UNIVERSITY OF SOUTHAMPTON

FACULTY OF PHYSICAL SCIENCE AND ENGINEERING

School of Electronics and Computer Science

A MODEL TO DESCRIBE THE ADOPTION OF MOBILE INTERNET IN SUB-SAHARAN AFRICA

By

Mike Santer

Thesis for the degree of Doctor of Philosophy

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ABSTRACT

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Mobile phones afford the capacity to connect the majority of people across our globe, irrespective of demographic and developmental factors, through voice calls and text messages (SMS). The mobile phone has, arguably, become the most powerful and pervasive information communication technology (ICT) innovation in human history, displaying a faster adoption rate than that of radio, TV or the personal computer. The mobile phone is even more prevalent in these countries than the supply of electricity and water.

Least Developed Countries (LDCs) in sub-Saharan Africa are significantly impacted by the introduction of mobile phones as they typically have little or no fixed line infrastructure. In sub-Saharan Africa the mobile phone is the primary technology used to access the Internet, offering a gateway to the vast resources of digital content and services such as social networking, entertainment, and financial transactions. This leapfrogging from little or no communication infrastructure to near ubiquitous mobile penetration has the potential to empower people through access to information and affordable communication tools.

This research investigates the drivers and dampeners of the “Adoption of Mobile Internet” (AMI) in sub-Saharan Africa to enable governments, non-profit organisations and commercial entities to plan strategic growth in this important developmental and capacity building technology. This thesis firstly draws on a literature review of the digital divide, empowerment and the implied key constructions influencing AMI in sub-Saharan Africa. Secondly, fieldwork from five sub-Saharan nations alongside findings from discussions with mobile experts into these AMI constructs are analysed using NVivo and presented. The literature review, fieldwork and expert discussion are then triangulated and bought together to develop a preliminary model using Systems Dynamic Modelling (SDM) which describes the main constructs and influences of AMI in Sub-Saharan Africa. The AMI SDM model is then tested for goodness of fit with validated data sets using Structural Equation Modelling (SEM) and the standardizes regression weights used to inform the creation of a simulation model.

The main findings of the thesis are that the exploratory model describing the adoption of mobile Internet in sub-Saharan Africa is a reasonable fit to published data. The two key influences for the adoption of mobile Internet in SSA are Digital Literacy and Digital Content. The two key indirect influences of AMI in SSA are the Service Provider and Literacy levels. The model predicts that both Education and Innovation are significantly impacted by an increase in the Adoption of Mobile Internet. The importance of Digital Content reinforces the conviction that the proposed BluPoint solution which offers free digital content to people living in constrained environments would be a suitable technology to offer in SSA. Adding the ability to publish and share local information freely would further enhance the need to develop this desktop prototype further.

It is expected that the AMI model will act as a strategic tool for government policy makers in sub-Saharan Africa seeking to encourage their citizens to use their mobile phones to join the growing global on-line community.

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Declaration of Authorship

I, Mike Santer, declare that the thesis entitled "A model to describe the adoption of mobile Internet in Sub-Saharan Africa" and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research.

I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this University;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- where I have consulted the published work of others, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
- where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

None of this work has been published before submission.

Signed: ………………………………………………………… Date :………

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Lastly, I thank God for giving me the bedrock of faith on which I stand each day and the provision He has provided to enable me to journey to this point.

Abbreviations

AMI	Adoption of Mobile Internet
CT	Communication Technology
ICT	Information Communication Technology
LDC	Least Developed Country
SDM	System Dynamics Model
SEM	Structural Equation Model
SMS	Short Message System
TCOMPO	Total Cost of Mobile Phone Ownership

“Logic will get you from A to B. Imagination will take you everywhere.”

Albert Einstein

“Our success will be measured by how well we foster the creativity of our children. Whether future scientists have the tools to cure diseases, whether people, in developed and developing economies alike, can distinguish reliable information from propaganda or commercial chaff, whether the next generation will build systems that support democracy and promote accountable debate - I hope that you will join this global effort to advance the Web to empower people.”

Sir Tim Berners–Lee, inventor of the World Wide Web,
Founder of the World Wide Web Foundation.

Chapter 1. **Introduction**

Mobile Phones have quickly established themselves as a pervasive and ubiquitous technology that is generally globally available to all, irrespective of developmental and demographic factors (ITU 2011). Voice and SMS usage of mobile phones already dominate developing markets and the use of mobile Internet is starting to gain traction. The objective of this research is to develop a model that adequately describes the adoption of mobile Internet in Sub-Saharan Africa. This thesis posits a strategic tool that enables policy makers within governments and other organisations to understand the factors that both accelerate and present barriers to the Adoption of Mobile Internet in sub-Saharan Africa (SSA). The model potentially has a wider geographical application, but is framed in SSA as the geographical research area as it displays one of the highest mobile Internet adopt rates globally and also contains countries with the highest variance in adoption rates.

Mobile everywhere

Mobile phones afford the capacity to connect the majority of people across our globe, irrespective of demographic and developmental factors through voice calls and text messages. The mobile phone has arguably become the most powerful and ubiquitous ICT innovation in human history, displaying a faster adoption rate than those of radio, TV or the personal computer (Kalba 2007; Kalba 2008). Just as the wireless radio does not require a fixed line infrastructure or significant power, the mobile phone stands well in the developing world context.

Whilst the elite in developing countries have had limited access to landlines, telex, or telegraph communication, the introduction of the mobile phone has enabled the general population to communicate and increasingly have potential access to digital information. We now have a universal reach of mobile technologies across Africa irrespective of the economic context of people and communities. A recent report from iHub, a technology business incubator and research organisation in Nairobi, shows that 60% of Kenyans on low income own a mobile phone and 1 in 4 Kenyans use the Internet on their phone

(Crandall et al. 2012). This is driven by a fundamental desire to connect with one another. It is the must have technology for both the affordances and the status that owning a mobile brings (Wallace Chigona et al. 2008).

Least Developed Communities (LDCs) in SSA are amongst the most significantly impacted by mobile phones as these countries were poorly served by a fixed line infrastructure (Aker & Mbiti n.d.). In 2000, Africa was the first continent where the number of mobile phones exceeded the number of fixed line telephones and between 2003 and 2008 has displayed twice the global average growth rate of cellular subscriptions (International Telecommunications Union 2010). The mobile phone is more prevalent in these countries than the supply of electricity and water. Africa, with a population of around 1 billion people now has an estimated 700 million active SIM cards (Shapshak 2012). The actual reach of mobile devices is much larger if we include family handsets and people holding multiple SIM cards (Khoja et al. 2009).

Internet Is Here And Is To Come …

Whilst the penetration of mobile phones in Africa is impressive, the ICT penetration levels are profoundly lagging behind not only developed nations but the average of developing nations as shown in the following table:

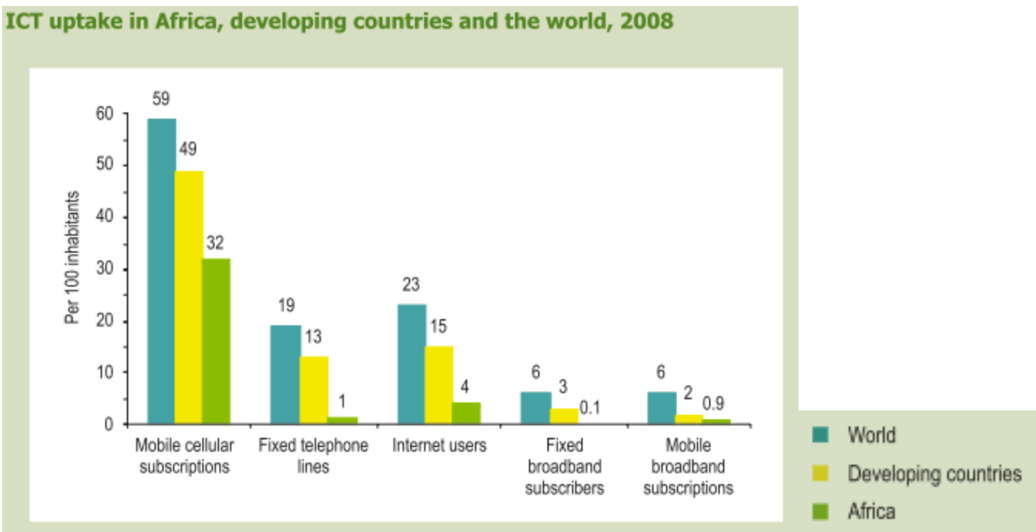


Figure 1-1: Uptake of ICT in Africa, developing countries and the World 2008 (International Telecommunications Union 2010)

However, people living in SSA are beginning to have access to affordable mobile phone handsets and airtime packages that enhance their mobile phone usage from voice and SMS to accessing data artefacts and services. A key driver in this mobile Internet adoption has been social networking and mobile instant messaging (Wallace Chigona et al. 2008) . Ordinary people are beginning to weave Internet usage into their lives - Google estimate in South Africa that searches from Mobile devices account for 25% of all searches during the week rising to 65% at weekends (KRUGER 2012).

In sub-Saharan Africa the mobile phone is the primary technology used to access the Internet, offering a gateway to the vast resources of digital content and services such as social networking, entertainment, and financial transactions. This leapfrogging from little or no communication infrastructure to near ubiquitous mobile penetration is empowering people through access to information and affordable communication tools.

The mobile phone is almost ubiquitous, with 67 mobile cellular subscriptions per 100 inhabitants globally,and the rate of penetration in developing countries more than doubling from 23% in 2005 to 57% by the end of 2009 (ITU 2010). Mobile phones have become the world's largest distribution channel (InfoDev 2009). Mobile phones are especially important for people living in rural areas which constitute 75% of the world's poor and nearly one-half of the world's population (The World Bank 2008). Irrespective of GDP and social climate, multi-modal mobile phones are enabling voice communications, short textual messaging and a gateway to the plethora of information and social interaction capabilities of the Internet.

A mobile phone is the very first electronic item that many individuals in Least Developed Countries strive to buy, cherishing it as their access point to the world and a symbol of hope. In South Africa for example, the 2007 Consensus shows that 72.9% have a cell phone but only 63.9% have access to a fridge, 18.6% have access to a landline and 15.7% have access to a computer (Statistics South Africa 2007). Mobile phones give more than hope; it has been demonstrated that economic growth of between 0.4 and 1.4% of GDP per capita is gained by an increase of 10% of ICT penetration, with the greatest effect seen with the introduction of mobile broadband in developing economies (Waverman et al. 2001).

Mobiles phones in developing countries are generally used to make and receive voice calls, with computers being used for connecting to the Internet (Essential 2010). Driven by the lack of a viable alternative, for all but the wealthy elite who have access to fixed line broadband and computers, Least Developed Countries (LDCs) are technologically "leap-frogging" to the mobile web revolution. In developing countries, where typically little or no fixed line infrastructure currently exists, until such time as affordable and accessible data packages on Internet enabled mobile devices are available, developing countries have largely been engaged in using mobile phones for Communication Technology for Development (CT4D) rather than Information Communication Technology for Development (ICT4D). It can be argued that Communication Technology has been provided through voice and SMS exchanges, but the tomes of digital content, that is fast becoming essential in developed nations, has been largely inaccessible to many of their citizens.

The manifestation of this mobile revolution in Least Developed Countries is varied, ranging from the well documented M-PESA in Kenya offering banking services to many people who were formerly without the means to access a bank account (GSMA 2009; Morawczynski 2007; Khoja et al. 2009); to MoCo which was developed and is owned by the community in Athlone in Cape Town, which provides counselling services through mobile phones (MB Parker et al. 2010) ; to Ushahidi offering a social exchange mapping service that has been used for on the ground reporting during political elections and in assisting disaster relief work (Xiaojuan n.d.; Coyle & Meier n.d.). The BBC's Janala service in Bangladesh, offers English lessons through mobile phones for less than the price of a cup of tea (3 pence), which, after a month of launching the service, had received over 750,000 calls (BBC World Service 2010)

Adoption

The term "adoption" in the context of this thesis refers to the binary single-stage adoption decision made by an individual to access the Internet on their mobile phone. The spread of adoption is then visible as "diffusion" within the populous of communities and nations.

Models of adoption of technology have been proposed (Rogers 1983; Moore & Benbasat 1991; Brancheau & Wetherbe 1990; Geroski 2000; Tornatzky et al. 1990) to represent the concepts and processes by which new technologies are assimilated in the lives of people. Rodgers (Rogers 1983) posits that there were five junctures of assimilating a new innovation: knowledge, persuasion, decision, implementation and confirmation. The four main elements he suggested for the sharing or diffusion of this innovation can be characterised as: innovation, communication, social system and time. These notions are carried forward into the model.

Social, Cultural, Educational and Political

The rapid embracing of mobile phones amongst young and old, rich and poor, within rural, peri-urban and urban settings alike, is leading to an unprecedented Adoption of Mobile Internet in SSA (Regional Huner and Vulnerability Program 2009). The Adoption of Mobile Internet in SSA has resonance with the general adoption of Mobile Phones but it is strongly influenced by economic, cultural, educational and political factors.

We have seen in recent times, for example in Egypt and Syria, that the availability of information, coupled with social connectivity, can lead to empowering people to collectively redefine social, economic, political, health and educational structures (United Nations Development Program 2012). Increasingly, the introduction of dispersive communication is both challenging and changing traditional values and worldviews within LDCs where the influence of media from Hollywood, Bollywood, Nollywood (Nigeria)and Gollywood (Ghana) are bought to bear (Sadowsky et al. n.d.).

In the Western world, our pedagogy and andragogy models are largely defined through the Enlightenment with education conveyed mainly through formal seats of learning such as schools, colleges, universities and latterly online courses. In the developing world the learning experience is more focused around social seats of learning through practical and oral skills transfer. This notion of social-learning is linked strongly to crowd adoption which impacts the Adoption of Mobile Internet in SSA (Miller et al. 2006)

From the printing press, to the railroad, to the telegraph, to the introduction of fixed line telephones, some of the greatest changes in human history have been catalysed through network and information transitions. This importance is highlighted in the following quote from a young man in Kenya:

> ***"This connectivity will be the most important thing for my generation since independence - genuinely! But, will it reach my door step, to where the people need it?"*** *A young man in Kenya,* (BBC Website 2009c)

Whilst mobile phones promise to empower people through access to information and communication services, we must be mindful of the negative influences in spending patterns, behavioural changes, worldviews and socio-cultural evaluation before declaring a whole hearted endorsement of this technology (Dijk 2009; Al-Qeisi 2009).

Given that the affordances of mobile technology have a strong cultural dimension, this upgrade thesis draws on a Literature Review of the digital divide and empowerment in the context of the LDCs. Findings from field studies in a rural and a peri-urban community in South Africa, alongside observations from multiple trips to in Northern Malawi and Central Zambia in 2010 and 2011, informed an initial model that endeavours to describe the adoption of mobile Internet in LCDs. This posited model was presented to five experts in the Mobile for Development space in Africa. Following feedback, the refined model is presented in this upgrade thesis and developed into a research question, with corresponding methodologies and instruments detailed.

Africa

Africa has the second largest landmass on earth, covering 30.2 million square kilometres or 22.4% of the total global land area and (CIA 2012). Africa is larger than the combined land areas of Argentina, China, Western Europe, India, New Zealand, and USA. Africa is home to over 1 billion people and is the least developed continent with the highest prevalence of disease, poverty and malnutrition (UNFPA 2011; Bureau of US Census 2012). It is also one of the richest nations with 50% of the world's gold; most of the world's diamonds and chromium and 90% of the world's cobalt (Williams 2009).

Figure 1-2: The True Size of Africa (Krause 2010)

Dr. Tokunboh Adeyemo states in his book "Africa's enigma and leadership solutions":

> *"It is said that Africa is the richest of seven continents of the world, yet black Africans are the poorest. Africa is probably the first home of the human race, yet it is the least developed. Africans are hospitable to people from other parts of the world but hostile to fellow Africans. African professionals and business executives are making many nations around the world great and prosperous, yet their own villages of origin remain in ruin. This is absurd; it is enigmatic."* (Adeyemo 2009)

The enigma of Africa's human potential married with the vast material wealth and the current developmental conditions of much of the continent is difficult to reconcile.

Communication and Information

Throughout the history of mankind, human endeavour has yielded moments of creative breakthrough that transform relationships, commerce and power structures. From the invention of the wheel, to the building of the Roman roads, to the Industrial Revolution, we have seen an amplification of empowerment in the communities that have access to the product of the said human endeavour, but conversely there is also a widening of the opportunity gap between those that have and those that have not.

Communication and information have always been two of the axioms that create and sustain those with power, and also catalyse social change. For example, the construction of "Via Appia", the first Roman Road, commissioned in 312 B.C., had the intended aim of aiding communication and moving military force to quicken the colonization process (Forsythe 2006). Over 80,500km of paved roads were created with a further 319,500km of prepared ground. These routes networked the 113 provinces by 372 great roads and enabled a 400% increase in mobility of resources, communications and military might, whilst also enabling the Romans to be tactically flexible (Gabriel 2002). New colonies were created along these roads to service this mobility enabled by the new physical infrastructure. New business opportunities grew with new business models, such as the Roman postal service, "Cursus publicus", which was founded by Emporia Augustus and enabled a package or letter to travel by a relay of horses up to 800km in 24 hours (Kelly 2004).

Similarly, the impact of mobile phone technology is creating new opportunities for people and communities across the world. However, the enemies of Roman Empire also used the very same roads, which afforded the Roman Armies their mobility and advantage, to bring about the downfall of the Roman Empire. This might serve as a warning that alongside the positive impact of innovation, there often lurk unforeseen negative consequences. As we will explore later in this upgrade thesis, the innovation of mobile telephony revolution brings not only benefits, but also challenges.

One of the underlying principles of the Roman roads network was that the roads were built to standards, as were the vehicles that travelled on them. In this age of pervasive and ubiquitous mobile communication and computing, it is essential that we learn from these lessons, decreeing the need of standards covering our communications, data exchanges and, increasingly, the applications developed.

Service Providers

Mobile operators in countries could be seen as an oligarchy, the Greek for the rule of the few. First used by Plato in "The Republic" to refer to those who have wealth and are in control, its meaning has adapted to include the state, the monarchy and latterly, multi-nationals. The notion of an oligarchy fits well in describing mobile operators, as they are few in number, often with strong ties with the government and they control a fundamental infrastructure within a nation or region. Typically in LDCs they are loosely regulated and as a commercial entity they are solely interested in large returns to their owners and shareholders. Tom Wheeler, the Chair of the Board of the GSMA Development Group, stated at the Mobile Health Conference in June 2011 that the target for the operators was now to extend their reach, decrease their costs and add new services in order to increase their consumer base, maximise spend and increase their profits. Whilst mobile operators undoubtedly create jobs, both directly and indirectly, the bulk of their profits are not recycled into the context in which they were derived; rather, they find their way to mainly northern hemisphere investors and owners.

Privacy concerns

In amongst concerns for privacy and security of nation states and their citizens, we must recognise the Panopticon effect present in mobile phone usage. “Panopticon”, a concept coined by J Bentham in 1786, is the ability to observe people without their knowing if they are being observed or not, unless there is an intervention (Brignall 2002). First posited as a revolutionary design for prisons, it has influenced all disciplinary community structures since that time and is a metaphor for social networking: Facebook; mobile phone usage and Internet usage - all of which leave a digital footprint that is often geo-tagged and could reflect an Orwellian outworking.

Socioeconomic

In LDCs where the future is uncertain, people tend to buy only what is needed for the immediate future; items such as toilet paper and cigarettes for example, are often bought in small quantities. These micro-spending patterns are largely driven by physical storage issues, financial constraints and security. In LDCs, the time frame for seeing a tangible return on investment is necessarily much shorter than in developed countries. For example, any tangible benefits from working or studying must be achieved within days, rather than years or decades as with the Western Education system. During visits in 2011 to Zambia, Malawi, Kenya and South Africa, I would often enquire of locals how much they were spending on airtime. Invariably they would reply, 'Not very much.' On closer inspection it was apparent that small amounts of airtime were regularly purchased, sometimes multiple times in a day, driven by need and dampened by available finance. It was clear that the majority of people spoken to did not realise that the cumulative costs of the many small transactions over a week or month actually represented between 40% and 80% of their disposable income. Interestingly, when the total cost was revealed, many seemed to take pride in how much they had spent on airtime.

This finding is echoed in the 2011 report from the ITU:

> *"… Broadband is still too expensive in many developing countries, where on average it costs more than 100 per cent of monthly income, compared with 1.5% in developed countries."* (ITU 2011)

Access to information is vital to people living in rural Africa. By accessing crop and market information, they can be sure to get the best price for their produce, whilst accessing health service online could be a lifesaver if you live 50 km from the nearest clinic.

So why does Internet connectivity cost so much in Africa? Surely it is time for governments to increase competition amongst network operators, by regulating the price of airtime and Internet connectivity if necessary? With people often spending 40-80% of their income on airtime top-ups, I came away with an overwhelming feeling that the mobile operators are walking the same path of exploitation furrowed by other imperialists of ages past.

The era of global connectivity

The world has entered a new era where communication and computing has become both mobile and ubiquitous. It is estimated that in 2011 the global population is over 7 billion people, with almost 6 billion active mobile-cellular subscriptions. Given that some people have more than one active mobile-cellular subscription, this equates to a global penetration of mobiles in 2011 of 87%, with an average of 79% in developing countries (ITU Telecom World 2011b). It is estimated that by the close of 2012 there will be more active SIM cards than people on the planet and an increase in mobile data from 0.6 Exabyte's per month to 10.8 Exabyte's with the largest rise occurring in Middle East and Africa. (Cisco 2012)

Historically, Information Communication Technology (ICT) has struggled to significantly impact the people of the developing world. The most significant advancement in communication technology over the last century has been the wireless radio, which does not require a fixed line infrastructure or significant power requirements. The mobile phone stands well in this developing world context alongside the wireless radio, as it now extends the paradigm of the radio's broadcast communication functionality with both vocal and textual bi-directional communication. With the introduction of both Feature and Smart phones, the affordance of mobile technology is further enhanced by the possibility of accessing the Internet through the mobile phone - even through 2G networks. People, irrespective of their location and means, not only have the ability to communicate and access information, but also to become contributors into the collection of artefacts that is the Internet. The International Telecom Union (ITU) now estimate that 2.45 billion people (35% of the world's population) are online and using the Internet, with 62% of these living in developing countries (ITU Telecom World 2011b). The majority of people in developing countries will use their mobile phones as their sole connected device.

The reach of the oligarchy of mobile phone providers is now near global with the ITU reporting that 90% of the world's population is now served by 2G coverage, with 45% of the global population being able to access 3G coverage. It has been contended that the last mile is now connected. However, a significant digital divide still exists between so-called developed and developing countries. Providing an individual in a Least Developed Country (LDC) with a mobile handset does not necessarily afford the act of digital inclusion as their financial capacity may not facilitate the cost of airtime, the socio-political context may limit digital empowerment based on their gender, or their lack of education may render them digitally illiterate. An ever-growing reliance on the Internet for communications, information, governance and commerce has the potential to marginalise many people in rural LDCs. People in LDCs increasingly have access to

Internet capable mobile phones, but due to the relatively high cost of airtime and data bundles, they are unlikely to download data intensive materials; my initial field work has highlighted that they spend up to 50% of their time without airtime credit. Further barriers to accessing the Internet on mobile devices include complex activation processes, living in a "sometimes connected" environment and the uncertainty on the cost of usage. This results in potentially life changing information not getting to the people that need it the most.

It is expected that the model will act as a strategic tool for government policy makers in LDCs seeking to encourage their citizens to use their mobile phones to join the growing global on-line community.

1.1 Structure of report

This research investigates the drivers and dampeners of the "Adoption of Mobile Internet" (AMI) in sub-Saharan Africa (SSA) by firstly drawing on a literature review of the digital divide, empowerment and the implied key constructions influencing AMI in LDCs.

It is worth noting that the literature review is drawn from research mainly in the ICT4D (Information Communication Technology for Development) domain and is underpinned from the literature on the digital divide and empowerment. The digital divide and empowerment have been garnered as the starting point for the various modelling elements that are posited as key constructs in the models that describe the adoption of mobile Internet in Sub-Saharan Africa in this thesis. A focus on the digital divide pertaining to the mobile Internet was used as a starting point, as it frames well the social, economic and political opportunities, alongside the constraints, that exist for people living in disadvantaged communities within SSA. Empowerment was also introduced as a springboard to gather research into the drivers of why people would seek the introduction of mobile Internet into their ecosystem of services and what agency and affordances this would bring. The notions of both "digital divide" and "empowerment" do not appear explicitly in the model but many of the model elements are derived, at least in part, from these concepts.

Fieldwork from four sub-Saharan nations alongside findings from discussions with mobile experts into these AMI constructs are analysed using NVivo and presented. The literature review, fieldwork, expert discussions are then triangulated and developed using Systems Dynamic Modelling (SDM) into a preliminary model describing the main constructs and influences of AMI in SSA. The AMI SDM model is then tested for goodness of fit with validated data sets using Structural Equation Modelling (SEM) and finally a simulation model is developed, tested and the results discussed.

This thesis is divided into nine chapters.

Chapter 2 contains a Literature Review of: the convergence of the Mobile Phone and Internet; the impact of mobile Internet in LDC's and factors influencing the adoption of mobile Internet.

Chapter 3 outlines the methodologies used to construct and validate a model to describe the adoption of mobile Internet for LDCs in SSA.

Chapter 4 details the analysis and findings of a field work from: a pilot study from two communities in South Africa in April 2010; discussions with experts on mobile adoption in SSA; observations from a series of three two-week trips to Zambia and Malawi between April–October 2011; and the results from a 6-month project using mobiles to enhance an existing maternal health project in Malawi and Zambia.

Chapter 5 triangulates the findings of the Literature Review (Chapter 2), the field work, and the Expert Review (Chapter 4). It then introduces an initial structural equation model describing the Adoption of Mobile Internet in Africa.

Chapter 6 takes the model of AMI from Chapter 5 and develops a Structural Equation Model which is tested for goodness of fit against published historical datasets.

Chapter 7 develops the results from Chapter 6's SEM model into a simulation model to validate the model further.

Chapter 8 discusses the quantitative and qualitative findings from the previous chapters and considers the main factors influencing the Adoption of Mobile Internet in SSA.

Chapter 9 draws conclusions from the research and presents an assessment on the adequacy of the model to describe the adoption of mobile Internet in SSA. Future areas for research are also suggested.

Chapter 2. **Literature Review**

This chapter presents a literature review of the mobile Internet, the digital divide, empowerment and the affordance of mobiles in Least Developed Countries (LDCs) in order to identify key constructs important in developing a model that adequately describes the adoption of mobile Internet in sub-Saharan Africa.

