Therefore, when operating in politically sensitive environments it is important to have various backup systems and communication channels in place.

5. Conclusion

For mobile phones to be a tool that increase the political participation at scale, a number of issues need to be addressed.

- Marketing is an issue, which in this case had not been resolved to a satisfying extent. A substantial proportion of the ICT-savvy general public had never heard of UgandaWatch and did thereby not have the opportunity to use it. Among those using UgandaWatch, there was confusion regarding the purpose of the service - people did not know what UgandaWatch really was. Marketing is key and should not be underestimated, preferable is also to make the marketing
campaign educational (how to use the service) and explain its cause (why use the service and what to expect).

- Close the feedback loop and find ways to interact with the crowd. Users described it as an obstacle to their participation when they experienced that there were no results of their reporting, or when their participation was not confirmed. This highlights one of the main crowdsourcing challenges when mostly low-end units are used as the only channel. When civil society uses SMS as a method for participation, it is presumably because it is believed that the interaction of SMSs provides an added value. However, if the tool itself is not used in an interactive manner, the idea falls flat. The automated confirmation reply solved some of the problems but not all. The geo-tagging could have been used better, for example by enabling feedback to the users in the form of a response SMS informing the user of the top-three reported incidents in his or her area. With a majority of those visiting the website, doing so through their mobile phones, it is crucial that the website is developed having the interface of a mobile browser in mind. Nevertheless, the fact that about half of the users of the SMS-service did not at all visit the website, emphasises the need for additional feedback channels. Without the feedback or the experience that one’s participation has some kind of result, there is a risk that users will argue that participation is useless and, as a consequence, abandon the service after their first try.

- Multiple channels are not only necessary when it comes to feedback to the user. When operating in politically sensitive environments it is important to have various backup-systems and communication channels in place. Relying on only one channel – SMS - as UgandaWatch did, makes the system very vulnerable. During Election Day when SMS were filtered and blocked for some hours the whole platform became static. By integrating more channels, such as a call-in function, status updates and tweets, the service would become more solid. A related issue is that some users might refrain from using a SMS-service when wanting to report sensitive information. Thus, a broader spectrum of channels to choose from may limit the serious issues of self-censorship and privacy/security, and as a consequence also result in more information.

New information and communication technology like mobile phones seems to offer a promising complement to traditional methods for participation. People, who have used ICT-enabled channels, seem to be keen on exploring them in the future. SMS-enabled participation also appears to attract those not usually participating, and thus contributing to political equality. By constituting a countrywide venue for observation of the electoral process, citizens all over Uganda could participate in creating
conditions for a freer and fairer election in Uganda. However, it is also important to remember the voices not being heard in this venue - whose problems were reported on and whose were not? In our study, issues regarding the construction and implementation of a mobile service of this kind became evident. Nevertheless, it was also clear that many of these issues could quite easily be remedied. Hopefully, lessons can be learned from this ground breaking initiative to make further use of the possibilities that mobile phones can offer for democracy and development.

6. ACKNOWLEDGEMENT

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Determinants of Mobile Communication Growth: 
A Case Study of India

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Abstract—The world is in the phase of a mobile revolution. About fifteen years ago only a small fraction of the world used mobile services. Beginning in the late 1990s, global development agencies came to recognize its potential benefits. In this piece of work we have studied growth of mobile communication over the past decade has shown its potential impacts upon quality of life in India. Quantitative and macroeconomic research has been conducted to find association between mobile phone penetration and developmental gains at a country level. Study is carried out to document the factors responsible for mobile penetration and its causal relationship with macroeconomic indicators. This work seeks to inform the policy-making debate and developmental practices over the coming years. Although this study focuses on India, our findings may be relevant for many other emerging economies.

Keywords: Mobile Communication, Gross Domestic Product, Foreign Direct Investment

1. INTRODUCTION

The spread of mobile phones across the developing world is one of the most remarkable technology stories of the past decade. Buoyed by prepay cards and inexpensive handsets, hundreds of millions of first-time telephone owners have made voice calls and text messages part of their daily lives. The rapid adoption of mobile phones has generated a great deal of speculation and optimism regarding its effect on economic development in developing countries. An article in the Economist (2008) similarly reported: "A device that was a yuppie toy not so long ago has now become a potent force for economic development in the world’s poorest countries.”

According to Oxford English Dictionary one of the earliest uses of word ‘mobile’ was in association with the Latin phrase ‘mobile vulgus’, i.e. excitable crowd. Today’s mobile phones live up to these origins. This technology introduces new senses of speed and connectivity to social life. If the fixed line telephone has brought communication links into the workplace and homes, the ‘mobile’ puts them straight into the hands of unprecedented numbers and varieties of individuals.

One indication of the benefits of telecommunications investment is the strong correlation between telecommunications development and overall economic development. A long series of studies, initiated first by Jipp (1963), demonstrated the positive relationship between measures of GNP or GDP per capita and telephone density indicators, including DEL or lines per 100 inhabitants. In a more recent study, Dutta (2001) finds that the evidence for causality that runs from telecommunications infrastructure to economic
activity is stronger than that for causality in the opposite direction. This pattern holds for all of the 15 industrialized and 15 developing countries being studied. The results of Chakraborty and Nandi’s (2003) study indicate a bidirectional relationship between teledensity and GDP in both the short run and the long run in 12 developing countries in Asia.

Mobile phones have become the primary form of telecommunication in both developed and developing countries. Globally, mobile phone networks play the same role that fixed-line phone networks did in facilitating growth in Europe & North America in the 20th century. The industry has experienced explosive growth in a relatively short time span. The first billion mobile phones took around 20 years to sell worldwide. The second billion were sold in four years. The third billion were sold in two years. Coverage has expanded and mobile phone subscriptions in developing countries have increased by over 500% since 2000 (Wireless Intelligence 2007). It is estimated that over 50% of the world’s population will own a mobile phone and that 80% of the world’s population will live within the range of a cellular network, by the end of 2008. The projections for future performance are similarly impressive to those tracking past performance. By 2010, GSMA projects that 90% of the world will be covered by mobile networks and mobile communication will deliver data, internet and voice services to more than 5 billion people by 2015 – double the number connected today (GSMA, 2007).

Using a spatially disaggregated dataset of mobile phone coverage and geographic characteristics, Buys, Dasgupta, Thomas and Wheeler (2009) find that the probability of having a mobile phone tower in a particular location is strongly and positively associated with potential demand factors, such as population density and per capita income, as well as the competitiveness of the mobile phone sector within the country. They also find that factors associated with higher costs namely, higher elevation, steeper slopes, and distance from a main road and major urban centers are negatively associated with mobile phone coverage. Empirical evidence suggests that these factors partially explain the rollout of mobile phone service within countries as well, but depend upon the topographical features of a particular country.