It is worth noting that the literature review is drawn from research mainly in the ICT4D (Information Communication Technology for Development) and is built on a foundation of the digital divide and empowerment. These terms have been garnered as the starting point for the various modelling elements that are posited as key constructs in the various adaptations of the models that describe the adoption of mobile Internet in Sub-Saharan Africa. A focus on the digital divide pertaining to the mobile Internet was used as a starting point as it frames well the social, economic and political opportunities, alongside the constraints, that exist for people living in disadvantaged communities within SSA. Empowerment was also introduced as a springboard to gather research into the drivers of why people would seek the introduction of mobile Internet into their ecosystem of services and what agency and affordances this would bring. The notions of both "digital divide" and "empowerment" do not appear explicitly in the model but many of the model elements are derived, at least in part, from these concepts.

Africa features in the Literature Review specifically, as it is one of the fastest-growing markets for mobile technology and mobile web and is the focus of this thesis.

2.1 Convergence of Mobile and the Internet

In 1973, Martin Cooper and a team from Motorola made the first cellular phone call in New York on a two kilogram handset that cost the equivalent of $1 million to produce (Teixerira 2010). It was not until the 1990s that mobile phone technology started to gain traction, although this was mainly in developed countries (Lacohée et al. 2003).

Around the same time, March 1989, in response to losing valuable information in a complex evolving system, Tim Berners-Lee wrote a paper entitled “Information Management” (Berners-Lee 1989). In this paper he proposed that a system be created to enable physicists from CERN to share digital artefacts through a global hypertext system. Despite being described by Mike Sendall, his manager, in a handwritten note as “vague but exciting”, the first interaction of the World Wide Web (WWW) was demonstrated on Christmas day in 1990 by Tim Berners-Lee and Robert Caillau (Greenemeier 2009). The guiding principal and vision of the WWW is to make its benefits available to everyone on whatever connected device they have (W3C n.d.). From one web server in 1990, nearly two decades later, over one trillion unique URLs (GoogleBlog 2009)and over 122.25 million active websites (DomainTools 2010) ensure continued storage and management of information.

Internet access via handheld devices was possible before WAP, but the technologies never took off commercially because they used proprietary technologies that didn’t work across platforms. Ericsson, Motorola, Nokia, and Phone.com launched the WAP Forum in December 1997 to promote universal standards. The forum currently has 335 members worldwide, including such major companies as AOL, AT&T Wireless Services, Hewlett-Packard, IBM, Intel, and Microsoft.

At the end of 2009, the world’s population was estimated at 6.9 billion (Bureau of US Census 2012), with an estimated 4.6 billion mobile cellular subscriptions. This corresponds to 67% penetration with the highest growth rates of mobile adoption occurring in developing countries (ITU 2010). Mobile technology is the most widely diffused ICT with almost three-quarters of the world’s rural inhabitants covered by a mobile signal by the end of 2008 (International Telecommunication Union 2010).

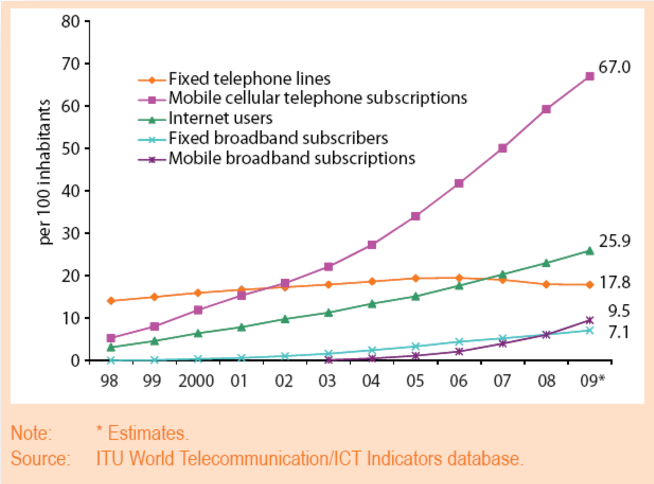


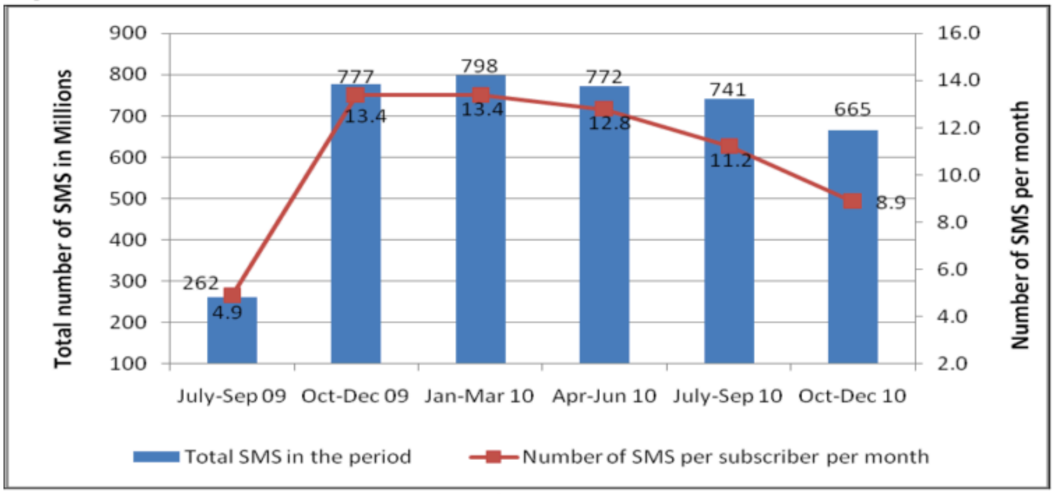
Figure 2-1: Mobile vs Fixed line telephone and Internet Subscriptions (ITU 2010)

The potential to talk and send short messages to almost anyone on the planet is no more than a string of sixteen numbers away. It must be noted that many cultural differences in the use of mobile phones exist. For example, in some communities, mobile phones are seen as a community resource with many people sharing a single handset and SIM card and paying for their usage on a pay-as-you-go basis. Many “public” mobile phone booths are also in evidence in LDCs, alongside street vendors offering use of GSM phones. Across South Africa it was observed that people often owned two or more SIM cards to enable separation of open and discreet personal calls.

Figure 2-2: Lady selling Airtime and Mobile Calls in Idutywa, South Africa

In 1996, the Nokia 9000 Communicator, the first mobile phone with Internet connectivity, was launched in Finland. In 2008, 12 years after the introduction of the mobile web, the number of people accessing the Internet on mobile phones globally overtook those using personal computers. In the developing world, given the lack of fixed line broadband and computer hardware, connecting to the Internet on mobile phones has always been the only tangible option for the average citizen (Hillebrand 2002).

Being able to connect to the Internet using a mobile phone has significantly impacted how people in developing countries are using their mobile phones. For example, a report from the Communications Commission of Kenya for Oct – Dec 2010 (Botha et al. 2007) shows a significant change in mobile phone usage patterns in 2010, with the number of SMSs being sent reducing for the third quarter in a row.



Source: CCK, operators compliance return forms

Figure 2-3: Number of SMS messages sent per month in Kenya in 2010

This reduction in SMS volume in Kenya is mirrored by a substantial increase of 46.7% in the number of mobile data subscriptions in a three-month period.

	Q2 10/11	Q1 10/11	Distribution of subscription type (%)	Quarterly variation % (+/-)	Q4 09/10
Total internet subscriptions	**4,716,977**	**3,230,023**	**100**	**46.3**	**3,096,952**
Terrestrial mobile/data subscriptions	4,684,473	3,192,667	98.8	**46.7**	3,059,906
Terrestrial wireless data/internet subscriptions	26,137	15,907	0.49	**64.3**	22,134
Satellite data/internet subscriptions	447	839	0.23	**-46.7**	953
Fixed DSL data/Internet subscriptions	4,305	12,216	0.38	**-46.8**	9,631
Fixed fiber optic data/internet subscriptions	3,824	8,369	0.26	**-54.3**	4,303
Fixed cable modem data/internet subscriptions	25	25	0.00077	**0**	25
Estimated Internet users[5]	10,199,836	8,689,304		**174**	7,832,352

Source: CCK, operators compliance return forms, (-) data not available

Table 2-1: Internet Subscriptions for Q2/10 and Q1/10 in Kenya

To gain a better understanding of mobile phone browser usage in South Africa, statistics for the Opera Mini Browser are presented as an indicator of accelerated growth of Internet usage. Opera Mini is used by over 100M people in 2009 (Communications Commission of Kenya 2011), especially in developing countries, as it compresses web content by up to 90% and consequently reduces the cost of access. Opera Mini is also pre-installed on many Feature phones.

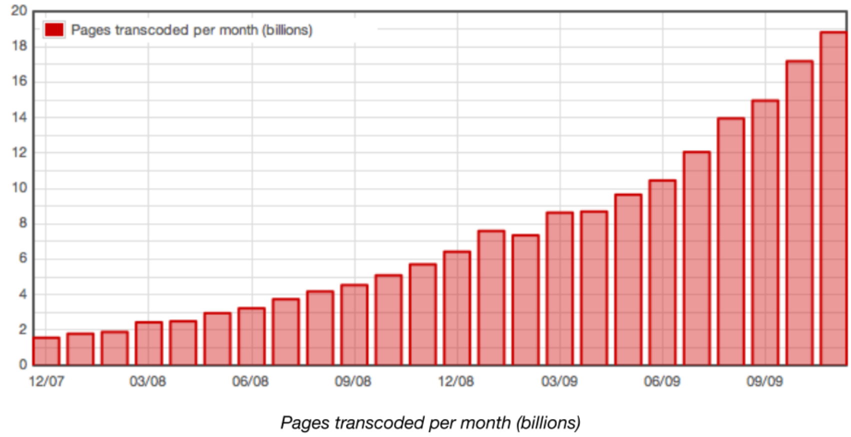
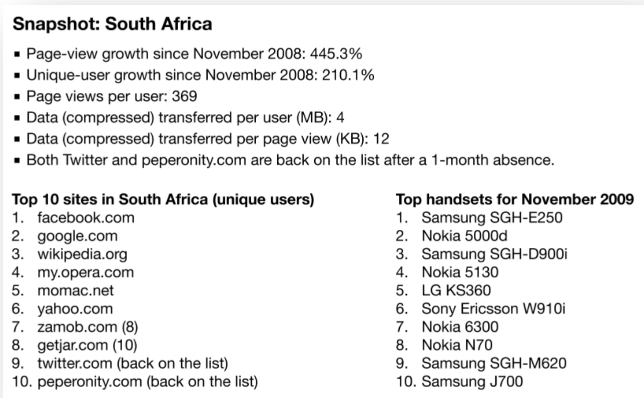


Figure 2-4: Mobile Phone views globally using Opera Mini (Czerniewicz 2009)

The specific snapshot for Opera Mini page views in South Africa in November 2008 shows a 445.3% increase, with the average person viewing 369 pages a month. Four of the top ten handsets are Samsung and the most visited site is facebook.com which highlights social connectivity as a key driver for the adoption and use of the mobile Internet (Czerniewicz 2009).



Snapshot: South Africa

- Page-view growth since November 2008: 445.3%
- Unique-user growth since November 2008: 210.1%
- Page views per user: 369
- Data (compressed) transferred per user (MB): 4
- Data (compressed) transferred per page view (KB): 12
- Both Twitter and peperonity.com are back on the list after a 1-month absence.

Top 10 sites in South Africa (unique users)	Top handsets for November 2009
1. facebook.com	1. Samsung SGH-E250
2. google.com	2. Nokia 5000d
3. wikipedia.org	3. Samsung SGH-D900i
4. my.opera.com	4. Nokia 5130
5. momac.net	5. LG KS360
6. yahoo.com	6. Sony Ericsson W910i
7. zamob.com (8)	7. Nokia 6300
8. getjar.com (10)	8. Nokia N70
9. twitter.com (back on the list)	9. Samsung SGH-M620
10. peperonity.com (back on the list)	10. Samsung J700

Figure 2-5:Opera Mini statistics for South Africa in November 2009 (Czerniewicz 2009)

2.2 The Context of Mobile Internet in LDCs

Historically the diffusion of new technology has been uneven both spatially and socially (Kleine 2010). The adoption of the mobile phone is one of the first technologies that have impacted people irrespective of geographical location and financial resources. During my travels in Africa the majority of people I spoke to have a mobile phone - even if they live in rural setting that do not have access to regular cell tower coverage. Millions of people from across all LDCs are beginning to use mobile phones to facilitate voice communications, SMS and increasingly to access the Internet.

LDCs in sub-Saharan Africa are generally not serviced with a ubiquitous fixed line infrastructure which is available to their citizens so the introduction of mobile phones has bought a revolutionary leapfrogging into the communication age using technology. This alone is a significant advancement that impacts socio-cultural, socio-economic, business and political structures (Shirky 2010; Waverman et al. 2005; Akpan-obong et al. n.d.; Making 2009). LDCs have also strongly adopted using SMS to communicate (Communications Commission of Kenya 2011). This has been a positive influencer in literacy rates as it introduces the notion of written text into a culture of oral tradition (Paper & Miyazawa 2009).

There appears to be two main drivers for the adoption of SMS in LDCs. Firstly, the cost of an SMS is fixed and known - although it must be noted that, byte for byte, sending an SMS is the most expensive activity on a mobile handset. For a financially poor person the notion of financial risk is very problematic and consequently many activities in LDCs operate on a micro basis with people purchasing what they need for that moment, rather than aggregating their need over a day, week or month. For example, when discussing food shopping in the UK on my African trip, people in rural settings were surprised that my family would make a weekly shop for food and even more surprised that this was done online and delivered to our door. They would often buy only what they need for the next meal, or top up airtime for the next call, or buy a single cigarette for their next smoke.

The limitation of 160 characters is a positive thing for the growing-literate, as it bounds expectations on the length of a communication which is of further benefit, as the device they are probably using does not afford quick and easy textual input. Secondly, an SMS is does not require the recipient to have their mobile phone switched on to receive the message at a later time. The SMS will be stored on the system until the phone is connected to a cell tower and then the message will be delivered. This is very important in a sometimes-connected environment. Many new and innovative uses of SMS are emerging including educational tools (Nwaocha & Open n.d.), transportation systems (Anderson et al. n.d.), money transfer systems (Vincent & Cull 2011; Morawczynski 2007; GSMA 2009) and health care (Alam et al. n.d.; Martin-Crawford 1999).

Whilst Africa is home to 14% of the world's population in 2008, it only housed 3.5% of the world Internet users (Sundaram 2008). Adele Botha from CSIR in South Africa terms these people as Mobile-First Internet users and posits that there are unique characteristics and affordances that Mobile-First Internet users demonstrate (Botha et al. 2007; Ford & Botha 2009). This is summed up well in the following quotation from a story in the Economist (Anon 2008):

> *"Shackled to our desktop and laptop computers, we in industrialized nations might just be missing the next computer revolution. Wouldn't it be deliciously ironic if developing countries leapfrogged ahead of us by using inventiveness born of the need to make-do with less? It might very well already be happening in the form of mobile-phone-based computing."*

Although mobile phone technologies in LDCs in SSA are becoming ubiquitous, research suggests that fixed line, shared public access points, such as Internet tele-centers, in areas of low income, yields economic, social and psychological benefits and enjoy a continued high demand - even in the post-mobile era (Wallace Chigona et al. 2011). Chigona asserts that there is interplay between fixed-line and mobile provision of the Internet that impacts both the adoption and affordances of the Internet in peri-urban low-resourced areas. Chigona's assertions, in my experience seem to hold true in urban and peri-urban communities, where on-grid services such as reasonably reliable provisioning of electricity and connectivity are a given, the availability of tele-centers are spatially high and the costs of usage relatively low or free. The interplay between fixed-line and mobile Internet may hold less relevance in off-grid rural settings where the provision of electricity is low and the existence of fixed line infrastructure is non-existent. Also, the geographical density of tele-centres would prohibit regular usage, as users would typically need to travel long distance to access a tele-centre.Least Developed Countries

The term LDC was created in 1971 and from the Economic and Social Council of the United Nations and refers to a country that meets the following three criteria (The Economic and Social Council of the United Nations 2003):

- Low Income – based on a three-year average of the gross national income per capita of under $750 for inclusion and $900 for graduation.
- Human Weakness - based on the Human Assets Index (HAI) based on adult literacy, education, nutrition, health
- Economic Vulnerability – using the Economic Vulnerability Index (EVI) which is derived from measure of agricultural instability, export of good and services, economic importance of non-traditional activities, occurrence of natural disasters, economic smallness and merchandise export concentration.

Following these criteria, in 2011 there are currently 49 LDCs globally with 33 of these in Africa.

Country	Date of inclusion on the list	Country	Date of inclusion on the list
1. Afghanistan	1971	26. Malawi	1971
2. Angola	1994	27. Maldives[1]	1971
3. Bangladesh	1975	28. Mali	1971
4. Benin	1971	29. Mauritania	1986
5. Bhutan	1971	30. Mozambique	1988
6. Burkina Faso	1971	31. Myanmar	1987
7. Burundi	1971	32. Nepal	1971
8. Cambodia	1991	33. Niger	1971
9. Central African Rep.	1975	34. Rwanda	1971
10. Chad	1971	35. Samoa[2]	1971
11. Comoros	1977	36. Sao Tome and Principe	1982
12. Dem. Rep. of the Congo	1991	37. Senegal	2000
13. Djibouti	1982	38. Sierra Leone	1982
14. Equatorial Guinea	1982	39. Solomon Islands	1991
15. Eritrea	1994	40. Somalia	1971
16. Ethiopia	1971	41. Sudan	1971
17. Gambia	1975	42. Timor-Leste	2003
18. Guinea	1971	43. Togo	1982
19. Guinea-Bissau	1981	44. Tuvalu	1986
20. Haiti	1971	45. Uganda	1971
21. Kiribati	1986	46. United Rep. of Tanzania	1971
22. Lao People's Dem. Rep.	1971	47. Vanuatu	1985
23. Lesotho	1971	48. Yemen	1971
24. Liberia	1990	49. Zambia	1991
25. Madagascar	1991		

Table 2-2: List of LDCs in 2011 from the United Nations

It is important to recognise that the affordances and assumptions of living in a developed world context are easily overlaid on a developing world context and result in an unrealistic abstraction of reality and the consequent deployment of non-appropriate technological solutions that are beginning to be documented through events such as FailFaire. (The World Bank 2010)

2.2.1 Impact of Mobiles

Technology in itself does not lead to social change; people decide how a particular technology will be used and, depending on the political and socio-economic environment in which they live, adapt it accordingly (Kling 1999).

> *"Community Informatics (CI) is concerned with carving out a sphere and developing strategies for precisely those communities {disadvantaged} to take advantage of some of the opportunities which the technology is providing. "*
> (Gurstein 2000)

The introduction of mobile phones in Africa has transformed people's ability to communicate. Unlike in the West, where there was already an existing network of communications through landlines, mobile phones in Africa provide communication where previously there was none. Placing the potential of the Internet into the hands of people in developing nations provides them with the opportunity to tell their story and engage in the political process. One single message sent by SMS to Twitter can spread throughout the world in minutes.

Mobile and Internet technology together are democratising social change in communities across Africa (Shirazi et al. 2010).

Optimists claim that bridging the information gap will accelerate growth, improve education and healthcare, increase efficiency of public administration, and encourage commerce and a greater public participation in democracy. Sceptics note that the application of ICTs reallocates scarce resources away from more needy causes and point to the sociocultural evolution, which takes place when the introduction of external influences into a closed culture occurs.

Two of the main functions of ICT are the provision and dissemination of information and knowledge. In addition to this, ICTs have the potential to facilitate delivery of better health, education and participation (Peterson et al. 2006)

ICT solutions have been used in the field of health and medicine to provide up-to-date information, as well as assistance in providing accurate diagnosis, especially in rural areas (Jagun et al. 2007). One good example of ICT helping healthcare is HealthNet; launched in 1989, it provides up-to-date health information and also collaboration, data collection, medical alerts and use of databases. HealthNet currently serves approximately 20,000 healthcare workers in more than 150 countries (Flynn et al. 1994; Mbarika 2004).

ICT is also used in the education field to enable distance learning, especially in rural areas (Fors & Moreno 2002a). ICT also has the potential of generating sustainable revenue for people in developing countries. The much heralded Greameen bank in Bangladesh pioneered a service in 2001, providing loans to rural villagers to purchase cellular phones to run as a business. These phones initially generated on average, US$1200 per year per handset (Grameen Bank 2007) . Marlon Parker of RLabs on the Cape Flats in South Africa has also seen the tranformatory impact of mobile phones on being able to providing services such as a drug advisory support service, debt counselling services alongside enabling local community members to develop ideas into self-sustaining businesses (M. Parker et al. 2008; Marlon Parker et al. 2012)

We are in the midst of one of the largest changes in consumer spending patterns that has ever been seen (Chepken & Muhalia 2011). Consumer enthusiasm for mobile commerce, both in developing and developed nations, is growing strongly and showing no signs of diminishing. In developed countries, the dominance of Smart Phones and the release of tablet devices are untethering people's experience of the Internet away from desks and providing the same mobile Internet user experience as those in developing nations, where the option of fixed line broadband and desktop/laptop Internet experience is severely limited.

In developing nations, applications that flourish on the mobile platform are ones that embrace the inherent limitations of screen size and navigation. The application needs to be designed with any bandwidth constraints or network issues in mind. Mobile application downloads across all handsets worldwide are poised to grow from 7 billion in 2009 to almost 50,000,000,000 in 2012. This represents a year on year growth rate of 92% (Chetan Sharma Consulting 2009).

Many people now claim that we live in an information society or a knowledge-based economy (Druker, 1993). The knowledge economy is defined as an economy where "the exploitation of knowledge has come to play the predominant part in the creation of wealth" (DTI, 1998, p.2). ICTs have the potential to change people's powerlessness and lack of information into increased participation and transparency of government policy and procedures. This can reduce corruption and increase revenue growth (Bhatnager, 2000, p1).

ICT cuts out the middleman and connects people with information. We have seen this in developed countries with insurance services, shopping and holidays, for example. Our consumer patterns have changed and the need for "middle-men" has diminished or been fulfilled by digital aggregators. ICTs have the potential to empower citizens to access information and knowledge, by providing them with relevant and accurate information. It must equally be noted that ICT has the potential to disseminate false information.

Mobile Money

> *"Mobile money is to developing nations what ATMs are to developed nations, transferring money instantly and securely over their mobile phone".* (Lyon 2010)

In March 2007, Safaricom, part of the Vodafone Group, launched M-PESA in 2007 in Kenya, as a joint initiative with the UK Department for International Development (Khoja et al. 2009). "Pesa" is the Swahili word for money, with an additional "M" for mobile. M-PESA enables users through the USSD messaging channel the ability to deposit, withdraw and transfer money, alongside paying bills and purchasing airtime, all from the most basic GPRS enabled mobile phone. More than 12 million people in Kenya now use M-PESA, which accounts for 40% of the adult population (allAfrica.com 2010). It has transformed social and economic life in Kenya, with 38% of Kenyan households now having at least one M-PESA user in them. This compares to only 22% of adults who have traditional bank accounts (Mit et al. 2010). M-PESA also launched in South Africa in September 2010 (allAfrica.com 2010). In 2012 it now reported that 80% of the world's mobile money transactions are happening in East Africa with M-PESA reportedly handling $20 million transactions a day (KRUGER 2012).

Charges for using M-PESA are as follows:

Transaction type	Transaction range (KShs)		Customer Charge (KShs)
	Minimum	Maximum	
Value Movement Transactions			
Deposit Cash	100	35,000	0
Send money to a registered M-PESA user	100	35,000	30
Send money to a non-registered M-PESA user	100	2,500	75
	2,501	5,000	100
	5,001	10,000	175
	10,001	20,000	350
	20,001	35,000	400
Withdraw cash by a registered M-PESA user at an M-PESA Agent outlet	100	2,500	25
	2,501	5,000	45
	5,001	10,000	75
	10,001	20,000	145
	20,001	35,000	170
Withdraw cash by registered M-PESA user at PesaPoint ATM	200	2,500	30
	2,501	5,000	60
	5,001	10,000	100
	10,001	20,000	175
Withdraw cash by a non-registered M-PESA user	100	35,000	0
Buy airtime (for self or other)	20	10,000	0

Table 2-3: M-PESA Tariff 2010 (Safaricom 2010)

The following table summarises the cost of sending R250 (~2,800 KES) by various methods within South Africa.

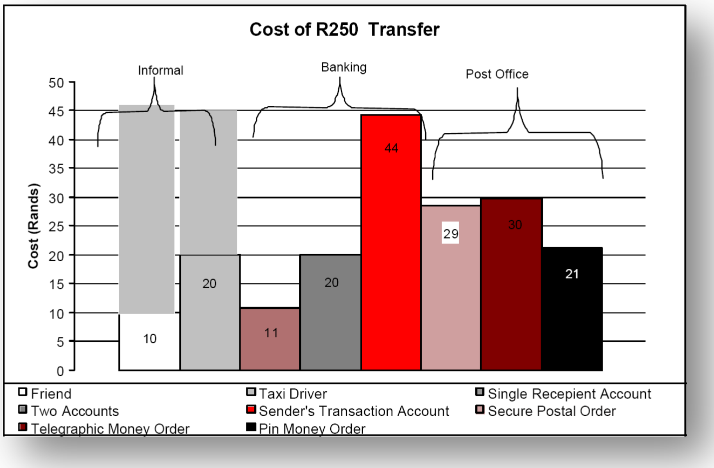


Figure 2-6: Comparison of the cost to transfer R250 using different channels in South Africa (Analytics 2003)

Comparing the two figures yields a cost for transferring R250 between two accounts using traditional methods of R20-R40 (8% - 16%). Using M-PESA costs R3 (1.2%) and the transfer is immediate.

M-PESA has serviced a real need in providing banking services to those the financial industry were not serving. In the first year of launch, M-PESA signed up more customers in Kenya than the entire banking system collected in a decade and transacted over $0.5 billion in the first 18 months (Sundaram 2008).

2.2.2 Socio-Cultural Evolution

We are in the midst of the biggest technology revolution, perhaps in the history of humanity. In 2010, it was estimated that the global Internet connected population would exceed 2 billion people (International Telecommunication Union 2010). Taking into account multiple SIM card ownership, mobile phone accounts already number over 3 billion. For the first time in our history, we live in a world where being part of a global Internet group is the norm for most citizens (Shirky 2010). Whilst the adoption of computer based Internet was impressive and unparalleled, we are now on the verge of a mobile revolution that has the potential to connect everyone on the face of our planet through voice, data and commerce, by means of a mobile phone.

Never before in human history has mankind been so connected, with each citizen having the potential to influence and be influenced. The evolution of cultures and society through these new global influences can be seen in a report from the South African Home Affairs department in 1993, which shows that the following words are being registered as first names for children: Call Later, SIM Card, Talk Time, SMS, Pays UK, and Air Time (South African Home Affairs 2009) . Whilst there is a tradition in southern Africa for adopting words from other languages into names, I would argue that this is a measure of the social importance of cell phones and an indicator of socio-cultural evolution.

Socio-Cultural Evolution speaks about the impact one culture has on another culture and the manifestation of that change in terms of manifested society. With the introduction of the mobile Internet, people in communities within LDCs are typically accessing content created in cultures as there are not yet significant amounts of content which imbibe their cultural values available to them. This results in a socio cultural evolution that is impacted largely by Hollywood, Bollywood, Gollywood and Nollywood. This is bringing about some interesting phenomena such as young people in Dutywa, South Africa (one community I visited), knowing more about the activities of Lady Gaga than they do about their own communities and individuals with it.

Digital imperialism is a concern of this incumbent digital content, alongside the obvious English language monopoly of the web, most of the materials strongly reflect the cultural values and worldviews of the society of authorship (Limb 2005). With over 6,000 languages in the world today we can get an indication of the reduction effect of the Internet by looking at the language support of some of the key players in this digital space. For example, Twitter supports 21 languages, Google Translate 63 languages, Facebook with 70 languages and Wikipedia supporting 285 (The Broadband Commission 2012). Of the nearly 2 Billion Internet users on 30th June 2010 the following profile of language usage was gathered:

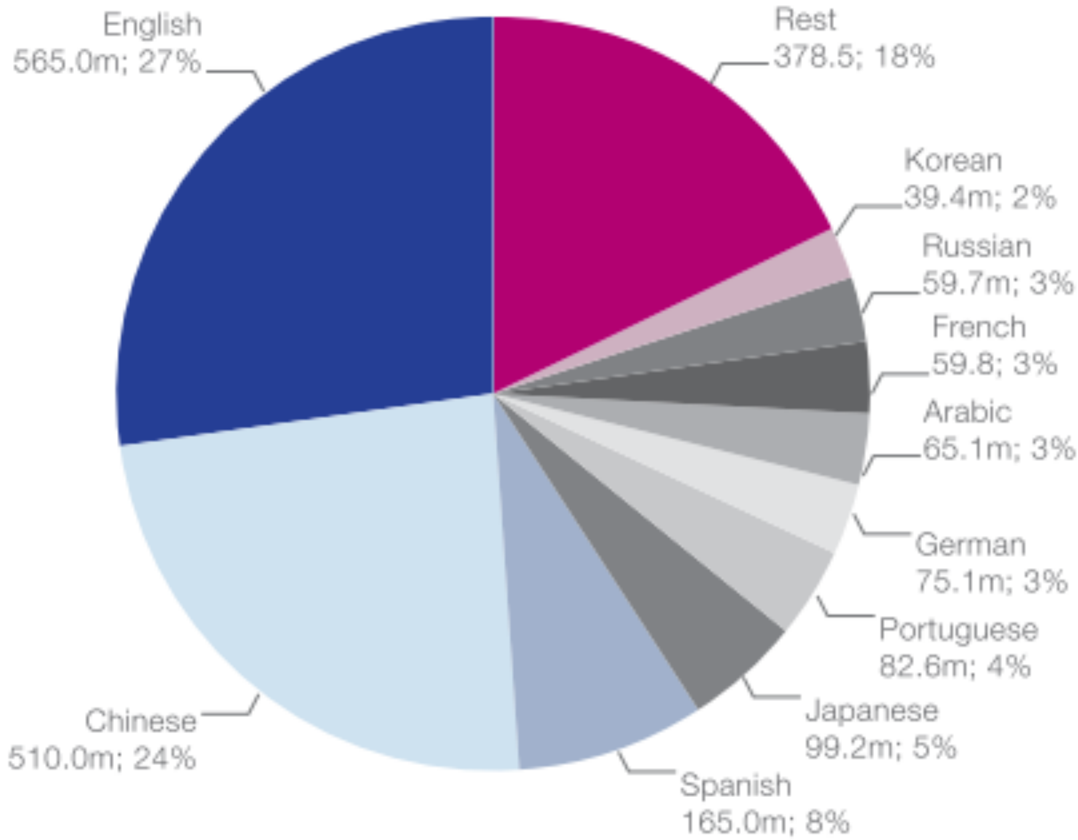


Figure 2-7: Languages used on the Internet in June 2010 (Internet World Stats n.d.)

We are in the midst of one of the largest changes in consumer spending patterns that has ever been seen (Donner & Escobari 2010). Consumer enthusiasm for mobile commerce, both in developing and developed nations is growing strongly and is showing no signs of diminishing (Khoja et al. 2009) .

This mobile revolution is manifest in many different ways across the face of our planet depending on culture. Global use of mobile Internet includes banking (GSMA 2009), healthcare (Bhavnani et al. 2008), education, disaster management, and government (Brewer 2005).

> *"**We dump hardware down and hope magic will happen!**"*
> *Michael Trucano, senior information and education specialist at the World Bank at FailFair, July 2010.*

Mobile devices have fast become more than just a communication device, as they also offer the ability to store calendar, contact information, gaming platforms, music player, camera, e-mail, SMS, instant messaging and many other services. With the advent of this increased intelligence through agent technologies and the convergence of location aware devices and geo-tagging, it is clear why the mobile phone has fast become humanity's must have item. This technology can be used for both positive and negative means: checking the location of your child or belongings with RF tags, or for the government or employers to check your location for monitoring purposes.

At "The Future of Cloud Computing conference" in Brussels in February 2010, a representative from Microsoft Europe indicated that mobile phones would cause a cloud to expand at a staggering rate. The largest area of website and application development is directed at the mobile consumer market. Cloud computing lends itself to mobile devices as it provides the ability for total connectivity and access to complex applications and large data stores, without requiring the user to have the power of a high spec computer at hand. This potentially will enable innovation and entrepreneurship to breakout with the mobile first Internet users of Africa. Innovation hubs such as mLabs, RLabs and the iHub, (to name but a few) are important stakeholders in encouraging and facilitating these Africa born innovations.

The DNA of the World Wide Web is free thought and free speech. This DNA is now manifesting through mobile devices irrespective of an individual's age, financial means, political allegiances and cultural context. Having a connected device yields the potential to become an eParticipant with an equal status (Dijk 2009). Potentially, one person with a mobile phone and Internet connection, can, in a matter of minutes, have their Tweet reposted to a global audience. Reports of wars and humanitarian disasters are crowd sourced long before traditional media channels have their feeds (Howe 2009). Cognitive surplus is no longer focused at passive consumption of TV, but more at active participation and collaborative creative activity (Shirky 2010).

With the ubiquitous and pervasive nature of always being online, there is a growing dependency in all areas of life on mobile technology through being easily and cheaply connected to the World Wide Web. It should be noted though that in many LDCs the cost of connectivity is high relative to their income and the speed, coverage and reliability of their Internet connection, whether mobile or fixed, is constraining. We need to be very aware of the dependency that this will manifest between humanity on technology. In light of the looming energy issues, we may dangerously be building on unsure foundations. The development of green solutions for both consumer devices such as mobile phones, mobile telephone masts and green solutions for the Internet, are imperative to ensure robustness in the technological solutions on offer. Alongside the tangible benefit, mobile phones facilitate social capital (Bhavnani et al. 2008)

2.2.3 Affordances of Mobiles

The term affordance was originally defined by American psychologist J J Gibson, as actions, possible within an environment, which can be objectively measured but are not dependent on the individual's ability to recognise them (Shaw et al. 1977; Gibson 1979). However, the affordance is limited by the individual's capabilities. For instance, a door handle 4 foot high does not afford the actor opening the door, if the actor is a crawling infant.

In 1988, Don Norman, a student of Gibson's, contextualised the term affordance within the Human Computer Interaction (HCI) paradigm to refer to the action possibilities that were readily perceivable by an actor. This replaced Gibson's objective affordance with the notion of perceived affordances. Consequently, the affordance concept is constrained, not only by the physical capabilities of an actor, but also by their culture, values, beliefs and past experiences. For instance, a tomato within most of Europe affords nutritional value, but on the last Wednesday of August in the town of Bunol in the Valencia region of Spain, 150,000 tomatoes afford 50,000 people an opportunity for a giant food fight (Tomatina 2009).

Similarly, providing an individual in an LDC with a mobile handset does not necessarily afford the act of digital inclusion, as financial capacity may not facilitate the cost of airtime, or socio-political context may limit digital empowerment based on their gender or their lack of education may render them digitally illiterate.

2.2.4 Empowerment

It is important to understand the nature of the word empowerment in the context of LDCs as empowerment has a strong cultural context and any notion of imperialism in our understanding of this word must be avoided.

> *"`Empowerment' is a term often used in development work, but rarely defined in the context of its root-concept: power. Different understandings of what constitutes power lead to a variety of interpretations of empowerment, and hence to a range of implications for development policy and practice."*
> (Rowlands 1995)

The World Bank defines empowerment as:

> "The process of enhancing the capacity of individuals or groups to make choices and transform those choices into the side actions and outcomes. Central to this processes are actions which both build individual and collective assets, and improve the efficiency and fairness of the organisational and institutional contexts which govern the use of these assets." (Unicef 2001)

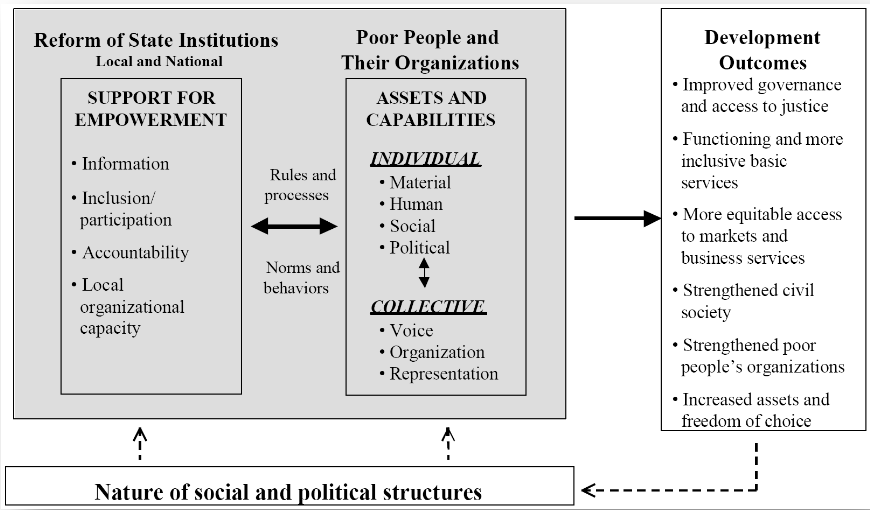


Figure 2-8: World Bank Empowerment Framework (Unicef 2001)

The definition of empowerment usually refers to either a process or an outcome.

Empowerment is defined as a person’s capacity to make effective choices: that is, as the capacity to transform choices into desired actions and outcomes. Degrees of empowerment can be measured by having a choice, exercising that choice and achievement of the intended outcome of that choice. (Alsop & Heinsohn 2005a)

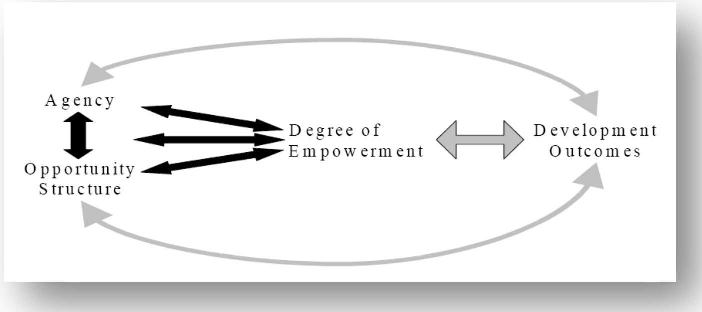


Figure 2-9: The relationship between Outcomes and Correlates of Empowerment (Alsop & Heinsohn 2005b)

The capacity to make an effective choice is primarily influenced by two sets of factors: agency and opportunity structure.

Agency is defined as an actor’s ability to make meaningful choices; that is, the actor is able to envisage options and make a choice. Opportunity structure is defined as the formal and informal contexts within which actors operate. Working together, these factors give rise to different degrees of empowerment. (Rowlands 1995)

For example, female weavers in a remote Amazonian region of Guyana developed a business creating and selling intricately woven hammocks for $1,000 apiece. The state phone company had donated a communications centre that helped the women find buyers around the world, selling to places like the British Museum. After their initial success, their husbands stopped the enterprise, worried that their wives’ sudden increase in income was a threat to the traditional male domination in their society (The World Bank 2010) .

Empowerment is a latent phenomenon, whose presence can only be produced through its action or its results. Consequently, observed behaviours are only proxies for the underlying phenomenon (Narayan-Parker 2005).

Castells suggest that a networked society, galvanised by mass communication over the Internet and wireless communication networks, will cause a shift of power from the institutional realm to the new communications space (CASTELLS 2007).

The World Bank empowerment framework suggests four axioms of Empowerment: access to information; inclusion and participation; accountability, and finally local organisational capacity.

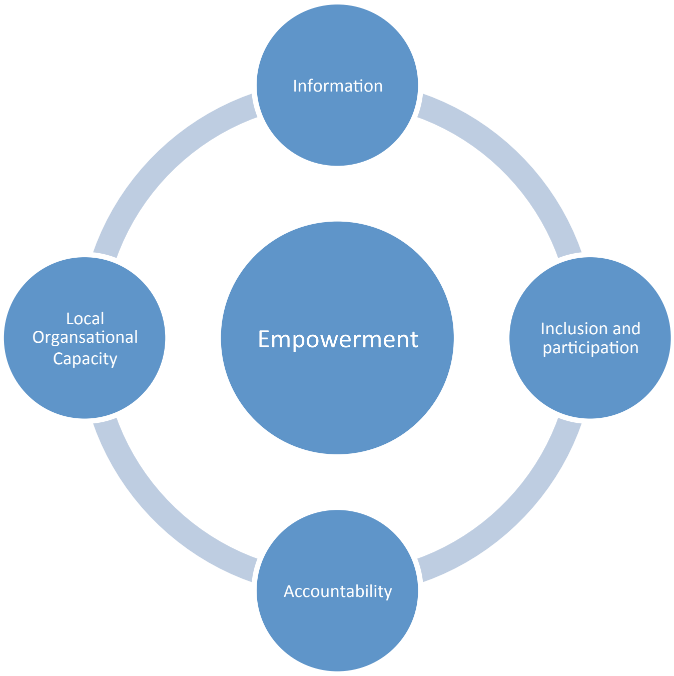


Figure 2-10: World Bank empowerment Framework (Alsop & Heinsohn 2005b)

The World Bank defines empowerment as:

> *"the process of enhancing the capacity of individuals or groups to make choices and transform those choices into the side actions and outcomes. Central to this processes are actions which both build individual and collective assets, and improve the efficiency and fairness of the organisational and institutional contexts which govern the use of these assets."* (Alsop & Heinsohn 2005a)

Empowerment is defined as enabling weaker, excluded and powerless citizens to gain or regain power over their lives. This means people participating in the decision-making and development process (Chambers, 1999, page 210).

In a report published in 2010 analysing 133 countries from 1995 to 2003, it has been shown that there is a very high correlation between ICT expansion and democratic freedom (Shirazi et al. 2010). The same report also shows that in some countries, empowerment to participate in social and political life is being significantly impacted by state led information filtering, designed to uphold incumbent regimes and social structures. In particular gender inequalities are enforced through filtering, which further disempowers women (Shirazi et al. 2010).

Mobile Internet is giving people access to information and services; however, empowerment does not occur if people cannot act on that information due to their social environment or literacy levels. Gilbert states that social structure and cultural precepts can counteract the affordances of technologies (Gilbert et al. 2008).

2.2.5 Digital Divide

The use of information and communication technologies has, up to recent years, been limited to high-income countries and the few elite in LDCs. This has led to concerns about a "digital divide" although the divide is not only concerned with access but also speed of connection, cost, content and digital literacy skills (Rice & Katz 2003; Gilster 1997; Wallace Chigona et al. 2008; Sundaram 2008).

The 'digital divide' of the 1990's has the potential of being breached, with billions of people now having access to reliable technology to connect them together and access to vast amounts of information and services. The appetite for information from the web is increasing dramatically, with page views in Africa increasing by 374% in a year (Czerniewicz 2009).

The digital divide tends to follow and reinforce existing inequalities and poverty patterns. Historic studies have indicated the ICT gap between rich countries and poorer countries are vast and that this gap is growing rapidly, rather than shrinking (Info 21,2000). For example, in 2000 the International Telecommunication Union released figures indicating that there were more Internet users in Manhattan than in the whole of Africa. (ITU,2000). In 2007, in Ethiopia, the cost of an average computer was 10 times the annual per capita GDP and accessing the Internet for 20 hours a month costs over 8 times the GDP per capita (Suregeni 2008). In 1999 the BBC reported that 80% of the world's population had never heard a telephone dial tone, let alone surfed the web (BBC News 1999). Less than two decades ago, the majority of LDCs would not have had access to telephony resources, let alone the vast resources of the Internet. Having access to information and knowledge plays a crucial role in advancing economic and social well-being (Waverman et al. 2001). Given the traditionally poor fixed line infrastructure in LDCs, ubiquitous mobile Internet provision affords an opportunity to close the digital divide, with literacy rates in LDCs being one of the biggest challenges (News24 2010).

The Digital Opportunity Task Force was set up to address and investigate the issues of inclusivity of the world's population on the Internet. Their report includes four overarching recommendations on how the G8 countries can contribute to creating digital opportunities for the world's population, especially the poorest and most marginalised groups (Force 2002). The four recommendations are: Fostering Policy, Regulatory and Network Readiness; Improving Connectivity, Increasing Access and Lowering Costs; Building Human Capacity; and Encouraging Participation in Global e-Commerce and other e-Networks.

In 1995, Uimonen reported that half the adult population in LDCs are illiterate (Fors & Moreno 2002b). When considering mobile phone usage for connecting to the Internet, which is largely textually driven, logic would indicate that the digital divide would still be manifest. However, in many situations, this has been shown to be quite the opposite. For example, in Cape Town, a project run by the Impact Centre is enabling mothers and grandmothers within the troubled community to use their cell phones to blog, tweet and engage in instant messaging platforms such as Mxit (Fors & Moreno 2002b; Julia Wills et al. 2009). The desire to share their story using ICT as a media is actually improving literacy (Paper & Miyazawa 2009).

The Genoa Plan of Action constitutes nine points of action (Force 2002)

1. Support development of national e-strategies.
2. Improve connectivity; increase access, and lower costs.
3. Enhance human capacity development, knowledge creation and sharing.
4. Foster enterprise, jobs and entrepreneurship.

5. Strengthen universal participation in global ICT governance.
6. Establish a dedicated LDC [less developed country] initiative for ICT-inclusion.
7. ICT for health care and support against disease.
8. Support local content and application development.
9. Prioritise the contribution of ICTs in Development Assistance Programmes.

Why do people in developing nations want to own a mobile phone? It brings hope, empowerment and has even been described as:

> *"My mobile is my soul!"* (Donner & Gitau 2009).

In areas of the greatest economic inequality, the drive and desire to own a mobile phone is at its highest. In a township near Cape Town, South Africa called Langa, people have a mobile phone but do not have access to basic provisions such as a toilet (Development Marketplace Blog 2010). Similarly, a community leader in Idutywa said:

> *"I used to walk down the road with R30 in my pocket and think what meat I would buy my family. Now I think how much I can spend on airtime and still have enough spare to feed my family." (Community Leader in Idutywa in April 2010).*

Since the widespread introduction of mobile handsets, many with Internet capabilities, many reports now suggest that the digital divide is shrinking rapidly. This is helped by the availability of low-cost handsets, reducing the cost of airtime, the introduction of ground up innovative products such as Mxit and a growing cultural inertia, enabling peer education on handset usage.

Perhaps the real digital divide is changing focus to bandwidth and capacity of the access to information.

2.2.6 Mobiles for Development

Many projects have been undertaken looking to use Mobile Phones to reduce poverty, empower citizens, improve medical provision, bring education, provide free or cheap access to information, encourage crowd sourced local information to be published, promote agricultural support services, enable government accountability and transparency, facilitate money transfers, create jobs and much more (Shih 2011).

Many projects looking to bridge the digital divide seemed locked into the northern hemisphere paradigm of the computer-first rather than embracing a mobile-first digital empowerment for their citizens. A good example of this is the Rwanda Information Technology Authority with their Internet bus that will give access for a few days a year to rural communities to access computers and the Internet. They spend time teaching people to use a computer which is connected to the Internet and associated programs. (BBC Website 2009b) These projects are predicated on the notion of PC-centricity rather than embracing the technology that people have in their pockets, their Mobile Phones, and equip them to use that technology fully.

Many of these projects are not scalable as they are developed by the Non-Government-Organisations (NGOs) that often do not have the finances, expertise or business model to scale or become self-sustaining (Heeks 2008).

2.2.7 Total Cost of Ownership of Mobile Phone

Owning or at least having access to a Mobile Phone is a reality for people globally whether in a Developed or Developing context. For the acutely poor, owning and running a Mobile Phone necessitates foregoing other important basic needs in order to purchase, top up, charge and repair their handsets. In Chepken's research in Western Kenya he concludes that of the 80% of the population that own their own mobile phone, 61% spent at least 10% of their deposable income on it (Chepken & Muhalia 2011). Whilst there is evidence for indirect gains to the individual, through saving travel costs and lost opportunity costs, he concludes that the introduction of Mobile Phones is likely to further impoverish poor communities.

The provision of fixed line Internet is even more expensive with a 1MB per second Internet connection in Nairobi in 2009, which was before the cables bringing fibre optic connectivity arrived, costing the equivalent of US$3,000 a month. (BBC Website 2009a) Fixed line broadband can often cost more than 100% of an average monthly income in

LDCs compared with an average 1.5% of monthly income in developed countries (ITU 2011)

During my visits to Zambia, Malawi, Kenya and South Africa in 2010/11, it was not uncommon to talk with people who spent between 40-70% of their income on mobile phone ownership. People would often relay with pride how much they spent with a visible sense of empowerment, excitement and hope. They would cite the reduced food, cleaning and schooling expenditures, which enabled this new expenditure to occur. It is true that less is being spent on travel and money can be transferred more freely within many countries using mobile money, but for the poor it can be contended that mobile phones are making them poorer.

An important indicator in accessing the relative Total cost of Ownership of Information, Communication Technology in nations is the ICT breadbasket although the results are highly influenced by the price of fixed line services and as such tend to skew the results significantly. (ITU 2011)

2.3 Factors influencing adoption of Mobile Internet.

In November 2011, Vodacom in South Africa announced a 29.4% rise in data revenue, which represented 15.8% of total revenue. This was mainly driven by Smart Phone adoption which is 10 times higher usage than dongles and modems. Active Smart Phones on the network have increased from 870,000 to 4.1 million in only 6 months. Vodacom say that Smart Phones owners use, on average, 80MB of data a month, which accounts for 30-40% of the total data usage on their network. Vodacom service 28.9 million subscribers in South Africa on 4,642 cell tower sites (Development Marketplace Blog 2010).

Tilson and Lyytinen proposed the following elements to describe the mobile ecosystem. They importantly emphasise the importance of the service providers, handset manufacturers and content/application providers.

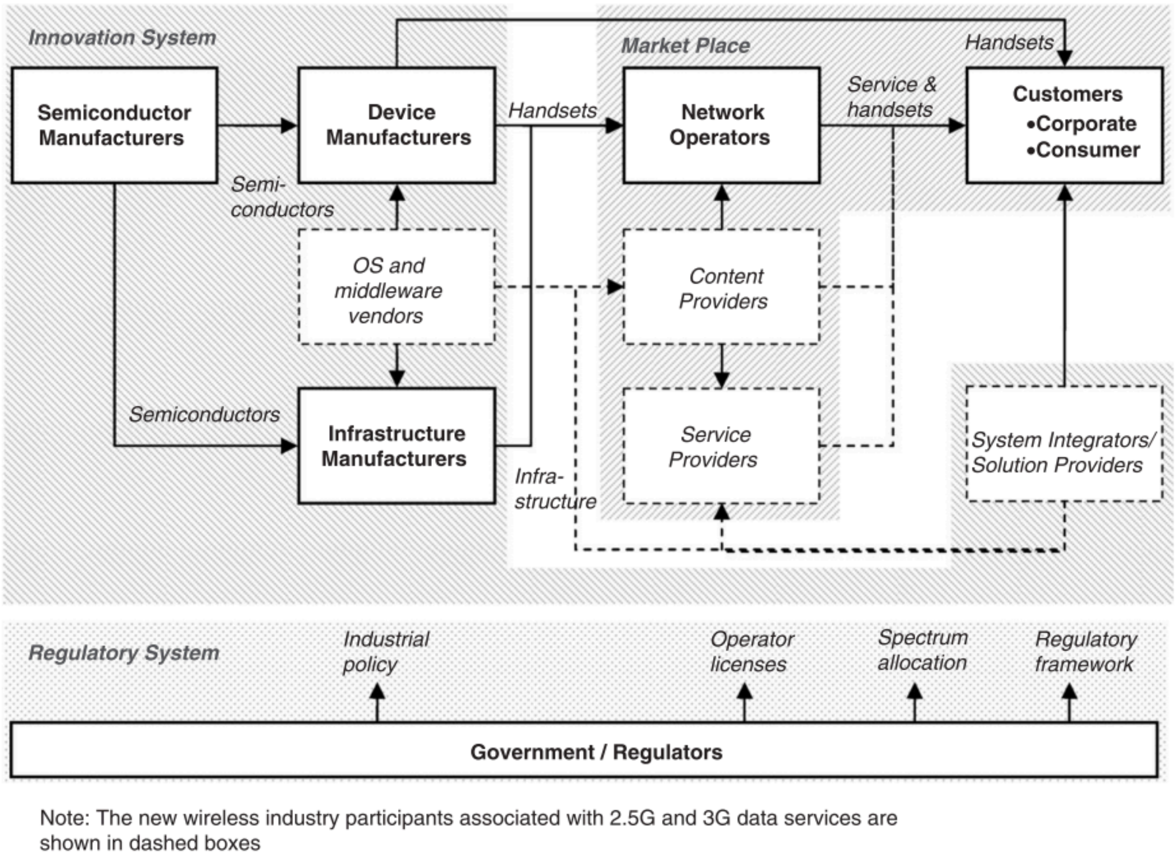


Figure 2-11: Main Wireless Industry Participants (Tilson & Lyytinen 2006)

The ITU recently reported that the adoption of the Internet in our poorest societies will come through wireless connectivity on mobile devices and is dependent on price, bandwidth, speed and quality of service, content and language, applications that are created for low-end users and skill or digital literacy. (ITU 2011)

2.3.1 Infrastructure

The adoption of mobile Internet is dependent on the following infrastructural elements:

2.3.1.1 Electricity

For one to continue to use a mobile phone one must have the ability to charge it. Many African villages and rural settings don't yet have electricity. Sub-Saharan Africa has the lowest electrification rate in the world in 2009 with only 14.2% of the population in rural communities being able to access electricity - 59.9% in Urban settings (International Energy Agency 2009).