A central concern in estimating the effect of mobile phones on market efficiency is omitted variables bias, as it can be difficult to attribute changes in the outcomes of interest to mobile phone coverage rather than to unobservable factors. In addition, estimates can be subject to reverse causality, as changes in the dependent variable could influence the geographic location or speed of mobile phone coverage. To address these concerns, existing economic studies typically rely upon panel data and the quasi-experimental nature of the rollout of mobile phone service to identify the effect of mobile phones on development outcomes. From ITU reports announcing the discovery of the “missing link” (Kelly, Minges & Gray, 2002) in the telecommunications and development problem, to researchers and journalists reporting on how mobile phones are empowering farmers,
fishermen, traders and poor people in general with increased operation efficiency, higher revenues and access to resources, there is widespread recognition of the unexpected impact of mobile telephony in the developing world.

India’s telecommunications industry is considered to be one of the more successful stories of Indian liberalisation attempt. This is indicated by the fact that the country has one of the cheapest and state of the-art telecom services anywhere in the world.

![Fig. 1: Mobile Subscribers vs. Per Capita GDP Growth](source: World Development Indicators, World Bank (WDI, 2011), UNCTAD (2011))

The density of telephones in the country has increased from merely 0.008 telephones per 100 people in 1995 to about 64 per 100 in 2010 Mobile phone services were introduced in India about 10 years ago. Then, barely one in 10 homes in cities had a landline and public phones were few. From those late 1980s, India has come a long way today. It has emerged as the second-largest market after China for mobile-phone handsets. The Indian telecom sector was thrown open to the private sector in the mid-nineties. This industry, along with IT, was labelled as one of India’s sunrise industries. Sensing the opportunity, a number of private players have ventured into this sector.

### 2. Mobile Communication and GDP Growth

Review Studies on the effect of telecommunications development on economic growth began in the 1960s. Many of these confirmed a clear, positive correlation between telecommunications and economic growth (e.g., Jipp, 1963; Hardy, 1980; Moss, 1981; Saunders et al., 1994; Lichtenberg, 1995; Greenstein and Spiller, 1996). Let us first examine the evidence that the use of mobile phones boosts overall GDP. Vodafone (2005) reported that, in a typical developing country, an increase of 10 mobile phones per 100 people boosts GDP growth by 6%. Ovum (2006) reported that the mobile services industry contributed Rs 313 ($7.8 billion) towards GDP in India. McKinsey (2007) estimated the contribution of mobile operators and mobile-related companies and reported that, in China mobile-related companies contributed twice as much to GDP, as mobile operators. Deloitte (2008) reported that, in all 6 countries analyzed (Bangladesh, Malaysia, Pakistan, Serbia, Thailand, and Ukraine) mobile phones had a significant impact on GDP.
In above figure we can see that in comparison to any other sector the contribution of tertiary sector is kept on increasing where as primary and secondary sector shows downward trend. Therefore instead of GDP growth only it would be wise decision to study all sector to find out appropriate causal relationship between mobile penetration rate and economic growth.

3. **Mobile Communication and Foreign Direct Investment**

FDI in telecommunication took place in developing countries during late 1980s and 1990s (World Bank). Since late 1990s certain companies from developing economies emerged as significant investors as they started to fill the gap left by withdrawal of some international providers from developed world (Aykut and Goldstein, 2006). During 1980s, utility of telecommunication sector was globally recognized and it was considered as the pre-requisite for the economic growth. Thus gradually in all countries various telecom sector regulatory reforms like opening of boundaries for foreign direct investment (FDI), liberalization and privatization were introduced. India started its liberalization process in telecommunication by allowing private competition in value added services in 1992 followed by the opening of cellular and basic services for local area to private competition.
National Telecom policy, 1994 stated that license bidding process should be initiated to end the monopoly on basic telephone and mobile services.

4. **Objective of the Study**

The broad objective of this study is to contribute to understanding and estimation of causal relationship between mobile penetration rate and economic development by exploring mobile subscribers in India. To find out how expansion of the telecommunications network contributing to economic development, and to identify the factors that make it possible. To fit appropriate model to forecast the penetration growth.

5. **Specification of the Model**

Based on the review of literature and on similar study studies done earlier, listing of variables that are considered for this study and possible determinants for mobile penetration. Empirical evidences are provided through econometric estimates of the models. The main objective of the study is to test for the presence of long run and linear relationship between mobile penetration and macroeconomic indicators.

The empirical methodology is motivated by the literature surveyed, but it is modified to accommodate the objective at hand. The choice of independent variables was dictated both by data availability and objective of the study. In the present study we purpose an estimation model as follows, where the selected variables are expected to determine the mobile penetration:

\[ MPN_t = \alpha + \beta_1 PCGDP_t + \beta_2 GDP_t + \beta_3 PRIMARY_t + \beta_4 SECONDARY_t + \beta_5 TERTIARY_t + \beta_6 FDI_t + u_t \]

(1)

Where

- \( MPN_t \) = Mobile phone penetration rate in country at time \( t \)
- \( PCGDP_t \) = Per Capita Gross Domestic Product growth rate at constant Prices (2005 prices) in country at time \( t \)
- \( GDP_t \) = Gross Domestic Product growth rate at constant Prices (2005 prices) in country at time \( t \)
- \( PRIMARY_t \) = Primary sector performance as percentage of GDP in country in time \( t \)
- \( SECONDARY_t \) = Secondary sector performance as percentage of GDP in country in time \( t \)
- \( TERTIARY_t \) = Tertiary sector performance as percentage of GDP in country in time \( t \)
- \( FDI_t \) = Foreign direct investment as percentage of GDP in country at time \( t \).
7. RESEARCH METHODOLOGY

Data about economic growth and mobile penetration in the country are required for the causality test. Following previous studies (e.g. Röller and Waverman, 2001; Chakraborty and Nandi, 2003), this study uses teledensity as a proxy to measure the development of the telecommunications sector. In view of the explosive growth of mobile communications in the past decade, the authors believe that including the number of mobile phone subscribers in our definition of teledensity is a better proxy to reflect telecommunications development in the country. Economic growth is measured by GDP in U.S. dollars at constant (2005) prices, Foreign direct investment data compiled by the World Bank. The data used in the causality study are taken from the databases of the World Bank (World Development Indicators), which provides a complete dataset of all needed indicators 1995 to 2010. As mobile communications were not popular in the early introductory stage, having a teledensity of less than one per 100 persons, the omission of these figures should not have any noticeable effect on the results of our study.

After that, the study would separately measure the causal relationship between economic growth and mobile penetration rate in the last 16 years (i.e. from 1995 to 2010) of the sample period, so as to assess the impact of mobile telecommunications development on economic growth To provide a assessment of the impact of mobile telecommunications on economic growth, mobile penetration rate (the number of mobile phone subscribers per 100 persons) and real GDP of the country is considered.