Alongside this it is important to be mindful that access to electrical power does not mean this access is ubiquitous as it may vary over time. For example, a blog by David Berg recently shared the results of power access in Tanzania for January 2012 (Berg 2012)

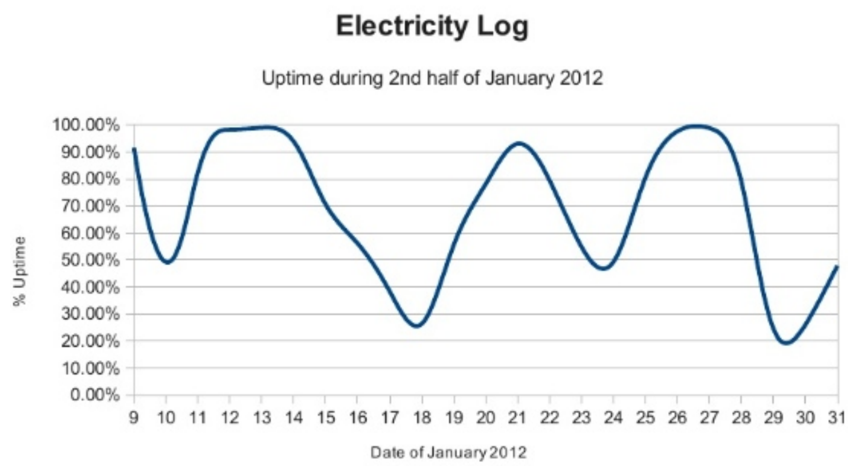


Figure 2-12: Provision of Electricity to a town in Tanzania, East Africa in January 2012 (Berg 2012)

Another important factor not concerned in Berg's research was the quality of the power being served. This is very important for electronic items as these so called brownouts can damage equipment.

This impacts the adoption of mobile phones in general, but as feature phones and smart phones require significantly more power and need charging more often. This is typically not a problem in a developed context; however, in an emerging and rural setting, this is not the case. Charging a handset may involve walking for forty minutes or so to a local shop and waiting whilst the shopkeeper charges your phone. Phones are frequently wired to a car battery, which is highly dangerous and can result in injury; furthermore this does not help the longevity of batteries and consequently they do not maintain their charge over any length of time. There is an increase in the use of solar energy, as many LDCs enjoy good sunlight and this energy is now being harvested by solar panels, both collectively within villages and also personal panels in order to charge phones. It must be noted that this technology is relatively expensive and counter-intuitive to the micro-spending patterns of the poor.

During a trip to Zambia and Malawi in October 2011, which have the lowest electrification rates in Sub-Saharan Africa of 18.8% and 9% of the population respectively (World Energy

Outlook 2011), I noticed that even when local people had access to electricity, they would run their cell phones down to zero charge before recharging them, even if that meant they did not have charge in their phone for some of the following day. This mirrors behaviour in rural dwellings, where due to the time and cost of charging a handset, the recharging occurs only when the mobile has totally run out of power. Even when solar panels were available to use in their own homes, locals still found it difficult to break the habit and struggled with this new concept of maintaining a full charge.

The GSMA estimated in 2010 that 639,000 base stations would be deployed in off-grid situations in the developing world (GSMA 2010). The introduction of cell towers across Africa has enabled more than just communication from mobile handsets to the base town stations. Spare electricity that is either generated in at the cell towers or taken from the national grid is now being used to fuel refrigeration units where medical vaccines can be stored and it is estimate that could provide power to a further 120 million people who currently live without access to electricity (GSMA 2010).

2.3.1.2 Regulation

Empirical studies have shown that the regulation of the mobile industry in Europe has bought a significant influence on both the price of the service and the penetration of mobile handsets. Not all regulations have a positive benefit for the end user, as the same research also shows that enforcing intercompany interoperability with services such as number porting can have a negative impact on pricing (Grzybowski 2005).

There are four phases to involvement with providing mobile phones across a nation in LDCs.

Phase One is often a monopoly that is borne out of a fixed-line business that the government already owns. This company would then be awarded a wireless or 3G or GPRS Licence for that country.

Often, due to issues around scalability, a partnership with an external provider is formed (Phase Two). In Africa this is often with Airtel, MTN or Vodacom who are the three principal players. For example, in Swaziland; the single mobile phone provider is branded as MTN within the country, but is majority-owned by the government and by the incumbent fixed-line telecom provider.

The third phase is the competition phase. This is seen principally in countries where there is an open and free market, which is encouraged by the government. The benefit of this is that prices will then start to drop and services will start to increase. In Kenya, for example, where there are four current providers (there were five but Airtel have bought out Zain) there is good competition that reduces the total cost of mobile ownership for its citizens. Typically governments will then be more inclined towards regulation of this sector considering factors such as Termination fees across networks, international dialling and other cross company/network transactions.

The fourth area that is beginning to emerge, especially in geographically land-locked areas in Africa, is the amalgamation of country operators into more regional mobile plans. In East Africa, for example airtime bought in Zambia with Airtel, can be used in both Malawi and Kenya without necessitating a change of SIM card or number. It is possible buy airtime top-ups in Kenya that will work on a Zimbabwean SIM card.

Regulating the price of mobile phones and their associated standards is also very important in LDCs. It is not uncommon for regulation to be very light at best. Kenya is currently undergoing tighter regulation on the service and provision of mobile phones which is responsible for the lowing of prices, cheaper cross network calls and better provision of services.

2.3.1.3 Open standards

At the heart of the adoption of new technologies is the notion of standards that mediate often conflicting interests and motivations between stakeholders (Yoo et al. 2005).

All 3G mobile communications are built on the TCP/IP protocol. This is a standard across Europe and the rest of the world and has now been adopted by the USA. It is a basic platform on which that all things mobile are built on. It is the adoption of these standards that ensure that a SIM card will work in any global region. When mobile phones were first introduced in America there was no coherent standard. Globally we have four bands of frequencies that mobile devices work in and one of the reasons Europe was able to leapfrog America in terms of mobile phone usage and affordability was because Europe adopted standards which enabled faster rollout and interoperability between the various mobile phone providers. As LDCs are currently rolling out cell towers, most of the towers are 3G enabled immediately.

Mobile companies are also exploring how they can use their agents who distribute airtime within local communities to perform other supply chain functions, such as serve as mobile money agents or gather data for governments or Non-Government Organisations (NGOs).

2.3.2 Network Providers

The number of mobile providers in a country affects the price paid by the end users for both the hardware and airtime costs of their mobile phone. In 2010, I visited Kenya, Zambia and Malawi and experienced a large disparity between hardware costs and airtime costs, as it seemed that the mobile operators and national governments were both endeavouring to maximise income and profits from their citizens.

Where competition exists there have been significant reductions in the cost of mobile handsets and airtime. In open markets, there have been significant price reductions in Egypt, Uganda, Kenya and Tanzania with 97% of the connections being prepaid. In Kenya, Airtel reduced in q3-2011 the cost of a minute voice call from KES6 (US$0.06) to KES1 (US$0.01). The aggressive introduction of low cost data modems and two months free browsing of the Internet are also driving the adoption of Mobile Internet. The industry is questioning the long term viability of such pricing scheme but it is evident that such strategies are helpful in priming the adoption of the mobile Internet in such economies.

		Africa	World
Connections (million)		620	5,883
Net Additions (million)		26	167
% Connections	Prepaid	97%	74%
	Contract	3%	26%
	2G	90%	74%
	3G	10%	26%
Growth (Connections)	Quarterly	4%	3%
	Annual	19%	14%
Market Penetration		63%	85%

Africa mobile connections, Q3 2011
Source: Wireless Intelligence

Table 2-4: Africa Mobile Connections, Q3 2011 - Wireless Intelligence (Wireless Intelligence 2011)

2.3.3 Internet Cable Companies

Africa is enjoying new connectivity with the arrival of fibre optic cables. These are now bringing much-needed cheap bandwidth to Africa.

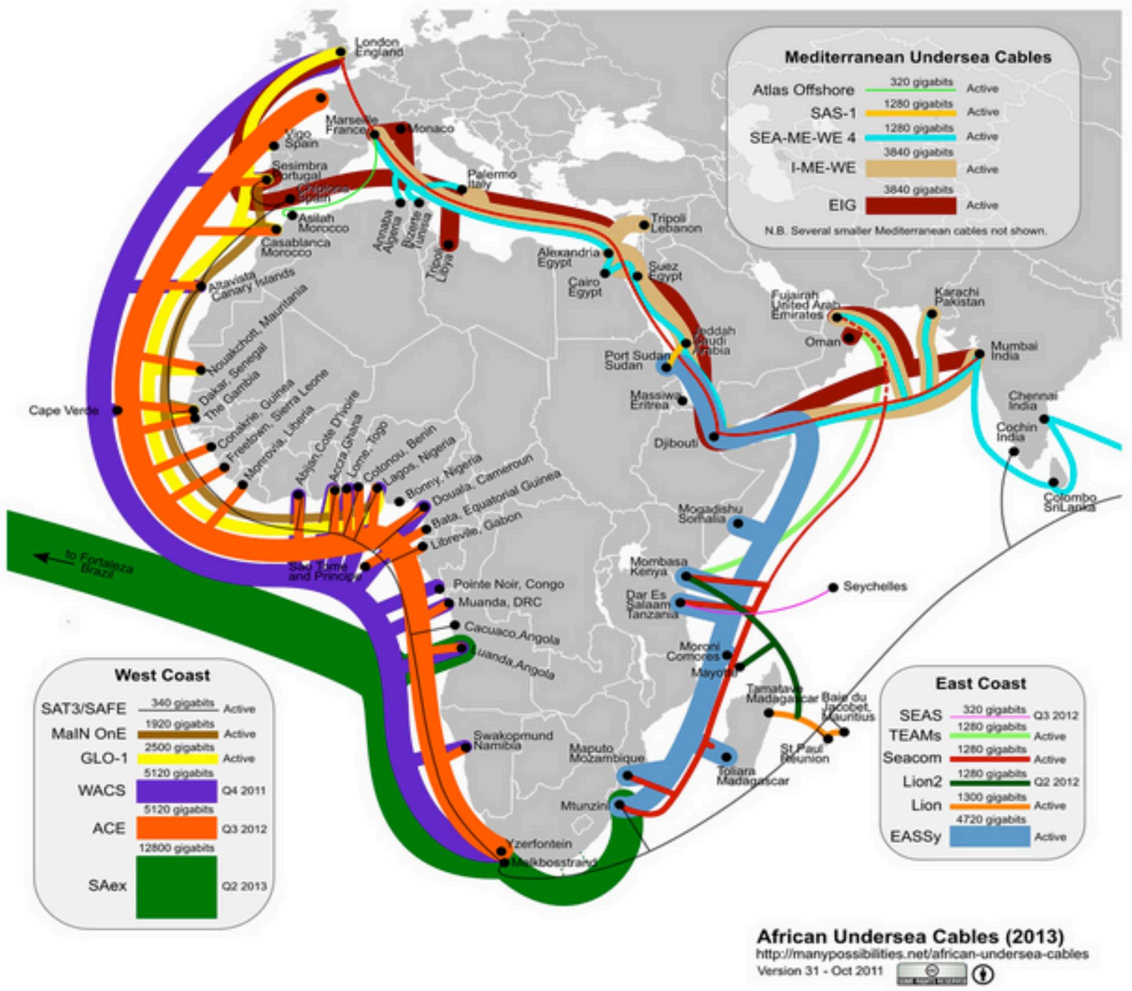


Figure 2-13: Current and Planned Undersea Cables for Africa - Oct 2011

As Figure 2-13 shows clearly, central Africa is generally not serviced by direct fibre connectivity, with the exception of Rwanda and Johannesburg. Fixed line and wireless infrastructure is still required to federate this new bandwidth across the continent to enable access in land locked countries and communities of both the relatively rich and poor.

In some regions the provision of bandwidth has resulted in cheaper broadband and mobile data packages being made available. The cost of the provision of Internet through fixed cable broadband or wireless 3G or other means, is solely down to the service providers that have licenses in the territories. In some countries where there is strong competition and regulation, the landing of the cables has resulted in the greatest cost reductions for the end users. Noor Mahmoud who is runs the station in Mombasa, Kenya where the Seacom cable lands said:

"We have already given the cheaper Internet to the service providers; we expect that they will add value and transfer the same (cost savings) down to the users in Kenya and in the region."

Noor Mahmoud was then asked by the interview whether that would happen in a hurry? He responded with a smile by saying:

"*It is up to each person's business plan.*" (BBC Website 2009d)

However, this cheaper more accessible international capacity has not manifested as cheaper availability to its citizens. This is echoed in the title of the AITEC conference in Nairobi in 2011, "We have bandwidth. Now what?" (AITEC 2011). Africa is in the process of leveraging this new connectivity for business, social, governmental and medical gains.

2.3.4 Content Providers

Having access to online content is seen as being vitally important. In a documentary by the BBC, a teacher in Kenya said:

"*If they [students], are not able to access information online, then we are basically saying that they are to be a hopeless society.*" (BBC Website 2009c)

It is not only having access to digital content that is important but also the nature of the digital content accessible. The notion of digital imperialism when viewing digital materials is evident. For example, although only 27% of people using the Internet are English speakers, 55% of all the websites on the Internet are written in English (Anon 2012) with the majority embedded with world views and values derived from Western culture.

The need for relevant content, as an enabler for tangible benefit for the poor in LDCs, is required. So much of the incumbent content on the Internet is both irrelevant in content, values and language. It is also published with no consideration to the bandwidth needed to access it. For the targeted northern hemisphere consumer this is not a problem but for the poor in LDCs they probably have neither the finances for high bandwidth information, nor the devices on which to consume the information.

The Internet is dominated by material from the US, Europe and Asia. Adam presented in his report that only 0.4% of Internet content in 1998 was generated in Africa and this went down to 0.02% if one excluded South Africa (Adam 1998). Given that over 1/7th of the world population live in Africa, we can see the need to encourage greater local content generation within the continent. The only access that many have to the Internet is on their mobile device, which affords reasonable content consumption but it is a difficult device to create content for the basic user.

New initiatives are starting to emerge such as Mobisoko which was presented at the AITEC East Africa Summit in Nairobi Nov. 2011 (Wakahe 2011). Its founder Michael Wakahe communicated that all of the application stores for mobile devices are foreign based or provided with operators “walled gardens” which leads to a complex environment for low digitally literate people to navigate.

2.3.5 Literacy

Adult literacy rates in LDCs have increased from 42% in 1990 to 53% in 2002 (UNDP 2006). The latest report from UNESCO indicates that 775 million adults could not read or write in 2010 and 2/3rds of them were women. One fifth of illiterate adults live in sub-Saharan Africa and the rate of population increase is faster than the rate of literacy increase seeing the number of illiterate adults increase by 27% over the past twenty years (UNESCO 2012). The report also demonstrates that the most common action people use literacy skills to facilitate is for mobile phone usage– mainly for reading and writing text messages.

Textual communication methods on basic handsets such as SMS can contribute to an increased literacy rate amongst people especially those living in LDCs (Vosloo et al. 2008). Due to the constrained environments in LDCs of low bandwidth speed, cost of data and handsets, it is likely that mobile Internet will mainly access textual content rather than multimedia artefacts. It is expected that this will further drive improved literacy rates. Conversely, if someone is not able to read they are at a disadvantage and are less likely to use mobile Internet. This disengagement is further amplified by the digital imperialistic notions discussed in the previous section.

2.3.6 Digital literacy

Digital literacy, first coined by Paul Gilster in 1997 (Gilster 1997), is defined as the ability to use hardware and be able to freely enjoy the affordances of a device and other similar devices. It is often used to describe the second digital divide that goes beyond the structural measures of the first digital divide that are pre-occupied with how people are empowered to engage digitally, to develop what people can do when they are online(Sáinz et al. 2008).Digital literacy embraces the notion of digital fluency of being able to function in a technological environment.

In an LDC, digital literacy is often enhanced by peer level learning through iterative social learning. The main barrier to digital literacy is access to the technology and overcoming the fear of exploration of the features and functionality.

2.3.7 Education

Education is one of the single most factors in people being able to access the Internet in LDCs (Suregeni 2008). The adoption of mobile Internet is impacting educational models in developing countries as it enables learning content to be delivered even in the most rural settings (Miller et al. 2006; Brown 2005). We are beginning to see evidence of this in the developed countries as universities such as the Open University, MIT and many others across the world recognising that they need to adapt their models in order to embrace mobile learning, both in terms of home-learning on PCs, but more recently adapting their materials so that they can be accessible on mobile devices and also examinable on mobile devices.

Education also drives innovation within LDCs and helps to improve literacy. This is demonstrated by the m4Lit program run by the Shuttleworth Foundation in South Africa to promote educational artefacts on common mobile phones (Vosloo et al. 2008).

2.4 Summary

Alongside making and receiving both calls and SMSs, mobile phones are increasingly being used in different ways such as: accessing information, aiding communication, using financial services, taking photographs, making governmental processes transparent, and listening to music. Mobile phones are changing lives in LDCs.

The mobile phone is decreasing the traditional digital divide, increasing agency and has the potential to empower people and improved their livelihoods. Through SMS and other textually based communication methods, mobile phones are improving literacy rates for people in LDCs. Mobile phones have potentially transformational powers in communities and bring the potential for global connectivity. They are changing spending patterns and cross boundaries of gender, age, education and wealth. This unprecedented adoption of mobile phones is revolutionising how societies operate and interact.

The literature search has identified the following notions that should be considered as key constructs in the model to describe the adoption of mobile Internet in sub-Saharan Africa.

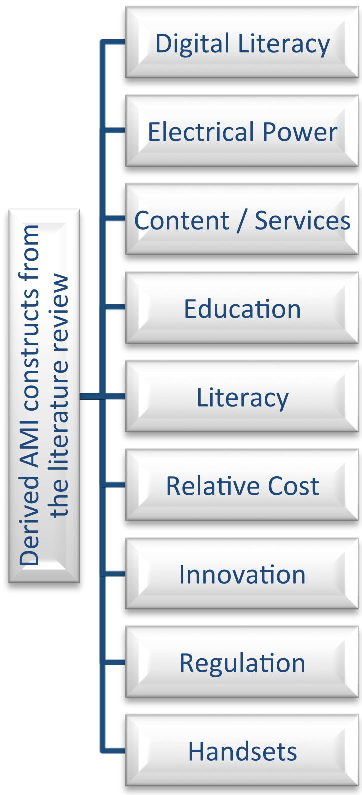


Figure 2-14: Constructed for a model of the adoption of mobile Internet in sub-Saharan Africa derived from the literature review

In the next Chapter we will present the research question and explore the methodologies used to answer the research question.

Chapter 3. **Methodology and fieldwork**

The previous chapter explored through a desk-based literature review some of the key constructs of the "Adoption of Mobile Internet" (AMI) in sub-Saharan Africa. These were identified as:

- Digital Literacy
- Electrical Power
- Content / Services
- Education
- Literacy
- Relative Cost
- Innovation
- Regulation
- Handsets

This chapter explains the methods used for constructing, refining and testing a model to encapsulate the key construction influencing AMI in SSA. The methods are then constructed into a methodology that speaks to the main research question of whether the posited model adequately describes the adoption of mobile Internet in sub-Saharan Africa.

3.1 Research Question

The primary research question of this thesis is:

Does the presented model adequately predict the adoption of mobile Internet in sub-Saharan Africa?

In order to address this research question a mixed-method approach was taken which by definition mixes qualitative and quantitative research methods, techniques and concepts into a single study (R. Johnson & Onwuegbuzie 2004). This will enable a model to be derived and then tested against published and widely accepted data sets. The model will finally be used to predict future outcomes related to the adoption of mobile Internet in SSA.

3.2 Methodology

In order to address the principal research question:

Does the presented model adequately predict the adoption of mobile Internet in sub-Saharan Africa?

A mixed methods approach involving a triangulation of findings from a literature review, fieldwork and expert comment will develop the model of AMI in SSA encapsulating the main constructs (amplifier and dampeners) of the adoption of mobile Internet in SSA.

Alongside this, building a Computer Simulation of the model would also demonstrate predictive capabilities, which can be verified against available historical data for various countries.

An overview of the research methods and methodology are summarised in the following diagram:

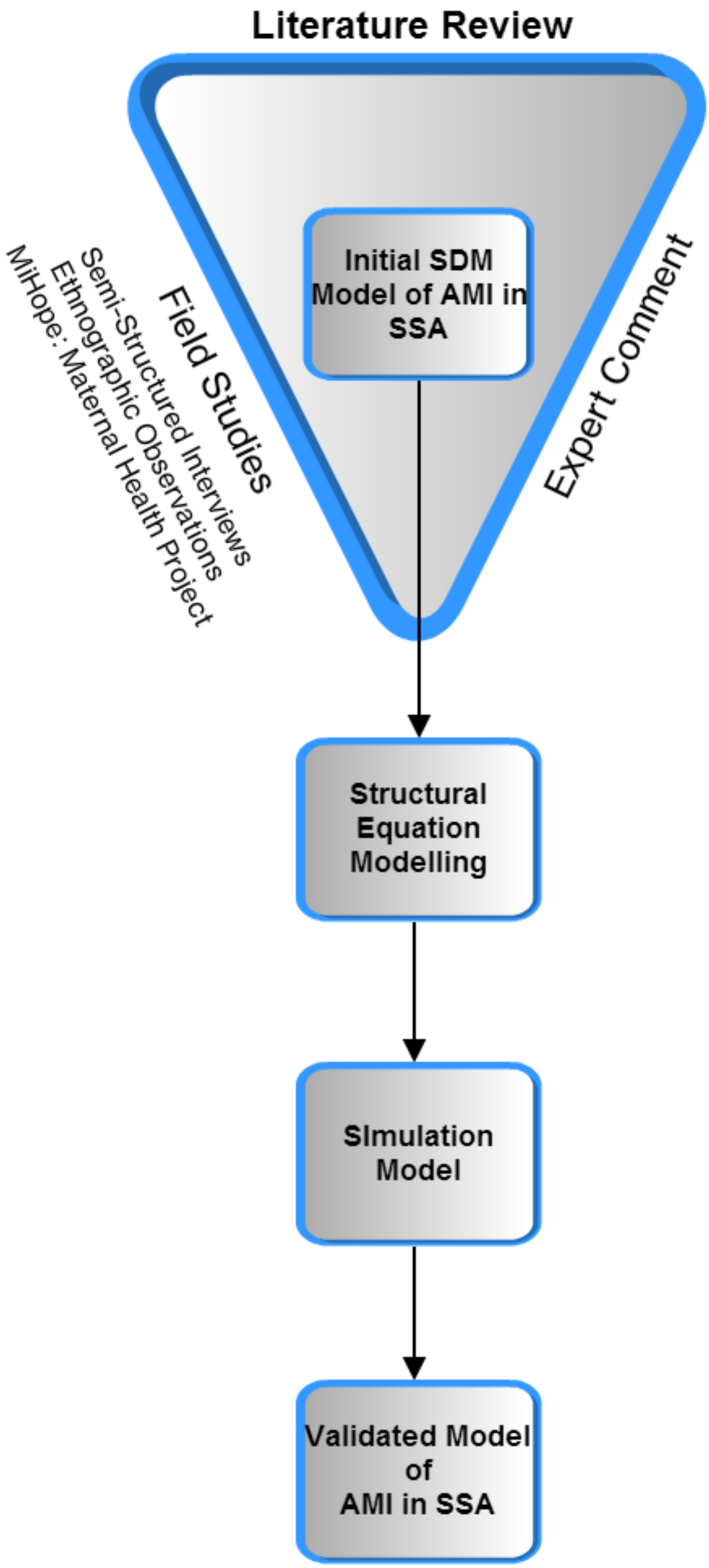


Figure 3-1: Summary of methods for investigating the research question.

3.2.1 Triangulation

Triangulation combines two or more theoretical research methods, data sources, investigators, data analysis methods or theoretical perspectives into a single study to minimise intrinsic biases, weaknesses and inherent problems introduced by using a single method or theory (Bryman 2001; Denzin 1970; Thurmond 2001) The analysis of the multi-modal artefacts in triangulation may yield evidence of convergent, contradictory and inconsistent resulting notions that could be unobserved if one research method, data source, investigator, data analysis method or theoretical perspective were employed. Triangulation gives increased confidence in the robustness of the findings and enables a view on richness and complexities of human behaviour (L. Cohen et al. 2000).

Triangulation of Case Study artefacts and a literature review will be undertaken to develop the model of AMI in SSA.

3.2.2 Case Study

A Case Study methodology involves gathering and analysing both qualitative and quantitative artefacts that investigate a phenomenon, in a real-life context, to ascertain the causation and reveal foundational axioms.

The following definition of a Case Study is offered by Gary Thomas from the University of Birmingham:

> *"Case studies are analyses of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame — an object — within which the study is conducted and which the case illuminates and explicates."*
> (Thomas, 2011)

The Case Study will explore the elements and connectivity of the model elements through semi-structured interviews with people living in SSA which will be analysed using NVivo software. These Case Studies will be drawn from South Africa, Malawi and Zambia from peri-urban and rural settings. The purpose of gathering and analysing the Case Studies is to validate the Model of Adoption of Mobile Internet in SSA. Ethnographic observations also form part of the case study artefacts.

In order to achieve a statistically significant study it is important that the correct numbers of case studies and questionnaires are conducted and analysed. In order to do this we must consider the power of a statistical test that determines the minimum sample size needed, to be reasonably confident of making a false negative decision or Type II error.

The Effect Size measures the strength of relationship between two variables. As the scope of this PhD research is to explore whether the posited model of Adoption of mobile Internet in SSA is an adequate reflection of the main drivers and dampeners, it is acceptable to have a larger Effect Size as we are focused on whether there is significant evidence to confirm a link between the model elements and the adoption of mobile Internet. Additionally, as the scope of this PhD research is determined as exploratory, as such it is acceptable to have a relatively large gross effect size or 0.8-1 REF. The sample size will be calculated later using the G*Power tool[1].

Full ethics approval for the field works was granted by the ECS Ethics panel reference number ES/11/05/004.

3.2.3 System Dynamic Modelling

“System Dynamics modelling” (SDM) is a methodology and technique for mathematical modelling complex issues and was developed by J Forrester in 1956 following a discussion with General Motors about their hiring and inventory decision-making. In 1968 Forrester applied the principals developed for corporate modelling to broader social systems by modelling Boston’s urban problems. By creating a system dynamics model of the urban issues of Boston, Forrester and his assembled team discovered that the policy of building low cost housing could actually increase poverty rather than alleviate it, as it used essential central business real-estate which in turn would create livelihoods for the poor. It also highlighted that too much low cost housing could not be supported unless the economic capacity of the area could sustain the rental income needed.

[1] http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/

SDM incorporates the notions of internal feedback loops, time delays, reservoirs or stocks, dampers and inverters. System dynamics is interested in modelling interconnects Stocks and Flows of Resources. (Varaiya 1972; Forrester 1989; Forrester 1992)

SDM as a notation has been chosen to represent the Adoption of Mobile Internet in SSA as it enables an encapsulation of mental models of process, complex situations and workflows. It is envisioned that the SDM model of the Adoption of Mobile Internet in SSA will be developed into a simulation further facilitating understanding through scenarios and enabling predictions over time.

3.2.4 Structural Equation Modelling

SEM posited in 1921 by Sewall Wright (Wright 1921) as a method of measuring the direct influence along each separate path in a complex interconnecting system. It is a graphical modelling notation that represents multivariate casual relationships between system elements that describe a complex hypothesis. Univariant model modelling techniques such as ANOVA were not employed to test the model of the Adoption of Mobile Internet, as Univariant methods are designed for studying individual processes rather than studying more complex systems with many associations. SEM is used to examine complex relationships between many measured or observed variables and latent or unobserved variables. SEM enables regression factor analysis, which compares patterns contained within the data to those implied in the model to give a measure of goodness-of-fit or consistency of the model to the data.

3.2.5 Simulation

Once the model has been validated through measuring the goodness of fit to published data of the derived model describing AMI in SSA, a computer simulation of the model will then be designed. This model will draw on publically available data and proxy-variable data to produce predications of the adoption of mobile Internet which, it is hoped, will provide a useful forecast tool to policy makers wishing to encourage the uptake of Mobile Internet in an LDC context.

3.3 Field Work

During the desk based study from published literature it became clear that the majority of reports on the adoption of mobile Internet were written from a global north perspective and a field study in the countries of interest would be needed. Africa has the fastest-growing market for mobile technology and has the fastest adoption rate of mobile Internet. Within the continent, South Africa is one the fastest country to adopt mobile technologies with two of the countries with the slowest mobile adoption rates being Zambia and Malawi.(ITU 2010). Consequently, field work was undertaken in South Africa, Malawi and Zambia to explore the key drivers and dampeners for the adoption of mobile Internet for people living in LDCs.

This chapter outlines the background, methodology, analysis and findings of the pilot study from two communities in South Africa in April 2010, alongside some observations from a series of three two-week trips to Central Zambia and Northern Malawi between April and October 2011. It then presents an Expert Review including a description of the methodology used; profiles of the four domain experts spoken to; their comments and how these informed the model describing the adoption of mobile Internet in SSA. Finally, I have included summary findings and observations pertinent to this thesis of a 6 month pilot project in Zambia and Malawi that used 60 mobile phones to support staff in delivering interventions to decrease the transference of H.I.V. from parents to their babies in rural settings. My role to the project was as a consultant overseeing the development, training, deployment and maintenance of the technology used to support the staff. My thanks go to David Deakin from Tearfund for his authorisation to include these findings in my thesis. The final evaluation report may be found in Appendix 7.

The following table summarizes the fieldwork undertaken:

Type	Location	Quantity/ Duration
Semi-Structured Interviews	Transkei, South Africa	12 people
Semi-Structured Interviews	Cape Flat, Cape Town. South Africa	5 people
Group Interview (Mum's 2.0)	Cape Flat, Cape Town. South Africa	2 people
Focus Group	Transkei, South Africa	12 people
Observation\MiHope Family Health Project	Rural Zambia and Rural Malawi	60 people over 6 months
Observation	Kenya, Nairobi	2 weeks
Observation	Kampala, Uganda	1 week

Table 3-1: Summary of field work

I would like to register my thanks for the assistance given by Julia Wills in processing interviews and performing a first pass analysis of the findings in NVivo (QSR International 2012).

The posited model of the Adoption of Mobile Internet in SSA presented in this chapter is derived from triangulating the findings from the desk based literature review detailed in Chapter 2 and both the fieldwork analysis and expert comment both described in Chapter 4. This chapter presents the model and explains the elements and their interconnections. Whilst we remind ourselves that any model is a simplification of reality and as such will not match reality exactly, it is expected that through the testing this model using Structural Equation Modelling we may then refine it and present a simulated model to aid the prediction of the adoption of model Internet in SSA.

3.3.1 Field Study

The Pilot or feasibility study was conducted during trips to Africa in 2010-12 to South Africa, Malawi, and Zambia. The purpose of the study was to enable the triangulation between literature, experts and views from people on the ground into a model that encapsulates the main drivers and dampeners of the adoption of the mobile Internet in LDCs particularly in Sub-Saharan Africa. Given the locations visited for the study were of low economic and development status, the study findings represent the drivers and dampeners that influence the adoption of mobile Internet for people that live in least developed communities in sub-Saharan Africa. A mixture of semi-structured interviews, conversations and observations were performed.

3.3.1.1 Pilot Study Locations

The location of the pilot studies were chosen to give a broad overview of the diversity of settings of people that live in least developed communities in sub-Saharan Africa, ranging from Peri-Urban Cape Town and a rural village in the Transkei in South Africa. South Africa was chosen for as the location for this initial study as it has, at the time, one of the fastest growing adoption rate of mobile Internet globally. Further visits and studies were made to extremely rural communities in Northern Malawi and Zambia and people living in low economic and development communities were studied. In April 2010-11, a series of observational and informal interviews were conducted through focus groups and contextual studies of people using mobile phones in two communities in South Africa. A full description of the study can be found in the ethics approval forms reference ES/11/05/004 found in Appendix Three: Pilot Study Ethics.

3.3.1.1.1 Dutywa, South Africa

Dutywa, in the Eastern Cape of South Africa (marked “A” in Figure 4-1 below) is a dusty, rural market town on the N2 main road about two hours north of East London in the formally known area of the Transkei.

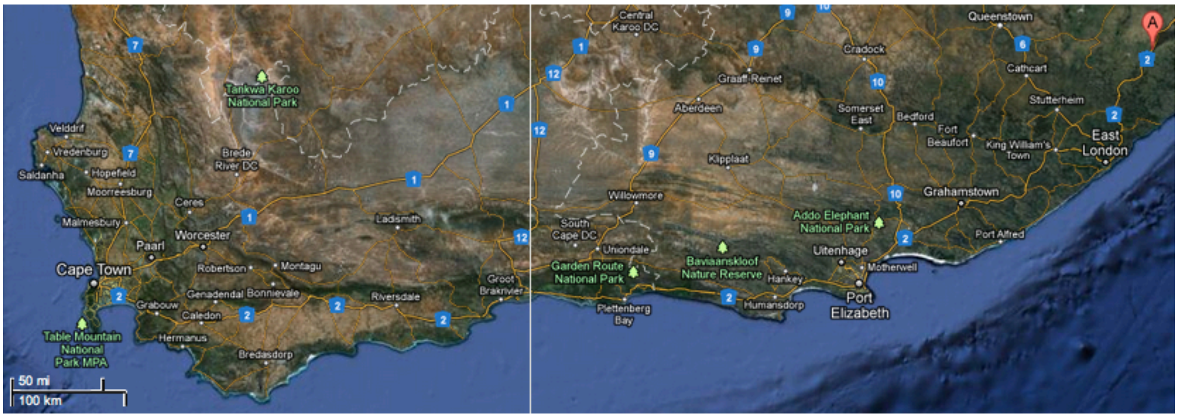


Figure 3-2: Location of Dutywa, South Africa marked “A” [2]

Dutywa, known as Idutywa until 16th June 2004(I , Phumzile-Ngcuka Mlamb: DEPARTMENT OF ARTS, CULTURE 2004), is part of the Mbhashe Local Municipality, which has a geographical area of 3,030km^2 with 262,000 people and contains three principal towns of Dutywa, Willowvale and Elliotdale. Mbhashe is mainly rural and is one of the poorest areas of South Africa with 75%-90% of the people living below the poverty line with most households earning less than R800 per month. The region also has the lowest technology and electrical levels in the Eastern Cape (Mbhashe Municipality 2011; Statistics South Africa 2007)

An existing relationship with a community group in Dutywa also made it possible to gain access to people in the local community for the focus group, semi-structured interviews and observations.

[2] Source: www.googlemaps.com © NASA, TerraMetrics, AfriGIS, Google

3.3.1.1.2 Bridge Town, Cape Town, South Africa

The Khoisan people have occupied the Cape Flats for thousands of years. The start of Cape Town as a settlement occurred around 1652 when some Dutch traders landed to establish a stopover point for the spice route between the Far East and the Netherlands. In 1806, Cape Town was seized by the British, who following the Boer War (1899-1902) shared joint rule with the Dutch Boers until South Africa became a republic in 1910. In 1948, the ruling National Party instituted a policy of apartheid which separated the races and favoured the white minority. This was successfully opposed in 1994 with the election of Nelson Mandela.

Figure 3-3: Location of Bridge Town, Cape Town, South Africa

Bridge Town is a district within Cape Flats of Cape Town. During the apartheid era over 60,000 designated coloured people were forced to leave Cape Town and were settled on the Cape Flats. Unemployment rates in 2000 for the under 30's is 61%, with 103 registered murders in the first 5 months of 2001. 97% of children surveyed have heard a gun shot with a third of them seeing someone shot or stabbed in their home. Bridge Town is considered as a no-go area for non-residents and is largely controlled by a few organised gangs. (Standing 2011)

The pilot study was undertaken through RLabs[3], a research and training organisation based in Bridge Town, Athlone, Cape Town.(MB Parker et al. 2010; M. Parker et al. 2008; Julia Wills et al. 2009)

3.3.1.1.3 Mzuzu, Malawi

Malawi is an agricultural country with most of its citizens relying on subsistence farming which given droughts is precarious. As a nation it has huge issues with HIV-AIDS and decades of underdevelopment. The political situation in Malawi is difficult with little transparency at the political level. More than 50% of the population live under the poverty line.

Figure 3-4: Location of Mzuzu in Malawi

Mzuzu is the capital of the Northern Region of Malawi and has 128,000 residents and 1.7 million people living around the outskirts of the City.

[3] www.RLabs.za

Two communities were visited in rural areas close to Mzuzu: Thoza that has a population of 7,500 people and Kamwe with 15,000 people. The work was facilitated through a local NGO called LISAP in Mzuzu.

3.3.1.1.4 Macha, Zambia

Zambia, formerly known as Northern Rhodesia, was made independent from British rule in 1964. Copper mining drove initial development but this was halted due to lower copper prices, economic mismanagement and a prolonged drought in the 1980-90's. Zambia is one of the recognised LDCs and one of the poorest countries in the world.

Figure 3-5: Location of Choma in Zambia

Macha is located in the Southern Province of Zambia close to Choma. The Macha area is populated by traditional villagers, living in small scattered homesteads which usually consist of one extended family. There are no commercial farmers or industries in the area. The primary livelihood is subsistence farming, with maize being the main crop.

There is an estimated population of 135,000 within an approximate 35 km radius around Macha. The average income for a person in the village in the areas surrounding Macha is USD 1 per day. A bus trip to the nearest town of Choma costs approximately USD 5 (BBC website).

3.3.1.2 Method

The field study was conducted using a collection of methods

Semi structured interviews were undertaken across many age ranges and backgrounds in both rural and Peri-urban settings within least developed communities within South Africa. Please note that mobile phones are commonly referred to as cell phones and talk time is referred to as airtime.

The questions asked were intentionally generally about mobile phone usage and not specifically about access to the Internet and related data services on their mobile phones. This method was undertaken to minimise interviewer influenced biasing of the results and to better understand the wider issues surrounding the use of mobile Internet in LDCs.

The following questions were used as a starting point for each interview:

1. When did you first acquire a cell phone, how old were you and what motivated you to get it?
2. What are you currently using your cell phone for?
3. How much do you spend per month on airtime and how long does this last?
4. Do you think life is better for your community with cell phones and what has changed?
5. What would you most miss if you did not have a cell phone?
6. Would you choose to have a connected computer or a cell phone?

The semi-structured interviews and focus-group session were recorded using a Live Scribe pen recorder for later transcribing and analysis. No defining personal details were stored with the collected data.

Study Sampling

The selection of study participants were chosen, by the local partner organization, from the various least developed communities I visited. Participants were selected at random by the organizations and informed of the reason for the questionnaire and that they were not obliged to take part the investigation in any way, and may withdraw at any time. In total 17 semi-structured interviews were conducted and one focus group was questioned.

3.3.1.3 Ethics

Full ECS Ethics approval under reference ES/11/05/004. See Appendix Three for documentation and questionnaires used for semi-structured interviews.

3.3.1.4 Process of Analysis

Following the collection of the interviews the recording were transcribed and then coded using the NVivo Computer program from IBM. This enabled a mapping of the qualitative research in a rudimentary quantitative domain for analysis.

From the transcripts of the interviews shown in Appendix One, the following nodes were coded and the frequency of code nodes collected.

Nodes	*sources*	*references*
Adoption of Mobile Internet	23	49
Cost issues with phones	11	14
Potentional Financial Capacity	2	2
Innovation	2	2
Social Momentum	9	16
Education	8	16
Well being	5	6
Information	7	10
Literacy	2	7
Content creation tools	1	1
Digital Library	2	2
Power	1	1
Behaviour change	3	6

Table 3 **3-2: Frequency of Nodes in Content analysis of transcripts of interviews**

This shows good evidence for a link between the adoption of mobile Internet and social momentum/crowd adoption, education, cost, content/information.

The relationship between the proposed model elements was then analysed using near neighbour clustering and running a matrix-coding query. The resultant table follows:

no references found	Reinforces	interviews	references	coverage
Internet enabled handset	Digital library		0	
Internet enabled handset	Information	2	2	1.5
Digital library	Adoption of mobile internet		0	
Adoption of mobile internet	Digital library		0	
Availability of Electricity	Adoption of mobile internet		0	
Literacy	Adoption of mobile internet		0	
Adoption of mobile internet	Content Creation Tools		0	
Content Creation Tools	Information	1	1	3.44
Education	Literacy	1	3	3.93
Adoption of mobile internet	Education	2	2	6.62
Information	Adoption of mobile internet	2	2	1.5
Adoption of mobile internet	Innovation		0	
Social Momentum	Adoption of mobile internet		2	1.74
Information	Well being		0	
Education	Innovation		0	
Innovation	Social Momentum	2	2	10.21
Education	Potential finance capacity		0	
Innovation	Potential finance capacity	1	1	3.44
Income level	Airtime cost		0	
Well being	Income level			
Information	Behaviour change	1	1	3.44
Income level	Education		0	
Behaviour change	Income level		0	
Behaviour change	Well being		0	
Education	Behaviour change	2	2	6.62
Behaviour change	Potential finance capacity	1	1	3.44
Open Standards	Innovation		0	
Open Standards	Adoption of mobile internet		0	
Potential finance Capacity	Income level		0	

Table 3-3: Matrix Coding Query of near neighbour clustering on content analysis of interviews

Iterating on the relationships within the content analysis within Nvivo enabled the following model to be derived:

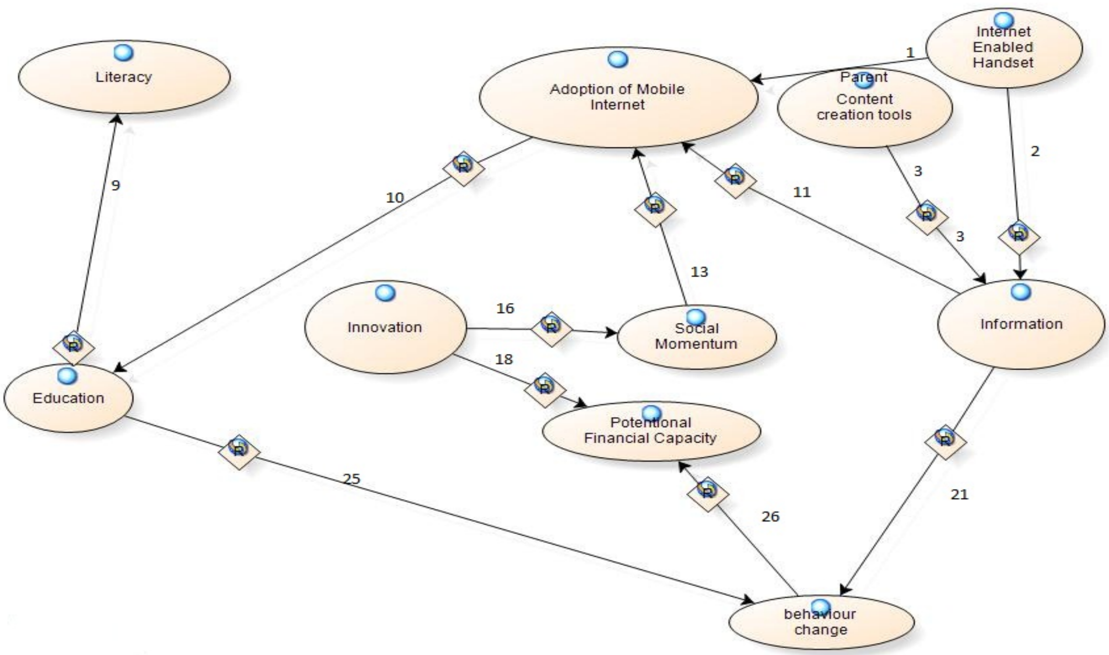


Figure 3-6: Nvivo derived model of Nodes from content analysis of Interviews

3.3.1.5 Interview Findings

In this section the themed results are presented. Full transcripts of the interviews are available in Appendix 1.

Mobile Phones are more important than computers

The majority of people spoken to, irrespective of age and social context, place more value on having a connected mobile device than on having a connected computer. It is the one thing that people would not leave the home without.

Mobile Phones give women a voice

The key driver for women engaging with social media is the ability for them to communicate with others about how they are feeling. Great value is placed on the fact that people will hear them and understand what they are saying. Previously, they did not think their opinions counted. The women related that they felt the Internet gave them equality through having a voice. It was interesting to note that the notion of influence was not predominant in precipitating the feelings of “being-heard”. For the women interviewed, merely being able to curate their thoughts, experiences and stories online and for feedback via comments both online and offline induced feelings that they were heard that were exclusively positive. They felt encouraged and saw the transformational potential of the Internet. A number of them said that they wanted to learn to use it, so that they could communicate better with the children in their communities.

Mobile Phones cause vulnerable people to feel less safe.

Mobile phones cause anxiety due to the correlation between violent crime and mobile phone ownership/usage. This is especially evident amongst the young, women and those living in socially challenged and rural settings. For these vulnerable people, mobile phones are left permanently on silent and not answered in public places for fear of robbery and assault.

Airtime is changing the spending patterns and priorities of people in Africa.

Airtime is treated as a precious resource which is changing the spending patterns and priorities of people in South Africa. In rural settings airtime is sometimes obtained by some young women by performing sexual favours. Mobiles have also caused people to reprioritise their budgets:

> *"I used to walk down the road with R30 in my pocket and think what meat I would buy my family. Now I think how much I can spend on airtime and still have enough spare to feed my family." (Community Leader in Idutywa in April 2010).*

The change of expenditure priorities is widely adopted with 1 in 5 Kenyans changing their spending patterns to buy airtime for their mobile phones (Crandall et al. 2012).

Prepaid Airtime lasts only 50% of the week or month

Most cell phone usage for those questioned is on a pre-paid basis. Only a few adults and no young adults questioned were on contract. Prepaid airtime is used up more quickly than expected by both adults and children, resulting in the majority of youth questioned having no airtime on their cell phones for at least 50% of the week or month, depending on their top up patterns. "Please –call-me" is widely used throughout South Africa to enable those without airtime to contact people with airtime to call them. Informal methods also exist to communicate other messages through this service, such as "Log onto Mxit". On occasions, cell phones are inactive, due to the shortage of electricity and the ability to charge the handsets.

Airtime is shared amongst the community

Airtime is shared amongst friends and family by both transferring airtime and sharing a handset that has airtime credit amongst peers.

Mobile handsets are comparable to the UK models

The stereotype that developing nations are using cheap, feature limited cell phones, was not substantiated in the observations. In fact cell phone models and brands were comparable to cell phones in the UK. The predominant cell phone brands amongst those interviewed, were Nokia and Samsung. Only one smart phone, a Blackberry, was observed.

Data rather than voice with the young

Cell phones are used amongst the poor and young mainly for data services, as it provides a secure, private and cheap method of communication. Mxit is the MIM platform of choice amongst the youth for peer-to-peer communications. This is generally not encouraged by parents due to the dangers of sexual grooming, distraction and lack of accountability. Facebook is the second most popular social media platform after Mxit.

Registering for a SIM is a lengthy process

The process of purchasing a SIM card is lengthy and requires ID and proof of address. One of the compelling reasons for the introduction of this legislation is to have visibility of illegal activity promoted through the use of cell phones. However, there is anecdotal evidence of people in volatile communities obtaining SIM cards through other means without the need to register. During the study in Cape Town, a SIM card and cell phone was purchased from a local shop. This took two hours to complete, and a further 30 minutes to activate the starter packs and credit.

Usage patterns observed

Young men are far more likely to use their cell phone to play games than young women. Seniors in rural communities are more likely to have a cell phone than seniors in peri-urban communities. Seniors are also more likely to use the cell phone for voice communications, although for some, wanting to engage in textual cellular communications has encouraged them to learn to read and write.

3.3.1.6 Summary of Pilot Study

This investigation has demonstrated that mobile phone usage is widespread in rural South Africa amongst all generations in both rural and peri-urban least developed communities. Purchase of airtime credit has changed spending priorities but the lack of finances means that handsets are without credit for up to 50% of the week or month. People feel more empowered by using mobile phones and feel they have a voice. Mobile phones are used for amongst all age groups for blogging, emailing, Mxit, Facebook, music, taking photographs, alarms, calling, and listening to the radio. People are more likely to use data communication than voice communication. In the investigation, many of the young adults in rural South Africa use their airtime to research information online for assignments.

Initial evidence would suggest that the digital divide has been diminished by the mass introduction of mobile phones in South Africa. This evidence is going to be used in the development of a framework that will make sense of these findings and will guide further work.

The South African context has relatively high uptake of mobile Internet usage which has been driven by social media platforms such as Mxit, the availability of handsets which afford Internet connectivity and the low cost of airtime/data. Barriers to the adoption of mobile Internet were identified as the difficulty in setting up the handsets to connect to the Internet.

3.3.2 Expert Review

People that have recognised familiarity and knowledge in the area being evaluated have long used inspection methods to evaluate a product, notion or model (Nielsen 2005; Nielsen 1994). This expert review explores the investigatory question what are the impacts of the components on the adoption of mobile Internet in Africa.

3.3.2.1 Method

The following process was undertaken in gaining the expert reviews:

1. I introduced my research area to the expert verbally.
2. Present the Expert with a paper copy of my proposed model.
3. Let them talk and ask questions.
4. Record the interview using a Livescribe pen and make notes on paper.
5. Transcribe the dialogue and collate themes and results.
6. Summarise the refinements to the model.

3.3.2.2 The Experts

The following experts were selected given their extensive knowledge of mobile phone penetration and the adoption of mobile Internet in low income, developing contexts. It was important to also gain input from a cross disciplinary perspective.

Dr Jonathan Donor, Microsoft

Dr Jonathan Donner is a researcher at Microsoft's Technology for Emerging Markets and is based in Cape Town, South Africa. He is a thought leader in the "Mobiles for Development" space. He is well published in this domain with 29 papers exploring the use of mobile technologies from the multi-disciplines of social science, Communication Research and Economic Development.

I met with Dr Jonathan Donner on two occasions specifically to talk through my research and also spent time with him at M4D2010 in Uganda and ICT4D2010 in London.

Dr Wallace Chigona, The University of Cape Town

Dr Wallace Chigona is an associate Professor in Information Systems at the University of Cape Town. Born in Malawi, his main research areas focus on ICT as a tool to improve literacy and general ICT4D.

Professor Gary Marsden, HCI, Cape Town University

Professor Gary Marsden is the Deputy Head of the Department of Computer Science at The University of Cape Town. His main research area is in Mobile Interaction Design and ICT for Development. His four main areas of current interest focus around sharing information through mobile devices, enabling digital storytelling, research the use of mobile Internet usage in townships in South Africa and developing HCI methodologies for the developing world.

Dr Adele Botha, Meraka Institute, CSIR, Peteria

Dr Adele Botha is the Principal Research Scientist at the Council for Scientific and Industrial Research, Meraka Institute in Pretoria, South Africa. The Meraka Institute is the largest group in South Africa focusing on Information and communication technology. Dr

Adele Botha’s research focuses on Mobile Cellular Technology in resource constrained environments.

Marlon Parker, RLABS, Cape Town

Marlon Parker is an Information Technology and Design Lecturer at Cape Peninsula University of Technology and is based in the Cape Flats in Cape Town South Africa where he runs RLABS (Reconstructed Living Labs) which train and develop people and incubates their innovative solution for social change.

3.3.2.3 Summary of Expert Findings

One of the key external influences on Africa currently is the nation of China. In Malawi the Chinese are buying up tracts of land - they are a big influence in Africa from healthcare to agriculture and exporting African wheat back to China.

There is a resistance to buying Chinese-made phones in Zambia, Malawi and Kenya. These phones break very easily and are not robust, therefore the attitude is that a phone bought one week would need to be replaced the following week. Samsung and Nokia are very popular phones, the ones that people aspire to own because they last a long time.

The cost of handsets differs between eg Zambia, Malawi and Kenya. The Ideos android touchscreen smartphone in Kenya costs US$60 and comes with about $30 of airtime plus data. The battery life of the Ideos is poor, which is one of the limiting factors on mobile phone adoption, given the intermittent provision of electricity in SSA. People ration their use of the phone because of the battery running out of charge. Mike recalls someone in Thoza who spends a morning, walking 5kmin order to get his phone charged once a week and loses half a day's wages. In the local market there are places for express phone charging - they attach wires directly to the battery, which is enterprising but dangerous.

Pricing models of mobile phone operators are not good for poor people, as the data chunks are very large to buy. People use SMS, and although it is expensive per byte, all they know is that it costs 5c per message. As far as data is concerned, you don't know how much it will cost; it is cheaper byte for byte but the uncertainty of pricing is discouraging and therefore a barrier to people. Also, if a SMS is bigger than the screen, the charge doubles - people are very conscious of this and worry about the size of their messages. There should be an indication of whether the message is going to be charged as one or two.

Data is charged per kilobyte which is intangible for users, as it cannot be imagined. In S Africa, the thing that really drove the Internet adoption was Mxit and still is, because of the social momentum behind it where a person would pick up from someone using Mxit that they could send 1000 messages for the price of one SMS. At the time of this interview there are 28 million users of Mxit in S Africa and 35 million users across the continent.

Cell phones are important to young people who are as concerned about the brand as they were at one time about designer clothes. They acknowledge that the phone is a status symbol with the young (and business people alike), who message each other even when they are in close proximity and could speak to each other.

In South Africa you must prove ID and your address before you can buy a SIM card and this is another barrier to mobile phone usage.

The more income people have the more airtime they will buy. Chinese phones are cheaper and although they are improved and have Internet connectivity, it is not the newness of the phone, which is important, but the type of phone. A young girl was given a new but basic phone and sold it at a second- hand shop in order to buy a second-hand phone that had the right brand name.