According to the classical regression model, the dependent and independent variables in a regression need to be stationary to avoid the problem of “spurious regression.” A spurious regression occurs when a pair of independent series is found to be apparently related according to the standard inference in an OLS regression (see Granger and Newbold, 1974). The presence of non-stationarity can be tested by conducting unit-root tests, which determine the stationarity of the variables and the order of integration. Fisher-Augmented Dickey-Fuller (Fisher-ADF) (Dickey and Fuller, 1979; Said and Dickey, 1984) has been applied to test for stationarity. A model is applied to investigate the causal relationship between mobile penetration and macro economic indicators, for India during the 1995-2010 period. The model for examining the causal relationship between same is shown as follows.

\[ Y_t = \alpha_0 + \sum_{t=1}^{m} \alpha_m Y_{t-m} + \sum_{t=1}^{m} \beta_m X_{t-m} + \epsilon_t \]  

\[ X_t = \alpha_0 + \sum_{t=1}^{m} \alpha_m X_{t-m} + \sum_{t=1}^{m} \beta_m Y_{t-m} + \mu_t \]

for all possible pairs of (x, y) series in the group. The reported F-statistics are the Wald statistics for the joint hypothesis: all \( \beta_i = 0 \) for each equation. The null hypothesis is that does not Granger-cause in the first regression and that does not Granger-cause in the second regression.
8. RESEARCH HYPOTHESIS

The tests of hypothesis are concerned with determining whether the findings lend support to some hypothesized causal relationship between the dependent and explanatory variables. The null hypothesis contend that there is no such relationship while the alternative hypothesis postulates the existence of such relationship. The literature review thus indicates, the following hypotheses which can be derived:

Ha: All determinants under study have significant impact on mobile penetration rate

9. STATISTICAL ANALYSIS

The outcome generated by economic models and analyses are only as valid as the initial data. An effective economic model requires a valid, reproducible and accurate statistical time series over a significant period of time. Regression analysis (was conducted to identify the major factors that might affect mobile penetration rate in the country countries during the sample period (from 1995 to 2010 shown in Table 1 of Annexure I). The results of the regression analysis (shown in Table 2 of Annexure I) indicate that the performance of tertiary sector and foreign direct investment has significant impact on growth in mobile penetration rate. Correlation matrix (Table 3 of Annexure I) indicates the significant correlation between performance of tertiary sector and foreign direct investment. We have conducted factor analysis (Table 1 of Annexure II) to make clear understanding of set of uncorrelated variables having significant impact on mobile penetration rate. Factor analysis result also verifies the same. The overall result of estimation indicates that there is a causal relationship between some macroeconomic indicators and mobile penetration in the country for the period 1995 and 2010.

<table>
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<th>Pairwise Granger Causality Tests</th>
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</tr>
<tr>
<td>Sample: 1995 2010</td>
</tr>
<tr>
<td>Lags: 3</td>
</tr>
<tr>
<td>Null Hypothesis</td>
</tr>
<tr>
<td>Tertiary does not Granger Cause MPN</td>
</tr>
<tr>
<td>MPN does not Granger Cause TERTIARY</td>
</tr>
</tbody>
</table>

Finally we performed Granger Causality Test for the significant variable and found that performance in tertiary sector Granger Cause mobile penetration rate at third lag. We have also noticed that in both the variables performance of tertiary sector and mobile penetration rate, growth follows Cubic Model significantly Shown in figures below in Figure 4.1 and Figure 4.2:
Hence through this causal relationship between mobile penetration rate and performance of tertiary sector where tertiary sector is significant determinant of mobile penetration rate we can foresee the vision 2020 of telecom sector of India.

10. CONCLUSION

In this paper we have examined model for the causal relationship between mobile penetration and macroeconomic variables. Data between 1995 and 2010 are used in the empirical estimation. The overall result of our estimation indicates that there is a causal relationship between mobile penetration and performance of tertiary sector and also confirmed by granger causality test. This implies that in the country, an increase in tertiary sector along with foreign direct investment which is significantly correlated, the demand for mobile services is also increases. The direction of causation sheds light on future telecommunications policies. In addition to this we have also suggested cubic model to have insight of future growth.

In future research, we may develop a structural model that includes the determinants of mobile communication, other than economic growth.

\[ MPN = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \alpha_3 t^3 + \epsilon_1 \]

\[ \text{TERTIARY} = \beta_0 + \beta_1 t + \beta_2 t^2 + \beta_3 t^3 + \epsilon_2 \]
such as business environment, transportation network, education, and manpower training. Although the empirical results indicate no overall causal relationship between mobile penetration rate and determinants considered for study but such a relationship may exist for state wise study of country. This task will be time-consuming, but the results will help us to better understand the patterns of causal relationships in different regions.

REFERENCES
## ANNEXURE 1

**Data Table 1**

<table>
<thead>
<tr>
<th>Year</th>
<th>Subscribers (Per 100 People)</th>
<th>Per Capita GDP Growth Rate</th>
<th>Primary Sector</th>
<th>Secondary Sector</th>
<th>Tertiary Sector</th>
<th>Foreign Direct Investment</th>
</tr>
</thead>
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<tr>
<td>1995</td>
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<td>4.05449847</td>
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<tr>
<td>2000</td>
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<td>2004</td>
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<td>2005</td>
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<tr>
<td>2010</td>
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<td>7.0049822</td>
<td>8.80640368</td>
<td>14.90197</td>
<td>26.62229</td>
<td>58.47574</td>
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### Table 2: Regression Analysis

#### Model Summary

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<th>Model</th>
<th>R</th>
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<th>Adjusted R Square</th>
<th>Std. Error of Estimate</th>
<th>R square Change</th>
<th>F Change</th>
<th>df1</th>
<th>df2</th>
<th>Sig. F Change</th>
<th>Durbin-Watson</th>
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<td>.59466</td>
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<td>9</td>
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a. Predictors: (Constant), FDI, GDP, Tertiary, Secondary, PCGDP, Primary
b. Dependent Variable: MPN

#### Table 2.1

#### ANOVA

<table>
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<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
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<td>Residual</td>
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<td>.354</td>
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</tr>
<tr>
<td>Total</td>
<td></td>
<td>114.472</td>
<td>15</td>
<td></td>
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</tbody>
</table>

a. Predictors: (Constant), FDI, GDP, TERTIARY, SECONDARY, PCGDP, PRIMARY
b. Dependent Variable: MPN
Table 2.2: Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
<th>Collinearity Statistics</th>
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<td></td>
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<td>Beta</td>
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<td>1</td>
<td>(Constant)</td>
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<td></td>
<td>PCGDP</td>
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<td>GDP</td>
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<td>Tertiary</td>
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a. Dependent Variable: MPN

Table 3: Correlation Matrix of Independent Variables

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<th>PCGDP</th>
<th>GDP</th>
<th>Primary</th>
<th>Secondary</th>
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<td>Sig. (2-tailed)</td>
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<tr>
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<td>SECONDARY</td>
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<td>.598*</td>
</tr>
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<td>Sig. (2-tailed)</td>
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<tr>
<td>TERTIARY</td>
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<td>.192</td>
<td>.585*</td>
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<td>.232</td>
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<tr>
<td>FDI</td>
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<td>.317</td>
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<td>16</td>
<td>16</td>
<td>16</td>
</tr>
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</table>

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Annexure II

Table 1.1: Factor Analysis

<table>
<thead>
<tr>
<th>KMO and Bartlett’s Test</th>
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<tbody>
<tr>
<td>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</td>
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<td>Bartlett’s Test of Sphericity</td>
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Table 1.2

<table>
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<td>FDI</td>
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Extraction Method: Principal Component Analysis.

Table 1.3: Total Variance Explained

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<th>Component</th>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
<th>Total</th>
<th>% of Variance</th>
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<th>% of Variance</th>
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Table 1.4: Rotated Component Matrix

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<tr>
<td>PRIMARY</td>
<td>-.909</td>
<td>-.344</td>
</tr>
<tr>
<td>SECONDARY</td>
<td>.403</td>
<td>.608</td>
</tr>
<tr>
<td>TERTIARY</td>
<td>.881</td>
<td>.163</td>
</tr>
<tr>
<td>FDI</td>
<td>.869</td>
<td>.091</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 3 iterations.

**Normality Test for Mobile Subscribers**

Table 2: Tests of Normality

<table>
<thead>
<tr>
<th>Mobile Subscribers (per 100 people)</th>
<th>Kolmogorov-Smirnova</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistic</td>
<td>df</td>
<td>Sig.</td>
</tr>
<tr>
<td>.111</td>
<td>16</td>
<td>.200*</td>
</tr>
</tbody>
</table>

*a. Lilliefors Significance Correction
* This is a lower bound of the true significance.

Table 3: Tests of Normality

<table>
<thead>
<tr>
<th>Tertiary Sector</th>
<th>Kolmogorov-Smirnova</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistic</td>
<td>df</td>
<td>Sig.</td>
</tr>
<tr>
<td>227</td>
<td>16</td>
<td>.052</td>
</tr>
</tbody>
</table>

*a. Lilliefors Significance Correction*
### Table 4.1: Cubic Model Analysis for Tertiary Sector

<table>
<thead>
<tr>
<th>Model Summary</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>.974</td>
</tr>
<tr>
<td>R Square</td>
<td>.948</td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>.935</td>
</tr>
<tr>
<td>Std. Error of the Estimate</td>
<td>.019</td>
</tr>
</tbody>
</table>

### Table 4.2: Anova

<table>
<thead>
<tr>
<th>Sum of squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>.076</td>
<td>3</td>
<td>.025</td>
<td>73.111</td>
</tr>
<tr>
<td>Residual</td>
<td>.004</td>
<td>12</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>.080</td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 4.3: Coefficients

<table>
<thead>
<tr>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Sequence</td>
<td>.051</td>
<td>.012</td>
<td>3.318</td>
</tr>
<tr>
<td>Case Sequence ** 2</td>
<td>-.004</td>
<td>.002</td>
<td>-4.914</td>
</tr>
<tr>
<td>Case Sequence ** 3</td>
<td>.000</td>
<td>.000</td>
<td>2.606</td>
</tr>
<tr>
<td>(Constant)</td>
<td>3.738</td>
<td>.024</td>
<td>155.923</td>
</tr>
</tbody>
</table>
Innovative Management with Mobile
Utilising Mobile Mesh Networks for Disaster Management

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Abstract — Disaster management process involves two phases: pre-disaster, which includes mitigation/preparedness and post-disaster that includes response and recovery. The latter deals with mobilising support, services and resources. The post-disaster management requires overall quick response from police, paramedics and anti-terrorist squad as well as specialist disaster recovery teams, available onsite and offsite, and are classified as first responders and control centre respectively in this abstract.

The model proposed in the research addresses preparedness, response and recovery stages of disaster management. The four major entities – people in the disaster area, hereby called victims, specialist application on mobile phones, hereby called, iSurvive, onsite specialist disaster management team, the first responders and offsite specialist team, the control centre, communicate using ubiquitous wireless and mobile communication technologies to address various stages in disaster management.

As part of preparedness phase of pre-disaster management, people subscribing to iSurvive application would have their profiles available on a web-based system, accessible at control centre. The mobile application, iSurvive, initiated by victims, would kick-start a communication process using wireless and mobile communication technologies from GPS, WiFi, Bluetooth and GSM, that would help to set up ad-hoc networks using functioning mobile phones within disaster area. These networks, which are self-configurable, would facilitate two-way communication within the disaster area and with control centre and first responders, using instructions, messages, images and videos. The control centre would also provide services, such as data validation, monitoring and logging of communication using iSurvive application to guide first responders and victims. During the recovery phase, after the connection between victims and first responders are established, data from within disaster area is gathered by first responders to pass on control centre for analysis and validation, guidance and instructions. The control centre would use the information received from disaster area to track victims’ profile, already available on web-based system, for purposes such as contacting next of kin etc.

As effective disaster response demands rapid access to reliable and accurate data and capacity to access, analyse and integrate information from varied sources, the security breach and misuse of communication in such networks pose a potential challenge and cannot be undermined. The reliability in communication process would be incorporated using data validation and authentication. As panic under disaster and emergency situations adversely affects normal human responses, other major challenge for mobile application design would be to make it user-friendly to guide victims under panic through series of guided steps. Other systemic challenges to address would include battery life and signal strength of these devices.

As versatile mobile disaster management application is far from reality. While the proposed application would serve disaster situations, such as, earthquakes, floods; additional extensions for security of communications in the proposed system would be necessary to deal with disaster situations involving terrorist attacks.
Traffic Management using Mobile Phones: A Case Study of Delhi

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Abstract—There are 5.5 million registered vehicles in Delhi (the capital city of India), which is the highest in the world among all cities. Delhi loses nearly 420 million man-hours every month while commuting between home and office through public transport, due to the traffic congestion. Also, Delhi has highest number of accidents according to a recent study conducted in 35 cities in the country with a population of over 10 lakh. This paper describes how Delhi Traffic Police uses SMS (Short Messaging Service) applications in monitoring traffic and in deploying new control strategies with the use of mobile phones. Commuters with mobile phones in Delhi can get traffic related information by simply pressing a few keys on their mobile phones. Delhi Traffic Police has considered the flexibility and versatility of SMS (Short Messaging Service) applications through mobile telephony and inaugurated SMS based traffic updates on 16th July, 2010 to reach out the people in matters concerning day-to-day traffic management. The aim of the project is to provide crucial traffic updates not only to the average motorist of Delhi, but also to the media persons (like city FM for announcements) and more importantly to traffic cops themselves while operating in the field (for traffic diversions). Delhi traffic police under this new initiative sends traffic updates to commuters in the city through SMS to their mobile phones. This technological advancement is done after the steep fall in the rates for mobile services and it has become favourite among all classes of people and no longer considered as only a rich man’s luxury. This SMS service is totally free of charge and can be subscribed sending requests to the mobile phone number 9219592195. The commuters need to subscribe to the service once and they start receiving updates on traffic congestion. The updates are sent every day and show points and stretches which should be avoided by the commuters and also specifies the reason for the congestion. This service comes after the successful implementation of facebook page of the Delhi Traffic Police, which saw many feedbacks and suggestions. General public can get information related to traffic situation information, helpline services, pending traffic violation notices and one or more challans pending if any on the basis of their vehicle registration number. Field traffic officers can get information related to prosecution information services, accident information service, vehicle ownership data and driver license related data details instantly. Investigative journalists can get authenticated and quick information on accidents and persecution etc. SMS Services include details of pending notice/s which has been issued for violation committed by a particular registration number and information about towed away vehicles. Thus the project offers, broadcast service to police personals, Information insertion service for administrators to insert records into database for helpline and other traffic information service. This facilitates regular updating of traffic situation like signal-light failure, power shut downs, congestion or traffic jams and other related data coming in from the field by traffic patrols Inspectors or by routine distress calls recorded in the traffic control or at 011-25844444, the traffic helpline number. Till now, there are 1.3 lakh registered commuters who regularly receive messages from the Delhi Traffic Police and hundreds more register every day. Through this initiative, traffic officials have realized the power of social media and mobile phones. If every city in the country adopts this kind of strategies, then there are ample chances of lowering the increasing traffic jams on Indian roads.
Opportunities of Mobile Technologies for Disaster Management in Bangladesh