Some schools confiscate cell phones and will only return them to the parent, but it was agreed that the capability to call your child or for your child to call you, would be vital when the child is walking to or from school as it improves their safety.

If a person is educated that will have an impact on potential financial capacity and possibly on innovation within a community. However, some of the greatest innovation has been from people who have had no formal education, but a huge entrepreneurial drive. Innovation does have a positive impact on potential financial capacity that then drives income. Just because you are educated does not mean that you necessarily have income. It increases the notion of having potential income, but that potential still has to be realised.

People often feel more vulnerable when they have a mobile phone particularly when visible, as they are fearful of being mugged with women feeling more at risk. Both young and older women are often too nervous to answer a cell phone in public, so would set their phone on 'silent', and make sure it was not visible; even so they felt more secure knowing that they had a phone to use if they really needed to, such as in an emergency

Digital literacy and literacy are not barriers for people using mobile Internet and cell phones as they will be motivated to learn from their communities how to operate the technology if either the social pressure or the affordance the cell gives them is high. There is a social status to owning a cell phone and a social pressure to have the very best one you can afford.

It is important to look at AMI through the eyes of people who have no experience of using a computer to connect to the Internet. These mobile first or mobile only people do not have a PC centric view of the digital world and have different needs and drivers for using mobile devices.

All agreed the initial model was a good abstraction of the main factors influencing the Adoption of Mobile Internet in SSA and would prove helpful in producing a predictive model. The notions of status and affordance are the key drivers for AMI in SSA with a surprising downplay of literacy, digital literacy and cost although all experts felt that there were important constructs and should remain in the model.

3.3.3 East African Field Trip

In April 2011 I visited Zambia, Malawi and Kenya. Whilst most of the places visited were very rural, mobile phone coverage was almost ubiquitous. In the few areas where this was not the case, the locals knew exactly at which rock, tree or landmark to stand, in order to obtain an adequate signal! There was a touch of déjà vu when told of a particular rock in the Luangwa District of Zambia where people queued to make a call – much the same as at our local phone box in England in the 70s.

The majority of people either owned a mobile phone or had the opportunity to borrow one from a family member or friend. Everyone saw the mobile phone as providing a positive impact on their lives to communicate and keep in touch with loved ones and business contacts. However, coming from a connected country blessed with fixed and wireless communications, it is not until you are in a remote village that you can actually appreciate the opportunity cost of being unable to use a mobile phone. Getting a message to a family member, even in a nearby town, may necessitate a 2-4 hour walk along dusty, undulating and rutted paths to a bus stop; the cost of a bus fare in a usually overcrowded minibus; a similar walk at the other end of the bus stop and the risk that the person is not even at home! A process lasting perhaps a day or more has now been truncated, by the simple mobile phone, to keying in 10 digits and pressing a call button!

One of the barriers from the mobile operators' point of view, certainly in Zambia and Malawi, less so in Kenya, is that they don't set the SIM cards up to access data when you buy them; i.e. they don't enable the SIM card or the handset, for data (more the handset settings, the APN settings). In Zambia and Malawi seven SIM cards were purchased with all the mobile providers and in all cases a request had to be made to set the phone up for data. One of the phones was done automatically; the others had to be done manually by the person in the shop, and this took up to an hour to complete. Do mobile operators want data to be accessed on mobiles as this may impact on airtime revenues?

Figure 3 7: Health worker, Katherine from the Luwangwa Regoin of Zambia.

The affordances of mobile phone communications are driving seismic changes in spending patterns and redefining social and business patterns in Africa. It was common, amongst the people I asked, to be spending 40% of their income on talk time (airtime or top-up) with some people spending up to 70%! Even health care professionals would often skip lunch and other meals in order to spend their money on airtime. Government, medical and business institutions commonly did not given their employees any airtime allowance, yet relied on the generosity and good will of diligent employees to use their own airtime to discharge the activities of their work.

Most people in Malawi and Zambia that I met were on handsets that only supported voice and SMS communications – this was not the case even in the poorest areas I visited in South Africa and Kenya where handsets were at least data enabled and often comparable with handsets in the UK. Whilst the mobile providers are rolling out data services including 3G, there are four main issues on widespread adoption:

1. The cost of handsets that support data services are relatively expensive compared to the basic handsets that are still being pushed by the operators through an array of special offers.

2. The mobile operators do not make it easy to connect phones to the Internet. Of the seven SIM cards I bought on my short trip from all the local providers, I had to request from each provider that Internet services were enabled on the SIM card – this was not offered in any outlet. Also, the settings needed to be manually set up on my phone, which in one case caused me to have to renew practically every setting on my Nexus One Android handset.

3. Potential users do not easily understand the cost of data. This is especially important for people on low income, as the ability to accommodate unexpected expenditure is very low. Despite the incredibly low cost of sending a mobile instant message compared with the cost of sending an SMS (about 1,000 times more expensive), people are more comfortable sending an SMS as they absolutely know the cost.

4. The digital literacy levels in LDCs are good for calls and SMS, but low for mobile Internet.

Of equal concern was the cost of 3G data services. During my time in Malawi, I met Lazarus, a worker for a NGO, who has a 3G dongle that was supplied through his work. This dongle costs 15,000 kwacha per month, which is about £60 and affords him 250 MB of data. This is in stark contrast with a 3G dongle in the UK, which costs £15 per month and affords 2GB of data. Lazarus explained that the average person in the northern district of Malawi would earn between 20,000 and 30,000 kwacha a month. Therefore, somebody with an average income would be spending 50% to 75% of his or her monthly income to have a 3G dongle. Putting this into a UK context, where an unskilled labourer earns on average £20,000 and a skilled labourer earns £40,000 this would put the cost of a 3G dongle between £830 and £1,167 a month. Whilst many people in Malawi won't be using 3G dongles to access data services, it does highlight the extraordinarily high cost of access.

Whilst in Kenya I visited Kibera, in Nairobi which is the 2nd largest urban slum in Africa housing an estimated two million people living on under $1 a day in acutely poor conditions. However, even in this environment there is at least one mobile phone in every household (Joen 2011) Mobiles were being used for water security projects (Joen 2011), mobile banking(Morawczynski 2008), social network as well as many of the other usages already explored. Even in the most desperate context the drive to join the mobile masses was demonstrative.

3.3.3.1 Field Trip Summary Findings

The main findings from the field trips to East Africa were:

- People are no less likely to have a mobile phone if they live in a poor connected rural context than in a peri-uban or urban context.

- Even the acutely poor will strive to own a mobile phone and all have access to a mobile phone.

- Service providers in the various countries offer differing levels of support and competency in enabling customers to connect to mobile Internet using appropriate handsets.

- The cost of usage of mobile devices is proportionately very high but this does not seem to dampen mobile related spending with rural people spending up to 70% of their money on airtime.

- Very few people had post pay contracts with most people topping up with airtime vouchers

- The pricing models for Internet data are not easy to understand for the average East-African and for the acutely poor; this is a barrier to using the Internet on their mobile devices.

- Many handsets in rural East-Africa are not Internet capable yet but there was anecdotal evidence that this is changing.

3.3.4 MiHope Project for Maternal Health in Malawi and Zambia

During 2010-11, I acted as a technology consultant on MiHope, a Tearfund project which stands for Mobile Interactions bringing Hope (MiHope). MiHope in Malawi and Zambia aimed to help achieve the UNAIDS target of 'Elimination of parent to child transmission of HIV by 2015' such that the next generation is 'Born HIV free'. This will be achieved by ensuring pregnant women and their male partners have greater access to testing, treatment and care, particularly in rural areas. It has been shown that testing male partners reduced HIV transmission and child mortality by 40%. MiHope improves vital communications between caregivers, their clients and Ministry of Health clinics and uses mobile and web technologies to improve communication between rural care givers, Ministry of Health and programme managers. Working with NGO partner Tearfund, I oversaw the development of a system designed for a sometimes connected environment that enabled mobile Chat, an offline information portal and data collection tools. The solution also included a sustainable solar charging pack to ensure that even in the most remote areas users can keep mobile phones fully charged.

Some of the project participants had not used a mobile phone before with the majority not having used mobile Internet. It was a rare opportunity to observe people's initial engagements with mobile Internet. The 60 participants were each given a Nokia X3-02, a solar power kit and airtime. The cell phones were pre- loaded with a solution to enable communication using mobile messaging or chat, information about the project including a 100 page manual, and the ability to submit their activity and outcome reporting forms using the mobile device.

The project was seen as a success by Tearfund and their partners as a review and base-line vs end-line data showed that in Malawi: the male HIV testing increased from 4% to 24% and in Zambia from 40% to 50.

3.3.4.1 MiHope Summary Findings

Whilst engaged in this project, during my four visits to the project participants and rural villages, the following observations were made:

- There are long periods of "down-time" in countries where mobile services are not available. This is almost expected by the people, as it is true for many of the things in their lives such as water, electricity and the provision of medicines.

- Significant help was needed to train people in using the solution and embracing the new technology. People found it easiest when trained by one of their peers in a social setting.

- In Zambia you have to register every month to continue to use the data services on a mobile phone even if you have used it the previous month and have credit on your pay-as-you-go SIM.

- Any application or service deployed needs to be able to support a sometimes-connected environment. Off-line caching is essential as is synchronization when the device is reconnected.

- People are nervous about using data because they do not know how much it costs.

- Deployment of solar panels to charge the cell phones has been a success, enabling the phones (plus three others) to remain charged without needing to have them charged at an outlet.

- The robustness of handsets was a challenge with a 15% failure rate during the course of the 6-month pilot project.

- Being able to send and collect information saved both time and money for the project.

- Project participants worked harder, were happier and felt valued.

- The mobile phone gave the project participants status within their communities and afforded them opportunities they did not have before to speak with groups and people.

- Information presented on a mobile phone carried greater gravitas then printed or verbal communication.

- Digital literacy was not a barrier for project participants.

- The language of the information content was a barrier for people who could not read English – although this was a requirement for selection some could not.

- Using mobile chat rather than SMS was so cheap that the supplied airtime enabled volunteers to communicate freely and often.

- Project participants reported that they had more time and more money by using the phones.

3.3.5 Summary of Field Work Findings

Drawing together the summary findings from the: semi-structured interviews and subsequent content analysis in NVivo; the findings from the discussions with ICT4D experts in SSA; the observations from field work; and finding from the MiHope project in Malawi and Zambia we are able to assert the following:

- Having a connected mobile phone is more important than a connected computer. Having the connectivity of voice, SMS and data that is available personally at any time is more significant to people than having the power of a computer processor and the screen size of a computer monitor. For the majority of those interviewed, the only interaction with ICT would be through a mobile phone.

- Mobile phones empower people, especially women, as they can communicate and access other services but this can conversely make them feel less safe as they are concerned about being attacked to steal their mobile. Consequently, the vulnerable will generally not use their phone in a public setting and keep their handset on silent so as to not attract attention.

- Mobile phones are changing spending patterns and priorities with people in rural settings spending up to 70% of their money on mobile phone ownership. Whilst spending a large proportion of their money people often spend 50% of the month without airtime credit.

- Pre-paid airtime vouchers are used more than post-paid or contracts for mobile phone expenditure.

- Mobile phones are ubiquitous in SSA with handsets and airtime being shared amongst the communities

- People strive to have the best mobile they can as it is seen as an indication of status. There is a strong difference between the handsets present in rural South Africa to rural Malawi and Zambia. A large price difference for handsets between countries exists. China plays a large role in providing cheap mobile handsets but these are seen as fragile and not good to have.

- Registering for a SIM card can be a long process and getting the APN setting to enable mobile Internet is not always possible.

- Electrical and cell tower blackouts frequently disrupt mobile phone usage. There are long periods of "down-time" of electrical service provision which is almost expected by the people, as it is true for many of the things in their lives such as water, electricity and the provision of medicines.

- Mobile Internet has been encouraged in South Africa by the use of Mxit (A. Chigona & Wallace Chigona 2008; Wallace Chigona et al. 2009), a social networking tool which enables users to communicate textual virtually cost free –

for the price of 1 SMS over 100,000 messages of the same length may be sent. The affordance of chat rooms for group chats also encourages usage. Once mobile users have enabled data for Mxit they explore other services and digital artefacts offered by the Internet.

- A barrier to AMI is the pricing models for data and a lack of understanding on how much it will cost to use.

- Mobile Internet enables all to innovate more freely irrespective to their level of education.

- Price, literacy and digital literacy are not large barriers to people using mobile devices to access the Internet. People found it easiest when trained by one of their peers in a social setting.

- People are no less likely to have a mobile phone if they live in a poor connected rural context than in a peri-uban or urban context. Even the acutely poor will strive to own a mobile phone and all have access to a mobile phone.

- Any application or service deployed needs to be able to support a sometimes-connected environment. Off-line caching is essential as is synchronization when the device is reconnected.

- Handsets need to be robust as the failure rate is high in the harsh environments.

- Digital content is less likely to be understood if it is not in the native language but is more likely to be believed.

These findings will be triangulated with the literature review in the next chapter as a Structural Equation Model is developed to describe AMI in SSA.

3.4 System Dynamics Modelling

"System Dynamics modelling" (SDM) is a methodology and technique for mathematical modelling complex issues and was developed by J Forrester in 1956 following a discussion with General Motors about their hiring and inventory decision-making. In 1968 Forrester applied the principles developed for corporate modelling to broader social systems by modelling Boston's urban problems. By creating a system dynamics model of the urban issues of Boston, Forrester and his assembled team discovered that the policy of building low cost housing could actually increase poverty rather than alleviate it as it used essential central business real-estate which in turn would create livelihoods for the poor. It also highlighted that too much low cost housing could not be supported unless the economic capacity of the area could sustain the rental income needed. SDM incorporates the notions of internal feedback loops, time delays, reservoirs or stocks, dampers and inverters. System dynamics is interested in modelling interconnects Stocks and Flows of Resources. (Varaiya 1972; Forrester 1989; Forrester 1992)

SDM as a notation has been chosen to represent the Adoption of Mobile Internet in SSA as it enables an encapsulation of mental models of process, complex situations and workflows. It is envisioned that the SDM model of the Adoption of Mobile Internet in SSA will be developed into a simulation further facilitating understanding through scenarios and enabling predictions over time.

3.5 The posited Model of the Adoption of Mobile Internet in SSA

The following model has been derived from a literature review, fieldwork and discussion with experts in the field of ICT for development in sub-Saharan Africa.

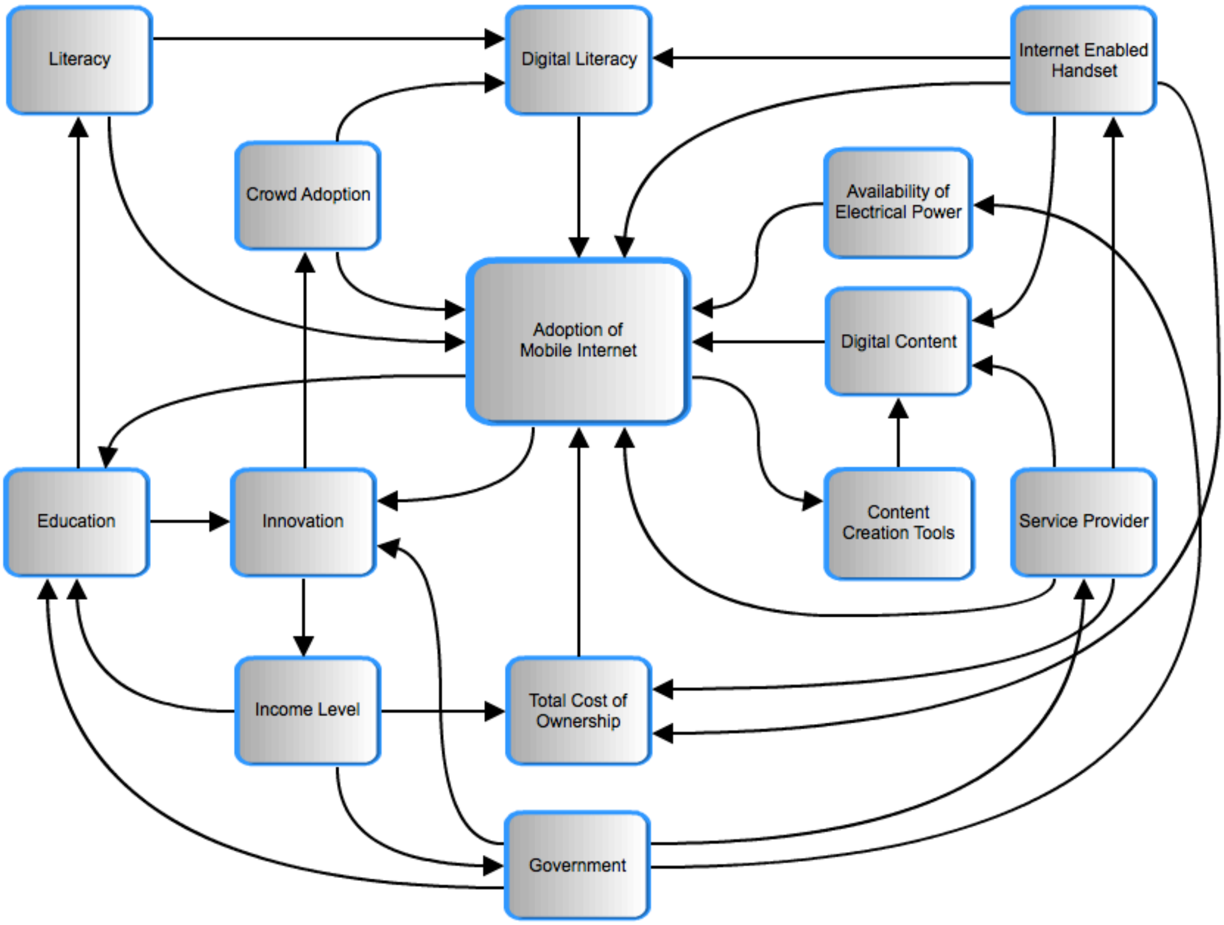


Figure 3-8: : Model to predict the adoption of Mobile Internet in SSA

3.5.1 Discussion of the model

The following section takes each model element and its interconnectivity and discusses the process of inclusion in the posited model of adoption.

Please note that the model does not account for gender, generation or other demographic determinates. This approach was taken, as the model will be evaluated against national indices that do not account for differences in gender, generation or other demographic determinates. Consequently the model should be viewed as describing the general populous of a country rather than highlighting differences between gender, generation or other demographic determinates.

3.5.1.1 Digital Literacy

It is posited that Digital Literacy reinforces and increases the Adoption of Mobile Internet in SSA.

The literature review for Digital Literacy can be found in Chapter 2.3.6 and is the capacity of individuals and communities to engage with new technologies and enable one another to use the technology to assist in the tasks they wish to perform.

Literacy mildly reinforces Digital Literacy. Whilst using a mobile phone for basic functions such as making and receiving a call does not require the user to be literate, more complex tasks such as sending and understanding a received SMS require an individual, or someone nearby, to have basic literacy skills. This requirement for basic literacy increases with the engagement of the mobile Internet on a mobile device as the complexity of both the setup, receiving and publishing of digital artefacts increases. In addition to this, the limitations of many low-end feature phones, limit the engagement of digital material to text rather than multimedia content where literacy level requirements are significantly diminished.

Crowd Adoption increases digital literacy as the technology becomes a social norm and the crowd will socially teach those wishing to engage in this technology or service. This is illustrated from fieldwork in Cape Town, time was spent with senior women who had no IT training and many were partially literate. They were taught through a 6-week program called Mom 2.0 to use their cell phones to access digital materials and write their own using a blog. The social learning and mutual support of the gathered women was self-evident as was the exploratory learning process that grew as the women became more confident with their mobile device. This exploratory learning process was a natural ability for all the teenagers I spoke to during my visits.

Digital Literacy is also very important in being able to set up an Internet enabled phone to access mobile Internet in many LDCs. The process is often very complicated and involved a Service Provider agent to manually set up the phone to enable Internet Access. Often little guidance and support is given from the Service Providers in how to use the technology and what affordances can be gained by access to the Internet on Mobile devices.

3.5.1.2 Internet Enabled Handsets

Internet Enabled Handsets reinforces the Adoption of Mobile Internet in SSA.

In order to access digital artefacts it is essential to have the technology to access the artefact. Basic handsets are prevalent through Africa and offer cheap value deals for consumers. Increasing feature phones and Smart phones are starting to be introduced into LDCs. Both of these groups of phones afford Internet access and often the provisioning of App Stores. Android is one of the fastest growing operating systems in Africa although Nokia phones still have a majority stake hold in the mobile ecosystem in Africa. Providing this access is particularly challenging for handheld devices because of their small screens, low memory and power, and differing platform technologies. It is also challenging for wireless networks because of their low bandwidth and high latencies. These limitations keep some older Internet protocols, such as HTML, from working efficiently and effectively for mobile Internet-based communications.

The relatively high cost of owning an Internet enabled handset is a barrier to the Adoption of Mobile Internet in SSA. Whilst there is a visible social pressure and momentum to owning the best Mobile Phone you can afford, the lack of low cost Internet ready handsets is a dampener.

Additionally, buying an Internet enabled handset is not itself sufficient to connect to the Internet. In LDCs typically there are set up issues to address before being able to connect to the Internet. These range from: having to supply ID and proof of address in South Africa to obtain a SIM card; to having to have the SIM card manually set up, often by poorly trained shop staff, to access mobile Internet; to having to reregister every 30 days to continue to use the Internet as in Zambia on Airtel.

3.5.1.3 Availability of Electrical Power

As we have discussed in Chapter 2.3.1.1, the provision of reliable, clean, accessible and affordable electricity is more important for Feature and Smart Phones as their operating power requirements are more than that of a basic handset. Consequently, the absence or fragility of sources of power will not afford citizens, even if they have the hardware and finance to access the mobile web on their mobile phones. It is noted from the East African field trip described in Chapter 4 that the provision of photovoltaic cells provides a robust and abundant free source of electrical power to maintain a charge on Feature or Smart phone.

3.5.1.4 Education

Education is a factor in people being able to access the Internet in SSA (Suregeni 2008; Crandall et al. 2012). The adoption of mobile Internet is impacting educational models in developing countries as it enables learning content to be delivered even in the most rural settings (Miller et al. 2006; Brown 2005). We are beginning to see evidence of this in the developed countries as universities such as the Open University, MIT and many others across the world recognising that they need to adapt their models in order to embrace mobile learning, both in terms of home-learning on PCs, but more recently adapting their materials so that they can be accessible on mobile devices and also examinable on mobile devices.

Education also drives innovation within LDCs and helps to improve literacy. This is demonstrated by the m4Lit program run by the Shuttleworth Foundation in South Africa to promote educational artefacts on common mobile phones (Vosloo et al. 2008).

3.5.1.5 Innovation

It has often been said that innovation excels and is more easily seen in communities and environments where the cost of failure is as low as possible. This is especially true in SSA where there is low capacity for risk and failure given the fragility of human life and sustainable living. With the adoption of mobile Internet and the convergence of cloud computing it is possible to have access to infrastructures in technology that only would have been the remit of large multi-national ten years ago. Most of these services are now available free of charge or at very little cost. This generates an environment where if the accessibility and affordability of mobile Internet is low enough for people to access, one would expect and indeed one is beginning to see innovation starting to emerge that would previously have been unthinkable within the LDC context. A good example of this is Macha a community in Zambia near Choma. They have invested over many years in ICT technologies, including radio, some fixed-line infrastructure. This was centred on a missionary community that built a hospital within that area. What we have seen is innovation piggybacking off that infrastructure and off mobile Internet to enable development of software and other activities to do with ICT.

The adoption of mobile Internet increases Innovation in communities as it enables new business models and practices to emerge alongside potentially bringing great profitability to existing businesses.

Innovation has a positive impact on Income Level over time and is re-enforced by have open standards.

Innovation can also reinforce Crowd Adoption of new ways to communicate, transact or be entertained.

3.5.1.6 Income Level

Income level within a community or country has been shown to increase with the introduction of mobile phones and with the availability of Mobile Internet and access to more services and information through innovation income levels increase.

Income levels are a key driver for the capacity to spend on Total Cost of Mobile Phone Ownership (TCOMPO). People in SSA are often spending over half of their income on TCOMPO and as the Income level increases it is expected that more will be spent on TCOMPO.

Income level is reinforced by Innovation. There is strong evidence that the adoption of mobile phones increases GDP with a region. It is expected that this association is strengthened further as more people begin to access the Internet on their mobile devices.

Income level also reinforces education levels within SSA. One of the main barriers to children being educated is the lack of financial provisions within a family or community. As income levels increase an increase in education levels will occur.

3.5.1.7 Crowd Adoption

Crowd adoption of Mobile Phones and the related services is a key driver in the Adoption of Mobile Internet in SSA. In SSA whilst marketing is important the recommendation of a trusted friend has far more significance than perhaps in developing countries. We have seen in South Africa, which as one of the fastest adoption rates of Mobile Internet, the Mobile Instant Messaging platform Mxit driving the adoption of Mobile Internet within the majority of South Africans. As the Crowd adopted the platform as one of the key communication methods it drove individuals to upgrade their handsets and explore activating data plans on their handsets in order to join the crowd. Innovation resulting in services such as Mxit and "0.facebook.com" reinforce Crowd adoption, which in turn drives the Adoption of Mobile Internet.

Due to the remote living conditions and difficulty in accessing formal education, crowd adoption is also important in LDCs as it enable peer level learning and an increase of Digital Literacy.

3.5.1.8 Total Costs of Ownership

In the 2011, Measuring the Information Society report it states, "The affordability of ICT services is key to bringing more people into the information age." (ITU 2011) With the cost of broadband in many developing countries costing more than the average monthly income, the majority of people in LDCs access information through wireless cellular networks. As detailed in Chapter (ITU 2011), the total cost of ownership of a Mobile Handset is solely buying airtime. It also includes the cost of the handset, maintaining charge on the handset and maintaining the handset. The Internet Enabled Handset reinforces the Total cost of ownership, as the cost of the handset needed for Mobile Internet is more than a basic one. Whilst it is true that using Mobile Internet for communications reduces the cost of airtime, for example we are able to send the equivalent of 10,000 mobile instant messages for the same cost as an SMS, it is true that the upfront costs of having a phone that will afford an Internet connection is greater. The Service Provider also reinforces the Total Cost of Ownership as they set the price of Airtime, which is reduced if there are other service providers offering mobile services in the region or a strong robust regulatory body the ensure a fair pricing model is offered.

The Total Cost of Mobile Phone ownership is a dampener on the adoption of Mobile Internet. As the price decreases we would expect to see an increase in the adoption of Mobile Internet in SSA.