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The geographic location, densest population and extreme poverty have made Bangladesh one of the most vulnerable countries in the world to the impacts of climate change and their miserable consequences. In recent times, the frequency and severity of the natural calamities increased, but inadequate resources and lack of accurate and real-time information for decision making impeded the ability of our central disaster management capacity, which results in long term negative impact on our socio-economic development.

Hence, this study was conducted to analysis the current use of information for disaster management in Bangladesh, and from various studies, some major bottlenecks identified in managing any pre- and post-disaster situation which includes, but not limited to, cumbersome paper-based data collection process, frequent changes in data collection formats, overlapping information collected by different NGOs and govt., gaps in organizational interoperability in information sharing, absence of real-time data visualization and analysis process, and rusty decision making from management-level based-on inaccurate, static and biased data. A mapping of emerging mobile technology-based initiatives to address these common barriers was conducted with a goal to understand what have worked and what have not in other countries.

Furthermore, this paper put forth a conceptual model for Bangladesh for closing the gaps in the information flow during the main three stages of disaster management- preparation, response, and recovery- by harnessing the power of mobile technology, data visualization, and information sharing tools. In brief, the frontline arms (e.g. volunteers, field-level officers) of govt. and NGOs can have inexpensive mobile phones loaded with sophisticated software (based on either Java (J2ME) or Android or iOS (iPhone/iPad) software) for collecting various data (including audio and picture) by interviewing beneficiaries and others, which then can be sent to a common server using GPRS connectivity to create a comprehensive and secured electronic database. The server can screen-out the data according to certain criteria, and interpret the information based-on the given logics. The GIS function of the smart cell phones can also create a digital zoning map of the vulnerable areas with important legends (e.g. schools as alternative...
shelters). Decision-makers can view the automatically processed near real-time information in different interactive dashboards/web-interfaces in any handy monitor (e.g., laptop, smart phone) to track the field situation and activity progress, and plan timely and targeted interventions through the field-level executors for minimizing the disaster impacts by optimal use of limited resources.
Providing Management Services through Mobile to Farm Youth, For Sustainable Agriculture Development

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In recent days, mobile is becoming one of the main instruments to help farm youth to ease the communication process. Mobile will help farm youth to operate sustainable agricultural operations more efficiently and overcome some of the challenges faced by the sector. The mobile becomes best due to its easy accessibility and convenient handling, the tool is highly reliable and enhances the scope of its utility, safety, security, style, status, heightened transactions, saves money, time and accurate advantage to farm youth. It won’t be a setback for illiterates. However, the Narayana’s Wheel Model of Management Services to Farm Youth explains that farm youth obtain assistance in getting operational activities required through mobile like TICMSIS i.e Technical advice, Production inputs, Credit support, Marketing services, Crop/livestock insurance, specialized services and Programme subsidy for different sustainable agriculture programmes at local level under present climate change. Further, Many times farm youth need assistance to adopt recommended sustainable agriculture technologies at local level. Farm youth need help in finding out the requirements of inputs and help to obtain these inputs. Many farm youth need marketing assistance through mobile. Credit is the most important input required for technology adoption, hence, timely finance is essential. Many times farm youth feel difficult to carry out operations due to lack of equipments hence, they need specialized services. Farm youth need insurance to escape from risk, hence, there is need to cover all types of crops/animals under insurance. Subsidy assistance is required to motivate farm youth.

Fig. 1
Many experiments in different parts of the world proved that, the mobile acted as platform to provide management service. Further, mobile in addition to functioning as a telephone, supports additional services such as SMS, MMS, e-mail Internet access, short-range wireless communications, photography, and advanced computing abilities. This ubiquitous technology would help in affordability, maintenance, optimal cost and would bring information equality concept in full swing in the fast paced world. Hence, Mobile for Providing Management Services to Farm Youth is a viable option for Sustainable Agriculture Development during the millennium.
Technical Issues in Mobile Proliferation
Energon: A Mobile Application, That can be Used as an Energy Management Tool

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Abstract—“Energy Conservation” is not a new phenomenon, yet a common person knows very little about the way he is affecting the environment and what are the long term effects of his lifestyle. There is no system that gives quantifiable figures, for the amount of energy being consumed or saved, by an individual and hence he cannot understand quantitatively his energy needs and energy wastage. The proposed system is a mobile application that can be used to calculate energy consumed and saved by a user in terms of monetary values and carbon footprints. The advantages of the system are that, being a mobile application, it has no added hardware and installation costs, by employing GUI tools the application would be easy to use and understand. The output is in the form of monetary values and carbon footprints and hence the user can interpret and appreciate the results immediately.

1. Introduction
In the past few decades, with the advent of industrialization and modernization, our environment has taken a serious hit. Pollution is at an all-time high, and the world is facing several environmental problems. Climatic change, global warming etc, are direct result of the ruthless exploitation of natural resources. With increased depletion in the existing resources energy is fast becoming a precious commodity.

In the present scenario, the focus is slowly shifting towards greener and cleaner technologies. It is fair to say that “Energy-saved-is-energy-earned”. Even as the world is slowly addressing this problem at a global level, there is a severe lack of awareness and motivation in the common man. A common person knows very little about the way he/she is affecting the environment and what are the long term effects of his lifestyle. There is no system that outlines the steps that a consumer can take to reduce his/her carbon footprint and reduce energy consumption, without added costs. None of the existing systems give quantifiable figures, for the amount of energy being consumed, and saved. There is no way a consumer can understand quantitatively his/her energy needs and energy wastage.

As discussed earlier, the main gap that exists in the present energy management system is the lack of a user-level-energy-management-system. The proposed system is a mobile application that can be used to calculate energy saved in terms of monetary values and reduced carbon footprints.

The advantages of the system are that, being a mobile application, it has no added hardware and installation costs. Special emphasis is laid to make the application easy to use. Using graphical user interface tools the
input would be taken from the user and the output will be displayed in any easy to understand method. As the output is in the form that the user can interpret and appreciate immediately, he/she will be motivated to use the system.

2. RELATED WORK

Energy Conservation techniques can be applied in several ways. At a commercial level, products have been designed to save energy. Some of them are, EnergyStar products [1], Horizon Light & Energy Pvt Ltd [2] and Anvi Energy Pvt. Ltd [3]. Several mobile applications exist in the Nokia OVI store that are related to the environment. Some of them are Green Phone [4] Environment news [5], Earth [6] and Green Dweller [7].

3. PROPOSED SYSTEM AND ARCHITECTURE

The proposed system is a mobile application based on Qt language and built for Symbian60 platform. The user can interact with the system in 2 modules

3.1 User Mode

The user inputs the various data, (e.g. The number of pages he didn’t print in the day, the number of hours the AC was switched off, etc) The application, converts this input to a monetary figure which is basically the amount of money saved by the user in the day. The user can also save these figures to a database and view them at a later date.

3.2 Other Functions

The user can calculate his/her daily carbon footprint, and cost of the energy that he/she consumes in a day, the user can set reminders according it his/her convenience that can remind him/her to switch off the lights while leaving home, while leaving office etc, access to latest environment related news through internet access and also the user can view the saved results, from the database.

4. IMPLEMENTATION

4.1 Hardware Implementation

Hardware implementation of the application requires, Qt SDK (Symbian^1 Qt 4.7.3), QtMobility 1.1.2 for Symbian^1and TRK (Debug Agent).

The procedure to install it on the device is:

1. Choose Start > Qt SDK > Symbian^1 Qt 4.7.3 > Install Qt 4.7.3 for Symbian^1 on Device.
2. Choose Start > Qt SDK > Symbian^1 Qt 4.7.3 > Install QtMobility 1.1.2 for Symbian^1 on Device
3. Start > Qt SDK > Symbian^1 Qt 4.7.3 > Install TRK (Debug Agent)
4.2 Software Implementation

At a software level, the application is implemented in the form of modules. In the **User Mode**, the inputs are number of pages that the user saved in the day, number of hours AC was switched off, and the number of hours the desktop computer and laptop were switched off. After calculations, the output obtained is the amount of money saved and a carbon footprint (i.e., the amount of carbon not released in the atmosphere).

In the second module (**Other functions**), the user can calculate carbon footprint and amount of money spent on energy in a day. The user inputs the number of pages that the user uses in the day, number of hours AC works in a day and the number of hours the desktop computer and laptop is used in a day. The output is the Money spent by user daily on his energy consumption and his daily carbon footprint. The user can set reminders also using the application. User can gain access to latest environmental news by clicking on the News feed option. The application will provide various links from different websites that host environment related news. The user can also view previous results from the database of the application.

4.2.1 To Calculate the Cost of Operation of a Device [8]

- Determine the average power consumed in KW. E.g. the device is rated at x KW.
- Determine the number of hours the device is operated. E.g. The device is run for t hours, hence the total power consumed in a day is x*t kilowatts hours.
• Cost of power is Rs. 3.5 per kWh. Hence the cost of operation for the device is Rs. $x t \times 3.5$.

• For production of 1 KWh power, 0.5 Kgs of carbon is emitted. Hence the carbon footprint is $x t \times 0.5$ Kgs

4.3 For the Application

Table 1: Information Regarding Devices

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Average Wattage in KW</th>
<th>Duration of Operation</th>
<th>Power Consumed</th>
<th>Carbon Footprint</th>
<th>Cost of Usage Per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>2.3</td>
<td>t</td>
<td>2.3$t$</td>
<td>2.3$t \times 0.5$</td>
<td>2.3$t \times 3.5$</td>
</tr>
<tr>
<td>Computer</td>
<td>0.18</td>
<td>t</td>
<td>0.18$t$</td>
<td>0.18$t \times 0.5$</td>
<td>0.18$t \times 3.5$</td>
</tr>
</tbody>
</table>

4.3.1 To Calculate the Carbon Footprint and Cost of Energy To Produce Paper

• Number of sheets = $x$
• Weight of the sheets = $0.000005 \times x$ tones
• Trees required = $0.000005 \times x \times 17$ trees
• Energy required = $2500 \times 0.000005 \times x \times 17$ KWh
• Carbon emission to produce energy = $2500 \times 0.000005 \times x \times 17 \times 0.5$ Kgs
• Carbon emission during paper production = $0.000005 \times x \times 800$ Kgs

a. Total carbon footprint = $(2500 \times 0.000005 \times x \times 17 \times 0.5 + 0.000005 \times x \times 800)$ Kgs

b. Total cost of energy = Rs. $500 \times 0.000005 \times x \times 17 \times 3.5$

Thus from a. and b. we can calculate the carbon emitted during paper production in Kgs and the total cost of energy required to produce that paper in Rs.

4. Advantages of Proposed System

Being a mobile based application, it has no added cost apart from the device itself. The cost of the system is minimal. The system requirements are easy to match, by most handsets available. The hardware required for the software, i.e. a mobile device is available with most of the general public. Thus no extra cost would be incurred in application of the system.

The application is designed in such a way, that it can provide energy saving solutions for an individual. The user must provide necessary input to obtain desired outputs. Thus, at every level user participation would be necessary. As the output is in the form that the user can interpret and appreciate immediately, he/she will be motivated to use the system. The output is in the form of a monetary value, and carbon footprint. The output directly affects the user and hence he/she would be motivated to use the system as efficiently as possible.

Being a user oriented application; it reduces the energy wasted by the user on a day to day basis. Thus energy saving begins at the bottommost level. Being a mobile application, special emphasis is laid to make the
Energon: A Mobile Application, That can be Used as an Energy Management Tool

application easy to use. Using graphical user interface tools the input would be taken from the user and the output will be displayed in any easy to understand method. The technical aspect of the application will be hidden from the user, and calculations would be done within the program itself.

5. CONCLUSION

The mobile application works on all Nokia Symbian 60 devices, and has been tested on an E-71 device. It serves as a user-level-energy-management system, which can be used easily by most mobile users. The functionalities as described in the User Mode, and the Other Mode have been incorporated in the software application and successfully verified on the mobile device.

REFERENCES

Design of RF Front-End for Ultra Wideband Receiver in Wireless Communication

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Abstract—One UWB CMOS low noise amplifier has been designed in 0.13um CMOS process. LNA is double ended type. Design procedure and simulation results are presented in this paper. With a 1.2 V supply, the LNA achieve power gain of 15 dB, Noise figure of 1.22dB, input third order intercept point(IIP3) of -5.7dB dBm of LNA. The power dissipation is 7.2 mw. The LNA is highly suitable for Ultra Wideband Receiver in the wireless communication.

Keywords: CMOS; Feedback; low-noise Amplifier (LNA); Ultra Wideband (UWB)

1. INTRODUCTION

Low noise amplifiers are one of the basic building blocks of any communication system. The purpose of the LNA is to amplify the received signal to acceptable levels with minimum self generated additional noise. Gain, NF, non-linearity and impedance matching are four most important parameters in LNA design. For integrated circuit design, it is a challenging work to implement a UWB low noise amplifier (LNA), especially in CMOS technology. According to the requirement of UWB communication systems, LNA should resolve these issues: 1) provide the wideband input matching network, 2) good linearity, sufficient and flat gain and low noise figure, 3) low power consumption and small chip area. Conventional narrowband inductor degeneration LNA shown in Figure 1 has been the most popular topology for LNA in most RF receivers [1]. However, it is difficult to adopt this structure for ultra wideband system because it cannot achieve input impedance matching in a band range of 3.1-10.6 GHz.