3.5.1.9 Service Provider

The Service Provider is a key actor and influencer on the Adoption of Mobile Internet in SSA. They are primarily responsible for: influencing the Total Cost of Mobile Phone ownership; marketing the availability and affordances of Mobile Internet; and they often provide limited Digital Content free of charge within their operator wall garden. In addition to this they are responsible for the provisioning of Cell Towers, which enable Mobile Phone users to access service on their mobile phones. It should be noted that the availability of cellular coverage, whilst being a very important factor, is not deterministic on mobile phone ownership with strong field evidence for cell phone ownership even in areas not served by a cell tower. The service provider generally offers good, best-value services in regions where there is strong competition and appropriate regulation (Chapter 2.3.1.2).

3.5.1.10 Content Creation

As more people adopt Mobile Internet, the latent capacity for them to become contributors as well as consumers of digital content increase. People are more likely to read digital content if it is in their own language, it is culturally relevant and if it has perceived value to them. As content creation tools are developed that enable people to create and share content on their mobile phones this will reinforce the relevance and quantity of digital content which will in turn drive the adoption of mobile Internet in LDCs. Some tools exist already such as Facebook, Twitter, Blogs and other tools. It must be noted that many of these tools require a user account creation process which is neither appropriate for completion on a mobile device; or involves difficult process like typing in the characters on an scanned image; or requires the user to have an email account which many people in SSA do not have. Facebook is a growing service which is driving the adoption of Mobile Internet as is offers the ability to easily share content including photos and audio files.

3.5.1.11 Digital Content

The availability of digital content to people in SSA is a driver for the Adoption of Mobile Internet with health and educational information being the most sort after (Crandall et al. 2012). As more digital content that has perceived value to people in SSA becomes available people will be more likely to use Mobile Internet on their handsets. As discussed in Chapter 2.3.4, the majority of Digital Content that is consumed in SSA is not generated in country and as a result does not imbibe the value and culture of the communities consuming the digital content. In addition to this there is little digital content available in the tribal languages of the people, which can provide a further barrier to the Adoption of Mobile Internet.

Increasingly, Service Providers are providing a limited amount of Digital Content within walled gardens to encourage people to explore the affordances and services of access the Internet on their mobile device.

In order to access digital content, a user must have access to an Internet Enabled handset, which is connected to the Internet.

3.5.1.12 Government

Government is an important model element as it provides the context of regulation, wealth, power, innovation and education that are model elements in the model describing AMI in SSA.

Government policies, laws and funding are a key driver for the education levels of SSA. Without these the general population are not afforded a rounded and comprehensive education.

Government also amplifies innovation through encouraging small medium enterprises through tax policies.

The availability of sustainable power is also government regulated and a key element in AMI in SSA.

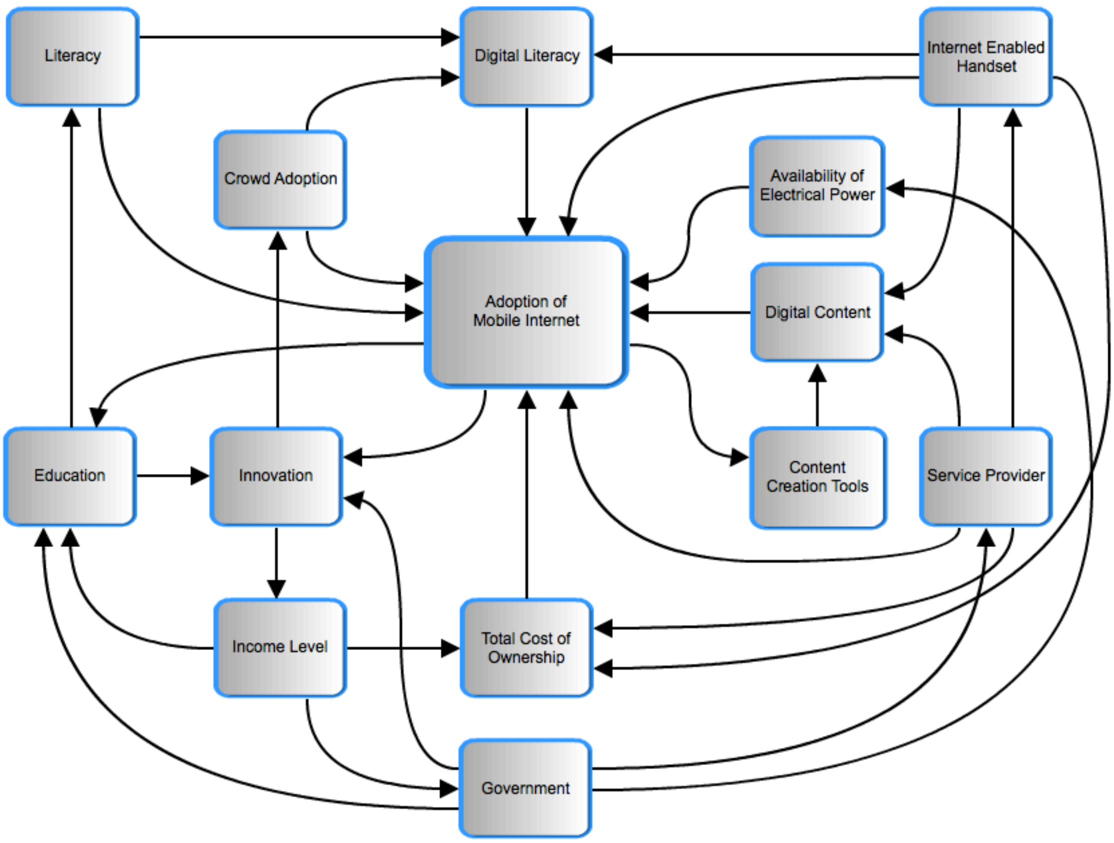
Another key area of regulation is that of the service providers in the provision of cell towers, interoperability between networks and regulating the cost and service level provision of cellular services (Communications Commission of Kenya 2011). They are also responsible for creating an environment for external investment and set the tax levied on telecommunication imports.

3.6 Summary

To derive a model that encapsulates the real drivers and barriers to AMI in SSA, a mixed methods approach was used to ensure that the model was drawn from qualitative analysis of users experiences gathered through ethnographic observation, semi-structured interviews and findings from a maternal health project run by Tearfund. This was triangulated alongside expert opinion through literature review and interviews into an initial Structural Equation model of the adoption of mobile Internet in sub-Saharan Africa.

In the next chapter, the initial model of AMI in SSA (Chapter 3.10) will be tested for goodness-of-fit against published data using regression analysis within a Structural Equation Modelling framework. Finally, the developed model of AMI in SSA was then developed into a predictive model and validated against known data (Chapter 5).

Chapter 3 introduces the posited model describing the drivers and dampeners of the Adoption of Mobile Internet in SSA as follows:



(Figure 3-8: : Model to predict the adoption of Mobile Internet in SSA).

Chapter 6 takes the posited model and refines it further through testing goodness-of-fit using Structural Equation Modelling. The refined model will then inform a simulated model to aid the prediction of the adoption of model Internet in SSA.

Chapter 4. **Structural Equation Modelling**

In Chapter 5 a model of the Adoption of Mobile Internet was informed from the triangulation of a literature review, expert opinion and a small pilot study describing of the Adoption of Mobile Internet (AMI) in SSA. This Chapter takes this posited AMI model and refines it using Structural Equation Modelling (SEM) to test the “goodness-of-fit” of the model to published data sets from: the World Economic Forum; the World Bank; the International Telecommunications Union; the United Nations Education, Science and Culture Organisation; Informa Telecoms and Media; and the Organisation for Economic Co-operation and Development. The SEM model analysis also enables the causal association of linked elements to be quantified from the value of the standardized regression weighting indicated by SEM analysis.

4.1 Method

SEM was posited in 1921 by Sewall Wright (Wright 1921) as a method of measuring the direct influence along each separate path in a complex interconnecting system. It is a graphical modelling notation that represents multivariate casual relationships between system elements that describe a complex hypothesis. For example, an equation representing a causal relationship between variable x and y may be written as:

$$y_1 = \gamma_{11} x_1 + \zeta_1$$

Equation 4-1: A simple causal relationship between x and y

This causal relationship is graphically represented as:

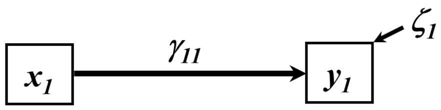


Figure 4-1: A SEM model of a simple causal relationship between x and y

Structural equation modelling is defined as a model that describes a complex hypothesis where two or more structural equations are used. ~For example:

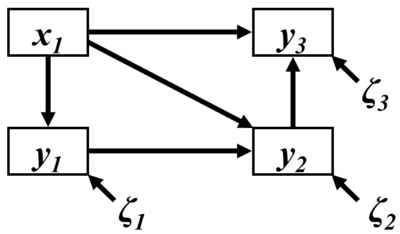


Figure 4-2: A SEM model of a more complex hypothesis

May be written as:

$$y_1 = \gamma_{11}x_1 + \zeta_1$$
$$y_2 = \beta_{21}y_1 + \gamma_{21}x_1 + \zeta_2$$
$$y_3 = \beta_{32}y_2 + \gamma_{31}x_1 + \zeta_3$$

Equation 4-2: A more complex causal relationship between x_1, y_1, y_2, and y_3

It is important that variables used in the SEM both have a demonstrative and repeatable causal effect on one another and that the values of the variables used for the SEM analysis are representative of the values when the effects of the other variables are present (Shipley 2002). This criteria is satisfied with the variables which were obtained through the triangulation of a literature review, expert comment and field work.

Univariate modelling techniques such as ANOVA were not employed to test the model of the Adoption of Mobile Internet, as Univariate methods are designed for studying individual variables rather than studying more complex systems with many associations. SEM is used to examine complex relationships between many measured or observed variables and latent or unobserved variables.

4.2 Constructing the SEM Model

The posited model from Chapter 5 describing the Adoption of Mobile Internet was shown as:

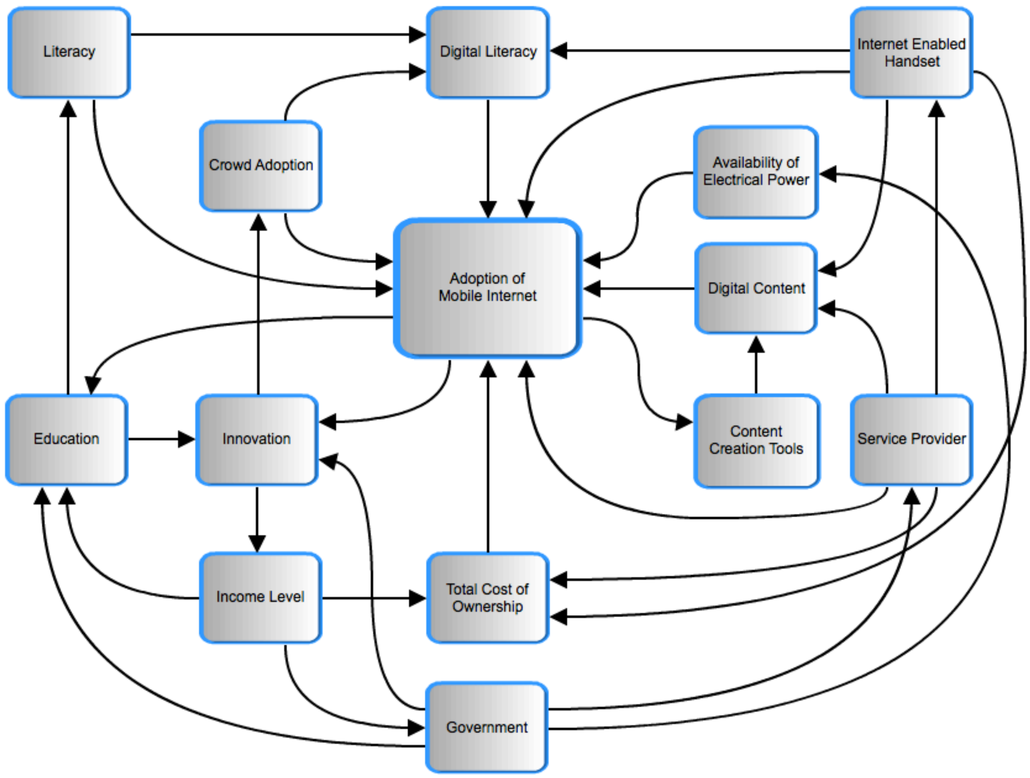


Figure 4-3: The SDM model of AMI in SSA (see Figure 5-1)

In order to create a SEM model the model elements in Figure 6-3 were mapped to the following variables that will appear in the SEM model of AMI in SSA.

SEM variable	SDM variable
Income	Income Level
Innov	Innovation
Innov1	Innovation
Innov2	Innovation
Edu	Education
Lit	Literacy
DigLit	Digital Literacy
CrowdAdop	Crowd Adoption
AMI	Adoption of Mobile Internet
AMI1	Adoption of Mobile Internet
AMI2	Adoption of Mobile Internet
AMI3	Adoption of Mobile Internet
GovReg	Government
ElecPower	Availabilty of Electrical Power
DigCon	Digital Content
TCO	Total Cost of Ownership

Table 4-1: Mapping of System Dynamic Model variables to Structural Equation Model variable

Please note that the "Internet Enabled Handset" model element in the SDM AMI model does not appear on the SEM AMI model as it is already represented in the index used as a proxy for the "Service Provider" and "Total Cost of Ownership" model elements. Similarly, "Content Creation Tools" are implicitly subsumed in the "Digital Content" proxy index.

Whilst this model has been derived from a triangulation of fieldwork in four African countries, a literature review and expert opinion, in principal this model should apply to all countries regardless. Consequently, data has been analysed and discussed from 113 countries from across the globe. This also ensures that the data sample is sufficiently large enough to ensure a statistically significant effect.

4.3 *Mapping Data Sets to the Model*

In order to refine the model and test goodness of fit of the model to published data sets, known indices were selected to map to the endogenous and exogenous variables. Where more than one index impacted a model element, both were included, as in the case of "AMI" and "Innov".

The following indices were carefully selected to represent actual data for each of the model variables. Care was taken to ensure that each index included, in as far as was possible, data relevant to mobile first environments (Botha et al. 2007) as seen in the highly constrained environments in sub-Saharan Africa.

Once the data indices were collated on a single worksheet, all country records with incomplete data for the indices chosen were expunged from the worksheet, as the results from AMOS are restricted if any data is missing from the supplied indices. This process yielded a data set of 113 countries as shown in Appendix Five.

The following indices were selected for use to test the AMOS model of AMI.

Innov1 > Business and innovation

Index description: "An enabling environment determines the capacity of an economy and society to benefit from the use of ICT. The success of a country in leveraging ICT and achieving the desired economic and social benefits will depend on its overall environment—including market conditions, the regulatory framework, and innovation-prone conditions—to boost innovation and entrepreneurship." (World Economic Forum 2012)

Innov2 > Capacity for innovation

Index description: "In your country, how do companies obtain technology? [1 = exclusively from licensing or imitating foreign companies; 7 = by conducting formal research and pioneering their own new products and processes] | 2010–2011 weighted average." (WORLD ECONOMIC FORUM 2010)

Edu > Quality of the educational system

Index description: “How well does the educational system in your country meet the needs of a competitive economy? [1 = not well at all; 7 = very well] | 2010–2011 weighted average. (WORLD ECONOMIC FORUM 2010)

Lit > Adult literacy

Index description: “Adult literacy is defined as the percentage of the population aged 15 years and over who can both read and write with understanding a short, simple statement on his/her everyday life. Whenever data come from economies classified by the World Bank as high income, we assume a rate of 99%, in accordance with the approach adopted by the United Nations Development Programme (UNDP) in calculating the 2009 edition of the Human Development Index."(UNESCO 2011; The World Bank 2011a)

DigLit > Percentage of households equipped with a personal computer, 2010

Index description: “The proportion of households with a computer is calculated by dividing the number of households with a computer by the total number of households. A computer refers to a desktop or a laptop computer. It does not include equipment with some embedded computing abilities such as mobile cellular phones, personal digital assistants (PDAs), or television sets."(ITU Telecom World 2011a)

CrowdAdop > Use of virtual social networks

Index description: “How widely used are virtual social networks (e.g., Facebook, Twitter, LinkedIn) for professional and personal communication in your country? [1 = not used at all; 7 = used widely] 2010– 2011 weighted average" (WORLD ECONOMIC FORUM 2010)

Income > GDP/capita

Gross domestic product per capita in current US dollars 2009. This is a proxy measure of income as actual figures were not available for all countries covered. (International Monetry Fund 2010)

AMI1 > Mobile phone subscriptions

Index description: Mobile telephone subscriptions (post-paid and pre-paid) per 100 population | 2010

“A mobile telephone subscription refers to a subscription to a public mobile telephone service that provides access to the Public Switched Telephone Network using cellular technology, including number of pre-paid SIM cards active during the past three months. This includes both analog and digital cellular systems (IMT-2000, Third Generation, 3G) and 4G subscriptions, but excludes mobile broadband subscriptions via data cards or USB modems. Subscriptions to public mobile data services, private trunked mobile radio, telepoint or radio paging, and telemetry services are also excluded. It includes all mobile cellular subscriptions that offer voice communications." (ITU Telecom World 2011a)

AMI2 > Mobile broadband Internet subscriptions per 100 population |2010

Index description: “Mobile broadband subscriptions refers to active SIM cards or, on CDMA networks, connections accessing the Internet at consistent broadband speeds of over 512 kb/s, which includes cellular technologies such as HSPA, EV-DO, and above. This includes connections being used in any type of device able to access mobile broadband networks, including smartphones, USB modems, mobile hotspots, or other mobile-broadband connected devices." (ITU Telecom World 2011a)

AMI 3 > Percentage of individuals using the Internet | 2010

Index description: “Internet users are people with access to the worldwide network." (ITU Telecom World 2011a)

GovReg > Political and Regulation

Index description: “An index that is derived from the following indices: effectiveness of law-making bodies, laws relating to ICT, judicial independence, efficiency of legal framework in settling disputes, efficiency of legal framework in challenging regulations, intellectual property protection, software piracy rate, number of procedures to enforce a contract, time to enforce a contract" (World Economic Forum 2012)

ElecPow > Electricity production (kWh) per capita | 2008

Index description: “Electricity production is measured at the terminals of all alternator sets in a station. In addition to hydropower, coal, oil, gas, and nuclear power generation, it covers generation by geothermal, solar, wind, and tide and wave energy as well as that from combustible renewables and waste. Production includes the output of electricity plants designed to produce electricity only, as well as that of combined heat and power plants. Total electricity production is then divided by total population. Population figures are from the United Nations Division of Economic and Social Affairs (retrieved November 10, 2011)." (The World Bank 2011b)

ServProv > Mobile network coverage

Percentage of total population covered by a mobile network signal | 2010

Index description: “This indicator measures the percentage of inhabitants who are within range of a mobile cellular signal, irrespective of whether or not they are subscribers. This is calculated by dividing the number of inhabitants within range of a mobile cellular signal by the total population. Note that this is not the same as the mobile subscription density or penetration." (ITU Telecom World 2011a)

DigCon > Accessibilty of digital content

Index description: “In your country, how accessible is digital content (e.g., text and audiovisual content, software products) via multiple platforms (e.g., fixed-line Internet, wireless Internet, mobile network, satellite, etc.)? [1 = not accessible at all; 7 = widely accessible] | 2010–2011 weighted average" (WORLD ECONOMIC FORUM 2010)

TCO > Mobile cellular tariffs

Average per-minute cost of different types of mobile cellular calls (PPP $) | 2010

Index description: “This measure is constructed by first taking the average per-minute cost of a local call to another mobile cellular phone on the same network (on-net) and on another network (off-net). This amount is then averaged with the per-minute cost of a local call to a fixed telephone line. All the tariffs are for calls placed during peak hours and based on a basic, representative mobile cellular pre- paid subscription service. The amount is adjusted for purchasing power parity (PPP) and expressed in current international dollars. PPP figures were sourced from the World Bank's World Development Indicators Online (retrieved November 13, 2011) and the International Monetary Fund's World Economic Outlook (September 2011 edition)." (International Monetry Fund 2010)

4.4 Running the Regression Testing in AMOS

The SEM model was constructed in AMOS from IBM and each element in the model was mapped to the relevant dataset shown in section 4.3.

The resulting model is shown below. Observed variables are shown in the model in rectangular boxes. Latent are variables in ovals.

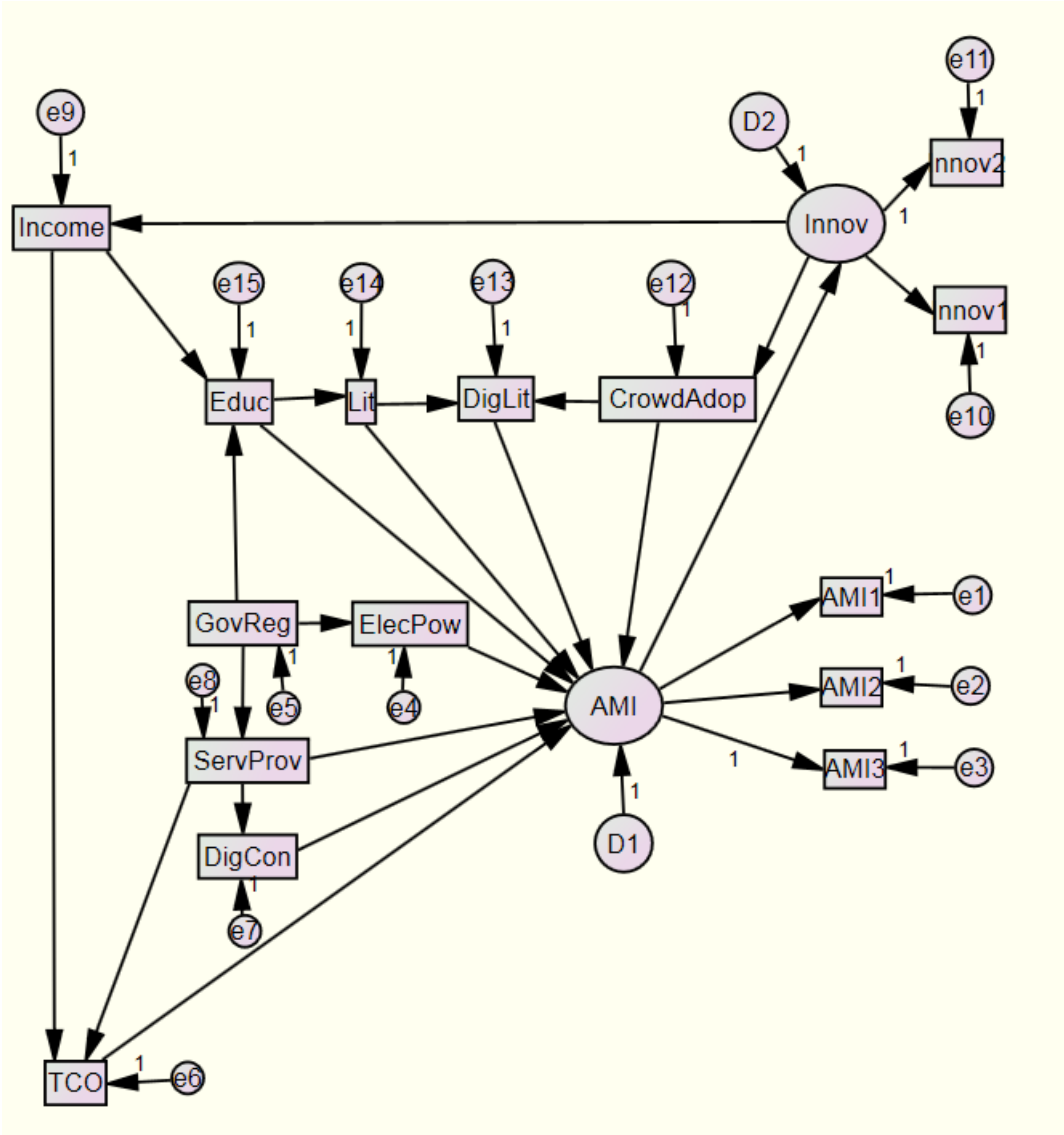


Figure 4-4: SEM model of the Adoption of Mobile Internet in AMOS

The variables [e] and [D] encapsulate the influence of variables that are not present as defined variables yet still influence the overall model.

The results of the SEM regression factor analysis can be found in the next section.

4.5 Results from the SEM model of AMI in SSA against published data sets.

The full output from AMOS for the AMI model may be found in Appendix Six. For the purpose of investigating the goodness-of-fit of the SEM AMI model to the published data sets.

The model contains the following observed, endogenous variables:

Innov2	DigLit	Lit	Educ	Income
AMI1	AMI2	AMI3	ServProv	GovReg
CrowdAdop	TCO	ElecPow	DigCon	Innov1

Table 4-2: Observed, endogenous variables in SEM of AMI in SSA

The model contains the following unobserved, endogenous variables

Innov	AMI

Table 4-3: Unobserved, endogenous variables in SEM of AMI in SSA

The model contained the following unobserved, exogenous variables:

e1	e2	e3	e4	e5
e6	e7	e8	e9	e10
e11	e12	e13	e14	e15
D1	D2			

Table 4-4: Unobserved, exogenous variables in SEM of AMI in SSA

Variable counts

Number of variables in your model:	**34**
Number of observed variables:	15
Number of unobserved variables:	19
Number of exogenous variables:	17
Number of endogenous variables:	17

Table 4-5: Number of variables in the model of AMI

Computation of degrees of freedom

Number of distinct sample moments: 120

Number of distinct parameters to be estimated: 42

Degrees of freedom (120 - 42): 78

Chi-square = 451.504

Degrees of freedom = 78

Regression Weights

The following regression weights indicate the influence of one variable on another and give a measure of how much the variable would change when the dependant variable changes. A P-value of less than 0.05 is shown as "***" and is deemed a statistically significant connection.

	Link		Estimate	S.E.	C.R.	P	Label
ServProv	<---	GovReg	7.446	1.956	3.807	***	
ElecPow	<---	GovReg	3745.218	600.928	6.232	***	
DigCon	<---	ServProv	.026	.004	7.366	***	
TCO	<---	ServProv	.002	.001	1.657	.098	
Educ	<---	GovReg	.880	.065	13.609	***	
AMI	<---	ElecPow	.000	.000	2.758	.***	
AMI	<---	ServProv	.005	.039	.122	.903	
AMI	<---	DigCon	9.827	.946	10.390	***	
Innov2	<---	Innov	1.000				
Innov1	<---	Innov	.781	.094	8.312	***	
AMI1	<---	AMI	.819	.156	5.242	***	
AMI2	<---	AMI	.450	.063	7.187	***	
AMI3	<---	AMI	1.000				
DigLit	<---	Lit	.988	.148	6.661	***	
Lit	<---	Educ	3.842	1.341	2.866	.***	
Income	<---	Innov	23065.582	3128.344	7.373	***	
DigLit	<---	CrowdAdop	12.820	3.793	3.379	***	
AMI	<---	CrowdAdop	.986	1.675	.589	.556	
Educ	<---	Income	.000	.000	-1.087	.277	
TCO	<---	Income	.000	.000	-1.604	.109	
CrowdAdop	<---	Innov	.774	.118	6.534	***	
AMI	<---	DigLit	.432	.037	11.538	***	

AMI	<---	Lit	.082	.056	1.478	.139
AMI	<---	Educ	4.171	.766	5.443	***
AMI	<---	TCO	4.823	2.888	1.670	.095
Innov	<---	AMI	.027	.003	9.054	***

Table 4-6: Regression weights of the model connectors

Standardized Regression Weights

This indicates the amount of standard deviations that a model element increases under the influence of a standard deviation increase in the linked model element.