In this paper we present 0.13um CMOS LNA in a band range of 3.1–10.6 GHz, and LNA is differential type. Design consideration of LNA is discussed in section 2. Simulation results are presented in section 6.

Fig. 1: Single Ended LNA Circuit
2. Double Ended LNA

A double ended LNA in a band range of 3.1–10.6 GHz. shown in fig-2. This architecture has commonly used cascoded, which provided good isolation between the input and output stages. Fig.2 shows the front-end architecture of UWB LNA. The proposed LNA consists of two cascaded amplifier stages. The first one is a shunt resistor feedback amplifier consisting of a cascode transistor pair $M_1$ and $M_2$, as shown in Fig.2. Resistor $RF$ is the feedback resistor, and capacitor $CF$ blocks the DC voltage to the gate of $M_1$. The bias voltage $V_b$ provides DC bias for input transistor $M_1$. The cascade transistor $M_2$ improves the isolation and reduces Miller capacitance while the voltage gain of input transistor $M_1$ should be small. Bandwire inductor $L_g$ performs a series resonant with $C_{gs}$ of $M_1$ for input impedance matching. To broaden -3 dB bandwidth to cover 10.6 GHz, the LNA employs a shunt peaking load constructed by resistor $R_d$ and inductor $L_d$.

For a receiver chain, high voltage gain of LNA can release the noise requirement of the next stage. However, in CMOS technology, it is difficult to provide enough gain in the frequency range from 3.1 GHz to 10.6 GHz only with the structure shown in figure 3. In this work, a second amplifier stage is cascaded, which also can transform single-ended input to differential outputs.

![Double Ended LNA Circuit](image-url)
3. SMALL SIGNAL ANALYSIS OF SHUNT-SERIES AMPLIFIER

Input Voltage \( V_s = I_{in} (R_s + R_f) + V_{out} \) \hspace{1cm} (1)

Output Voltage \( V_{out} = (I_{in} - g_{m} V_{gs})R_L \) \hspace{1cm} (2)

Gate to source Voltage \( V_{gs} = I_{in}R_f + V_{out} \) \hspace{1cm} (3)

From equation 1, 2 and 3

Total gain = \( \frac{V_{out}}{V_s} = \frac{R_L (1 - g_{m} R_L)}{R_L + R_F + R_s + g_{m} R_s R_L} \)

If \( R_F \gg R_s \) and \( g_{m} R_F \gg 1 \)

Then \( A_v Total = - g_{m} R_L \)

Also \( Z_{in} = (R_F + R_s) / (1 + g_{m} R_s) \)

One important point is gain is not depending upon feedback resistance but here we can get input impedance low by taking large \( g_{m} R_L \) and I can get large gain i.e. merit of LNA.

Table 1: LNA Design Circuit Parameters

| \( M_1(W) \) = 390um | \( L_3 = 4.4nH \) | \( R_{bias} = 1.1k\Omega \) | \( V_{dd} = 1.2V \) |
| \( M_2(W) = 70um \) | \( L_g = 10nH \) | \( R_{bias} = 250\Omega \) | \( C_f = 10pF \) |
| \( M_3(W) = 70um \) | \( L_d = 4.4nH \) | \( C_{le} = 1pF \) |

The first step in the design procedure is to determine the MOS transistor size in input stage. The optimum device width is 390um to minimize the noise figure.

Input resistance, \( Z_{in} = \frac{j0(L_s + L_d) + 1/j0C_{gs} + g_{om} L_s / C_{gs} for matching L_g + L_s}{1 + \omega_0 C_{gs}} \) and \( R_s = 50\Omega = g_{ms} L_s / C_{gs} \) behaves like pure resistor and it also depends upon \( C_{gs} \) and \( L_s \). Input resistance should be low that is equal to \( 50\Omega \) so I have to put low value of \( L_s \), but for doing so I get low cut of frequency. But this problem can remove by adding one extra inductor \( L_g \) in series with the supply voltage so that sum of these two inductor produces resonant at high frequency. Reverse isolation removes by adding NMOS transistor \( M_2 \) and NMOS \( M_3 \) provides biasing. Fig. 4 shows S-parameter (Gain) of LNA. Fig. 5 shows Noise Figure and minimum NF. Fig 6 shows IIP3 point of LNA.
4. ROLE OF DIFFERENTIAL AMPLIFIER

We can improve the gain of LNA by cascading differential amplifier at output of actual LNA. So total gain will be

\[ A_v = A_{v1} \times A_{v2} \]

where \( A_{v2} \) is gain of differential amplifier.

We know that cutoff frequency \( W_T = \frac{g_m}{C_{gs}} \)

If we can reduce \( C_{gs} \), Cutoff frequency increase. We can reduce \( C_{gs} \) by using differential amplifier because \( C_{gs} \) is in series in case of differential amplifier. Hence differential input capacitance is one half of each transistor. The differential transconductance, on the other hand, is unchanged because input voltage divided equally between the two transistor, the differential output current is twice the current in each devise. Hence overall transconductance is equal to that of each transistor, and doubling of \( W_T \). BW is directly proportional to \( W_T \); hence BW increases. Other important characteristics of differential amplifier are to cascade mixer very easily.

5. GAIN

Since the UWB LNA is used in a direct conversion receiver, it is the voltage gain which is important at the input of the mixer. However, \( S21 \) is measured as a standard figure of merit. In order to measure \( S21 \), an single to differential amplifier is used after LNA such that it provides 50 matching to the output port as well. Voltage gain of the LNA can easily be calculated by adding 6dB to \( S21 \).

6. SIMULATION RESULTS
7. CONCLUSION
An RF front-end for an Ultra Wideband receiver is designed using umc 0.13 μm CMOS process. The front-end, consisting of LNA and mixers is designed to operate over a wideband of frequencies (3.1-6.5 GHz). The proposed LNA in the dashed range consists of two cascaded amplifier stages. The first one is a shunt resistor feedback amplifier consisting of a
cascade transistor pair $M1$ and $M2$, as shown in Figure 3.6. Resistor $R_f$ is the feedback resistor, and capacitor $C_f$ blocks the DC voltage to the gate of $M1$. The bias voltage $V_b$ provides DC bias for input transistor $M1$. The cascade transistor $M2$ improves the isolation and reduces Miller capacitance while the voltage gain of input transistor $M1$ should be small. Bandwire inductor $L_g$ performs a series resonant with $C_{gs}$ of $M1$ for input impedance matching. To broaden -3 dB bandwidth to cover 10.6 GHz, the LNA employs a shunt peaking load constructed by resistor $R_d$ and inductor $L_d$. Resistive feedback LNA architectures suited for wideband operation are investigated. Broadband input matching is achieved by using passive. New output network is proposed which results in high gain with maximum gain flatness. LNA is implemented resistive feedback circuit with bond-wire effects taken into account.

References


Enhancing Security in Mobile Cloud Computing

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Abstract—Mobile cloud computing (MCC) is emerging as branch of cloud computing in which resources are accessed using mobile phones (Smart Phones), PDA’s and other wireless enabled devices. Primarily two models of MCC are in use, one in which mobile devices itself acting as node for the cloud and another having the analogy with client server technology. MCC which uses client server model, mobile devices act as client, while cloud is acting as a server. Present work has considered this second type of MCC. In wide area network of MCC, the response time is one of the big constraints because of the distance involved from cloud and these smart devices having limited processing and storage capabilities. To improve the response time in wireless network solution with the name cloudlet exists, in which related content is available in the cloudlet and these cloudlets are near to accessing devices, hence latency is reduced to a great extent but security of WLAN and the mobile devices particularly, smart phone is of great concern. Present work suggests improvement in the security of mobile cloud computing using two phase model. In first phase security vulnerability of WLAN is assessed and monitored considering the advancement of technology and attacks, ways to plug these securities loopholes are suggested. In second phase vulnerabilities in mobile devices used to access cloud resources is assessed and methods to improve security for mobile devices are suggested. As two phases model is evaluating the security both in WLAN and mobile devices, hence, will be very useful to improve the overall security in MCC.

Keywords: Mobile Cloud Computing, Wireless Network, Cloudlet, Smart Device Security.

1. Introduction

Computing is being transformed to a model as services, and delivered similar to utilities [1, 2] like water, electricity, gas and telephone. Services [3,4] for the resource requested will be provided on demand and transparent to the users. User has to pay for what has been used and data will be stored at remote location under the control of cloud provider. This computing model is known as cloud computing. To provide the ease and mobility to the user branch of cloud computing is emerged and known as mobile cloud computing. Mobile computing means using portable devices to run stand alone applications accessing remote services via wireless network. Mobile devices are coming with features which enable them to access resources from cloud. These devices are suitable to be accessed because of their ease and portability. In mobile cloud computing, mobile devices can be used for two purposes. In first type mobile devices act as a client to access
resources from the cloud because these mobile devices are having limited processing and storage, hence using cloud for storage and processing. This type of architecture is similar to client server architecture. In the second type mobile devices itself are acting as node for the cloud and resources are pooled from all participating mobile devices to overcome limited storage and processing power. Mobile cloud computing, using WAN have latency as one of the constrained. This constraint is overcome to a great extent by solution known as cloudlet, [4] provides data from the cloudlet when requested by the user rather from the cloud to reduce the latency. Considering the security of personal information, Huang et al. [5] suggested a new processing framework for mobile cloud computing through trust management and data isolation.

2. Security for WLAN and Mobile Device

Two phase security model perceive WLAN and mobile devices separately. In first phase monitoring of security improvement of WLAN is performed, while in second phase monitoring and security improvement of mobile devices, smart phone in particular has been considered.

2.1 Phase One Method

In phase one following measures are required for WLAN.

2.1.1 Security Monitoring

Security monitoring can be characterized as monitoring and assessment for security. Assessment means evaluation of security [6] in WLAN periodically i.e. weekly, monthly, quarterly etc. while monitoring is evaluating the security in real time so that corrective action can be taken immediately. Issues which are required to be monitored are as follows:

1. Unauthorized WLAN Device: unauthorized access of WLAN devices including access point (AP).
2. Unusual WLAN Usage Pattern: Excessive use of particular AP in comparison to other AP and high volume of WLAN traffic to a particular client.
3. DoS Attacks: Monitoring for the denial of services attack which may be event based and counting for threshold values.
4. Impersonation: Monitoring for the man in middle attacks.

2.1.2 Security Improvement

- Standard Configuration for Common WLAN Components: configuration of WLAN common components with security specified for these devices as it makes external accessibility more difficult. Configuring devices to standard configuration takes less time and effort if security evaluation is automated.
- Dual Connections Prohibition: Dual connections means device are connected both to wired network as well as wireless network such
as Bluetooth, radio communication and infrared etc. as attack on one risk other network, hence dual connection should be prohibited.

- **Vulnerability Monitoring**: WLAN must be monitored and assessed for vulnerabilities within specific interval of time may be quarterly, half yearly or yearly depending upon sensitivity of the data used.
- **Configuring Mobile Device and AP with Organizational Policy**: Mobile devices and access point should be configured to the organizational policy to improve the security further aligned with organization.

### 2.2 Phase Two Method

Securing the mobile devices is a paramount, which is very challenging because of diversity of mobile devices. The best solution will be covering the diversity of the mobile devices and should in need with the some of the popular mobile phones like [7] Apple iOS, Windows phone 7, RIM Blackberry, WebOS, Nokia symbian and Android.

#### 2.2.1 Security Monitoring

- **Unauthorized access**: required to be monitored for any bypassed and unauthorized access.
- **Malware**: Presence and ingress of malware as they opens the backdoor or may inflate your bills.
- **Spam**: received spam mail or link available in the spam.
- **Electronic tracking**: Monitoring to check whether mobile is tracked for its location
- **Server resident data**: monitoring for data stored at server and its level of sensitivity.

#### 2.2.2 Security Improvement

While mobile devices provide productivity benefits, but lack a number of security[9] features commonly found in desktop computers. Hence, following measures will be improve the security significantly:

- **Physical Care and User Authentication**: Mobile devices should be treated like credit cards and should not be left unattended, will help to prevent any activity by attacker. Using devices must be password and PIN based to give layer of security.
- **Reduce Data Exposure**: Avoid keeping sensitive information such as personal information and financial information on mobile because authentication mechanism depicted earlier may be bypasses, accumulated information is subjected to high risk.
- **Curb wireless Interface**: wireless interface with Wi-Fi and infrared should be curbed if not needed as they are the major source of malware.
- **Minimize Functionality**: smart phones are supplied with number of functions and majority of them may not be needed. Extra features pose security threat, hence should be disabled if not needed.
• **Organizational Security Policy:** Organization should have security policy for mobile devices and determine whether computational devices will be held by individual or will be issued by the organization, as organizational issued devices can be easily managed centrally because of their known make and similarity with other devices.

3. **Conclusion**

Mobile cloud computing enables the users to access the data from outside their corporate network and is highly suitable for users who remain mobile and require immediate response to tackle the business need. Mobile devices are also accessible to others hence security is needed for the mobile devices as well as wireless network from where the user is accessing the information. Variety of threats both simple as well as complex are emerging daily for the wireless network and the smart phones especially, SDK enabled. Considering the complexity of attack at one hand and the security of the data on the other it is essential that both network and mobile devices should be dealt separately for threats in real time so that remedial action can be taken instantly rather than after days, weeks, or months. Suggested methods will be very useful to improve the overall security in wireless network and mobile devices.

**References**


Computation of Ideal Location for 3G Communication Towers in Urban Areas on Web Based 3D Environment

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Abstract—This paper focuses on finding ideal location of 3G mobile towers for a given coverage which will cover maximum population under various assumptions. Factors of particular importance include coverage and capacity issues in the planning process for cellular 3G networks. A novel algorithm based on weighted K-Means has been developed for obtaining optimal location of telecommunication towers in Dehradun municipal area. Probable sites for tower installation are obtained on 3D in a web environment. Results are compared with industry software and the advantage is analyzed.
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