	Link		Estimate
ServProv	<---	GovReg	.339
ElecPow	<---	GovReg	.507
DigCon	<---	ServProv	.571
TCO	<---	ServProv	.163
Educ	<---	GovReg	.825
AMI	<---	ElecPow	.098
AMI	<---	ServProv	.005
AMI	<---	DigCon	.462
Innov2	<---	Innov	.700
Innov1	<---	Innov	.818
AMI1	<---	AMI	.455
AMI2	<---	AMI	.582
AMI3	<---	AMI	.915
DigLit	<---	Lit	.474
Lit	<---	Educ	.268
Income	<---	Innov	.736
DigLit	<---	CrowdAdop	.290
AMI	<---	CrowdAdop	.034

Educ	<---	Income	-.070
TCO	<---	Income	-.165
CrowdAdop	<---	Innov	.647
AMI	<---	DigLit	.651
AMI	<---	Lit	.060
AMI	<---	Educ	.210
AMI	<---	TCO	.057
Innov	<---	AMI	.967

Table 4-7: Standardized Regression Weights of model connectors

4.6 Model Fit

In order to assess the fit of the model to the data, the following two tables produced by AMOS analysis will be discussed in the next section. We may derive from this analysis if the model is a reasonable fit to the published data and whether it provides a useful abstraction of the interactions between the model elements.

CMIN and Baseline Comparisons

AMOS reports CMIN as Chi-squared; the smaller the Chi-squared value, the better the fit of the model to the data. A completely saturated model in which model elements all have a casual effect on one another will have a Chi-square value of 0 as it gives a perfect fit.

As AMI is an exploratory model; we will limit this analysis to the comparison between the Default model of AMI and the Independence model where all the model elements are not connected.

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	41	511.409	79	.000	6.474
Saturated model	120	.000	0		
Independence model	15	1670.256	105	.000	15.907

Table 4-8: CMIN values for SEM model of AMI

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.694	.593	.728	.633	.724
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Table 4-9: Baseline comparisons of SEM AMI model

4.7 Revised SEM model

Using the SEM notation from AMOS, the model of AMI showing the standardised estimates is as follows:

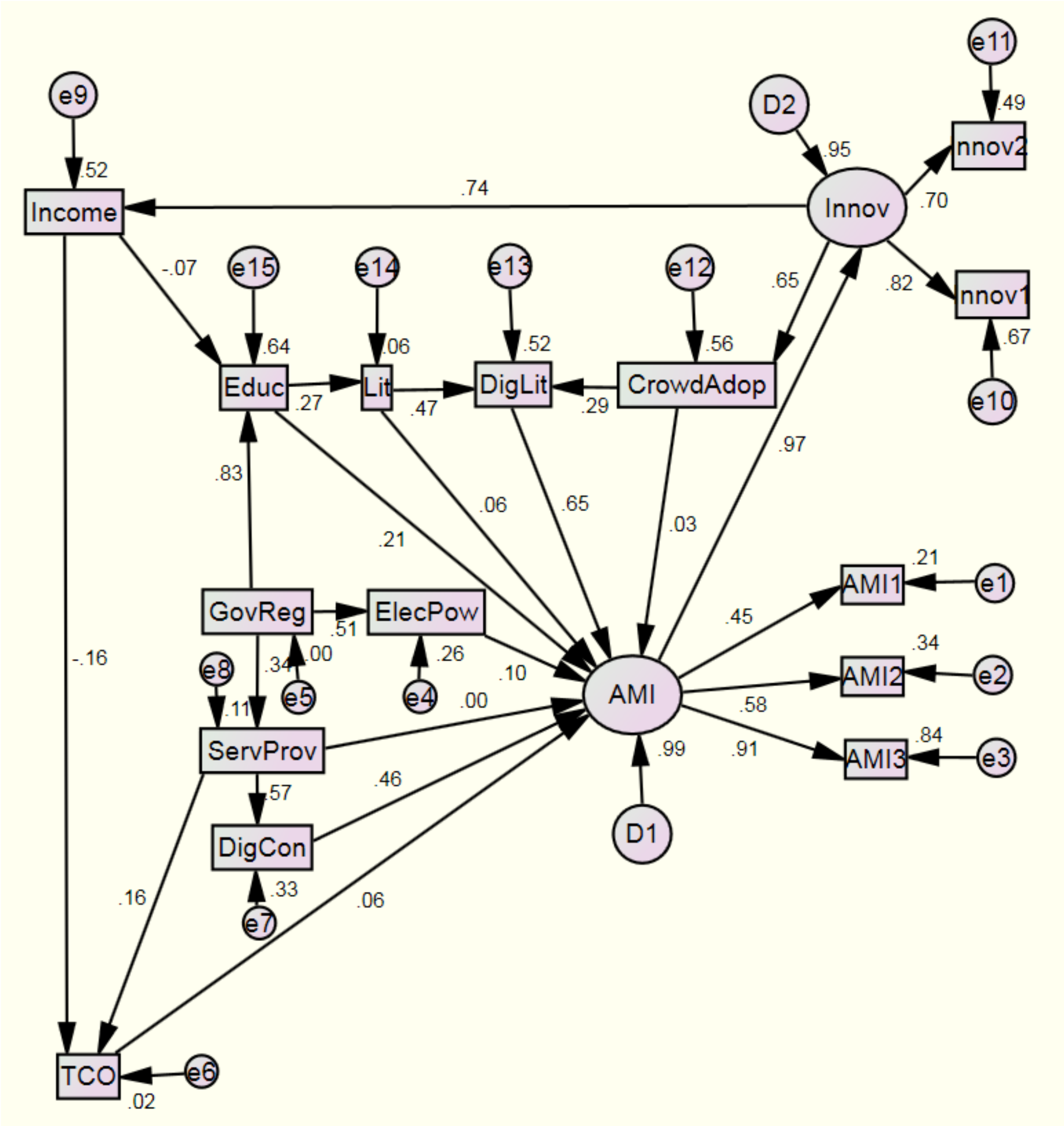


Figure 4-5: SEM AMI model showing standardized estimates

Using the SEM regression weights shown in Table 4-6 we may show the statistically significant links on the model of AMI as follows:

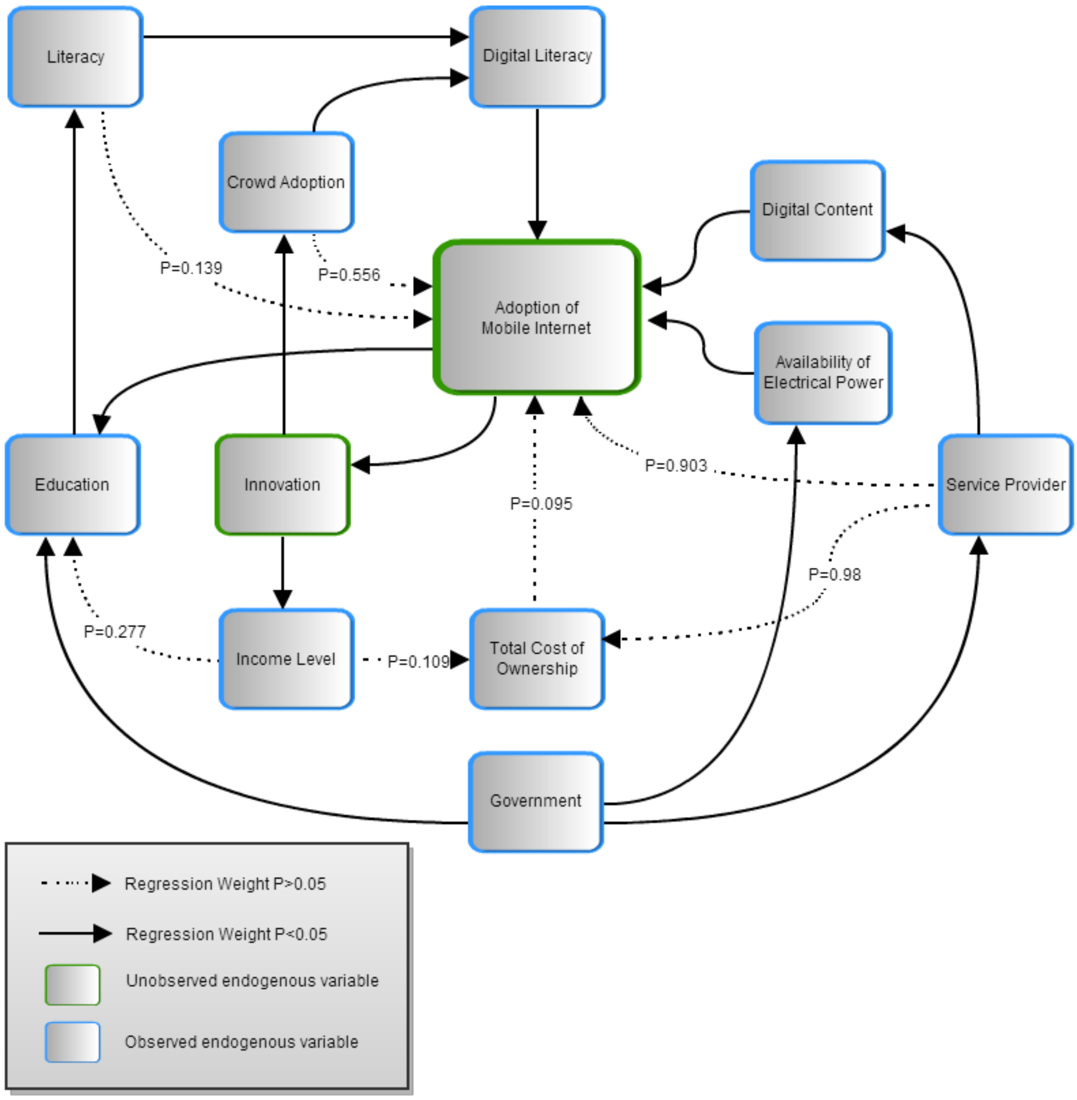


Figure 4-6: P Values of model element connectors of AMI based on SEM findings

Now displaying the standardized regression weights of the model connectors from Table 4-7, the model of AMI becomes:

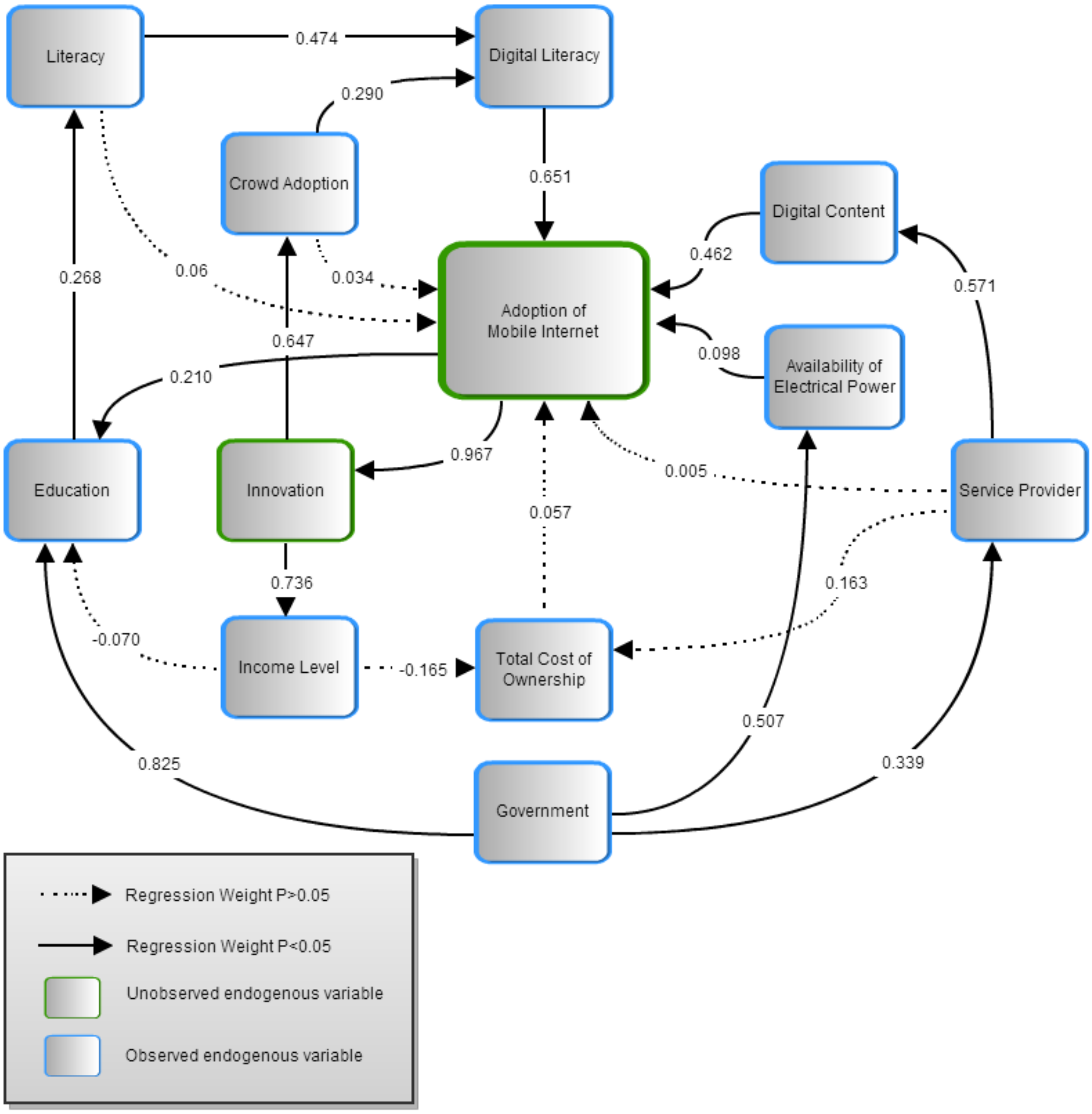


Figure 4-7: Weight of relationships between the model of AMI from SEM analysis

4.8 Post-hoc Power Calculation

A Post-hoc Power calculation was made In order to ensure that we have a degree of confidence that the model will reject the null hypothesis, that there is no causal effect between the model elements specified in the model of AMI, and thereby not committing a type II error. As this is an exploratory model we are only interested in modest effect sizes and will use a generally modest effect size of 0.30 (J. Cohen 1988).

The following parameters where inputted into G-Power 3 (Faul et al. 2009):

Input variables

t tests - Linear multiple regression:

Fixed model, single regression coefficient

Analysis: Post hoc: Compute achieved power

Input:

Tail(s)	=	One
Effect size f^2	=	0.30
α err prob	=	0.05
Total sample size	=	113
Number of predictors	=	34

Output:

Df	=	78
Power (1-β err prob)	=	0.99

The β value is 0.01 which indicates that there is a statistically insignificant chance of the hypothesis being false and it not being rejected by the test.

4.9 Discussion

The model of AMI derived from a triangulation of a literature review, field work and expert review was translated into a Structural Equation Model (SEM) and linked to published data sets that reflect the notions of each model element (Chapter 4.3). AMOS, a program from IBM, provided an analysis of the “goodness-of-fit” of the model to the published data sets for 113 nations. The AMOS analysis also indicated the Standardized Regression Weights of each defined link between model elements which indicates the casual effect of the elements on one another (Table 4-6). Confidence in the validity of the defined links were also derived (Table 4-7) and shown on a revised model of AMI. A post-hoc power analysis revealed that the AMOS results were statistically significant with a β value of 0.01.

4.9.1 Discussion of the model element connections

From Table 4-6, the following model element connections were supported as statistically significant from analysis of the data:

ServProv	<---	GovReg
ElecPow	<---	GovReg
DigCon	<---	ServProv
Educ	<---	GovReg
AMI	<---	ElecPow
AMI	<---	DigCon
Innov2	<---	Innov
Innov1	<---	Innov
AMI1	<---	AMI

AMI2	<---	AMI
AMI3	<---	AMI
DigLit	<---	Lit
Lit	<---	Educ
Income	<---	Innov
DigLit	<---	CrowdAdop
CrowdAdop	<---	Innov
AMI	<---	DigLit
AMI	<---	Educ
Innov	<---	AMI

The statistical support for these model elements and their connectivity to one another as shown in Figure 3-8 was to be expected given the work undertaken to derive the model. It was encouraging that at a 95% confidence level 19 connections were supported by the data, with 7 not confidently supported and of those 7 a further 4 were within a 90% confidence rate (1.6σ). This is a positive indication that the model adequately describes the adoption of mobile Internet.

However, from Table 4-6, the following model element connections were not supported as statistically significant from analysis of the data:

TCO <--- ServProv P=0.098

The connection between Service Provider and Total Cost of ownership did not achieve a 95% confidence rate, although it did achieve 90% confidence in the connection as defined in the model of AMI in Figure 3-8. The proxy variables used to map to the model were the % area of mobile network coverage (ServProv) and the average cost of different types of mobile cellular calls (TCO). It is anticipated that as the data did not include solely LDC countries that the effect of TCO on ServProv was diluted, as developed markets have near ubiquitous coverage and the relative cost of total cost of ownership is much lower than running a mobile device in LDCs (page 79). Given these factors the association between TCO and ServProv will be maintained.

AMI <--- ServProv P=0.903

The connection between Service Provider (ServProv) and Adoption of Mobile Internet (AMI) did not achieve a 95% confidence rate and received the lowest confidence rate of all the connections of less than 10%. The proxy variables used to map to the model were the % area of mobile network coverage (ServProv) and a joining of the following three indices for AMI: mobile phone subscriptions, mobile broadband Internet subscriptions and percentage of individuals using the Internet. As this connection has very poor support from the analysis and has a very small standardised regression weighting of 0.005, it will be dropped in the revised model. Service provision does, however, strongly impact Digital Content which in turn impacts AMI. However, this negative result is strongly countered in the triangulation research which shows a strong association with adoption patterns and the influence of the general populous, that further investigation into the failure of the data to support the hypothesis is required. It is perhaps a function of either the countries chosen to appear in the dataset or the proxy data used to present these model elements was not appropriate.

AMI <--- CrowdAdop P=0.556

The causal link between crowd adoption (CrowdAdop) and the adoption of mobile Internet (AMI) was not strongly supported in the data. However, a strong association with Digital Literacy was supported with a standardised regression weighting of 0.290. Digital Literacy in turn has a strong causal link with AMI. Given this indirect path through Digital Literacy linking Crowd Adoption with AMI, the link will be withdrawn from the revised model.

Educ <--- Income P=0.277

The link between Income and Education (Educ) had modest confidence at 72.7% but little causal impact at 0.07 of the standardized regression weight. The standardized regression weight is also a negative number which suggests that the casual link has a dampening effect. Whilst income level and education would generally be correlated, for the purpose of this model it is rendered as inconsequential in magnitude and is not statistically supported by the data. Consequently, this has been removed from the model.

TCO <--- Income P=0.109

The connection between Income and Total Cost of ownership did not achieve a 95% confidence rate, although it did achieve ~90% confidence in the connection as defined in the model of AMI in Figure 3-8. The proxy variables used to map to the model were the GDP per capita (Income) and the average cost of different types of mobile cellular calls (TCO). It is anticipated that as the data did not include solely LDC countries that the effect of Income on TCO was diluted as the relative cost of total cost of ownership is much lower than running a mobile device in LDCs (page 79). The analysis from AMOS also suggests that the association has a negative impact which is supported by the field work with strong evidence that TCO has a strong impact on spending patterns. Also as the Income Level increases, one would expect TCO as a factor to decrease. Consequently, the causal link will be maintained.

AMI <--- Lit P=0.139

The connection between Literacy (Lit) and Adoption of Mobile Internet (AMI) did not achieve a 95% confidence rate, although they reach ~90% confidence levels. The proxy variables used to map to the model were the % of the population aged 15 years and over who can both read and write (Lit) and a joining of the following three indices for AMI: mobile phone subscriptions, mobile broadband Internet subscriptions, and percentage of individuals using the Internet. The strength of the association is mild at 0.06. This link will be maintained in the model moving forward.

AMI <--- TCO P=0.095

The causal link between Total Cost of Ownership (TCO) and the Adoption of Mobile Internet (AMI) was slightly below the 95% confidence rate with a standardized regression weighting of 0.057. This weighting is much less than initially expected, but given the social and personal pressures (observed during the field work) to purchase airtime and have the best possible handsets, it should not be surprising that this element has less of an impact on the adoption of mobile Internet than initially supposed.

4.9.2 Discussion of the “Goodness-of-fit” of the model to the data.

A measure of goodness-of-fit of the model to the data is given by considering the CMIN values (Table 4-8) and the Baseline Comparison (Table 4-9).

Wheaton et al. state that CMIN/DF of less than 5 indicates a significantly good fit of the model to the data (Wheaton et al. 1977). The CMIN/DF of the AMI model is calculated to be 6.474. Whilst this falls a little outside the recommended range to call it a significantly good fit of the model to the data, when compared to the Independence model it shows a 60% better CMIN/DR ratio. Comparing the CMIN for the AMI model to the CMIN for the Independence model, it shows a 70% better fit. One can then assert that the current model of AMI is significantly better than the Independence model, but not yet complete.

Another good measure to get a feel for how well the model fits the data, is the normed fit index (NFI). The model is deemed to be a good fit to the data if the NFI value for the model is about 0.9. With this exploratory model we have not achieved this threshold with a NFI for AMI of 0.694. This does reinforce the assertion that the model is approaching statistical significance, but is need of refining further.

4.10 Summary

The SEM analysis of the model of AMI has shown that the model is a good exploratory step towards a robust model of the Adoption of Mobile Internet in SSA. It has a reasonable goodness-of-fit to the data, but falls short of being an acceptable fit. However, given that this research is exploratory this level of association between the model and data is welcomed and may be built on in the future.

The direct connector between ServProv and AMI has been removed from the model as this was not supported by the data. ServProv still maintains an influence on AMI through a strong causal link with Digital Content. Similarly, the link between crowd adoption and AMI was removed with an indirect influence existing through Digital Literacy. The link between Income and Education was also not support in the data as an significant influence on AMI.

The SEM analysis has also shown that the total cost of ownership model element has less impact on AMI than first contended. This is somewhat counter intuitive but supported in observations during the field work.

Through considering the standardised regression weights and confidence of each causal link in the model, a new iteration is presented as follows:

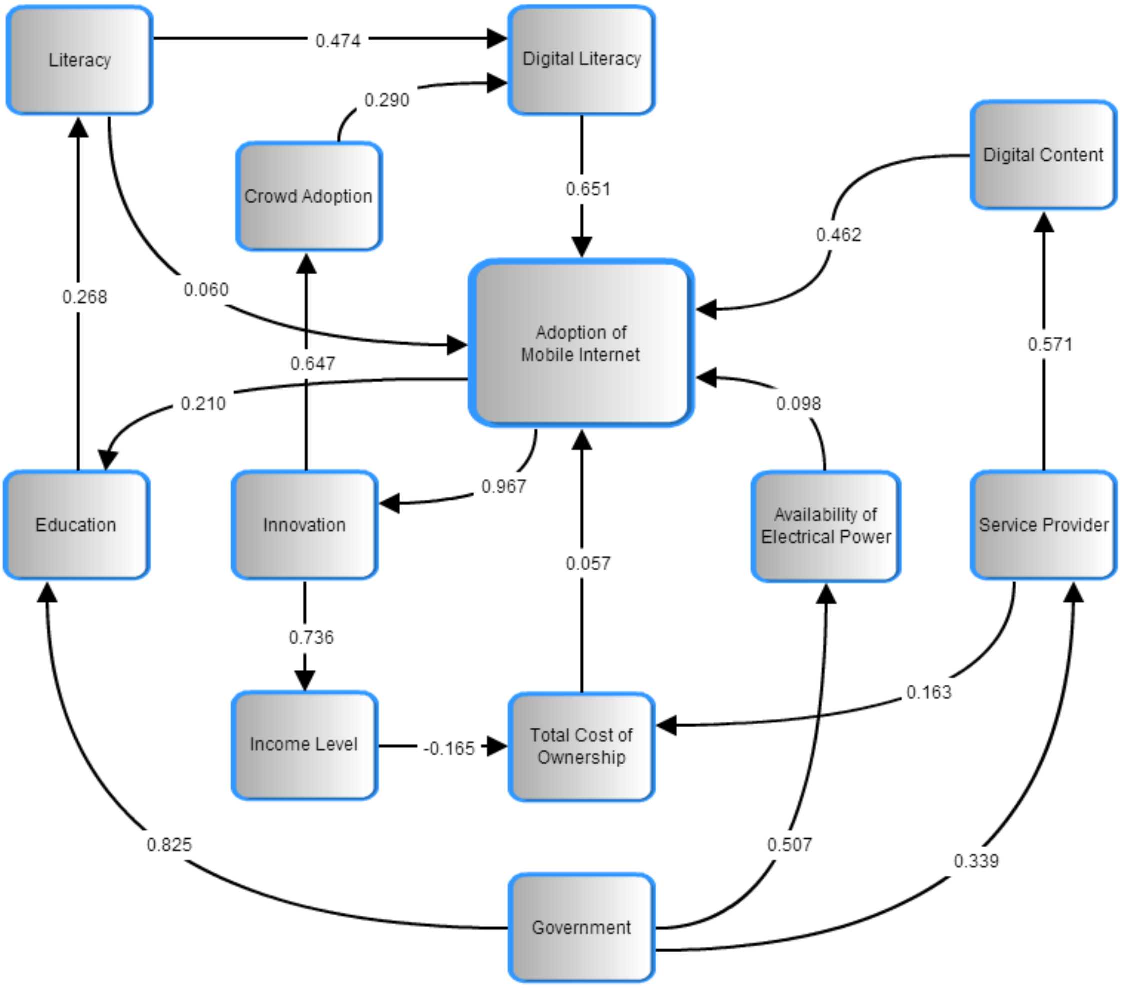


Figure 4-8: Model of AMI post SEM with standardized regression weights

This model will be carried forward into the next Chapter where it will be used to inform and develop a model to aid the simulation of AMI.

Chapter 5. **Simulation Model**

The previous Chapter demonstrated through SEM that the model of AMI showed a reasonably good fit with the published data from 113 countries. A revised model of AMI in SSA was informed from the SEM analysis and presented in Figure 4-8. This model quantifies the causal association of linked elements which are derived from the value of the standardized regression weighting indicated by SEM analysis. These values have been used as influence factors for the model constructs in the simulation, in order to derive a standard score for each country of the rate of change of AMI over many iterations. We use these standard scores and correlate them against the Human Development Index (HDI) to test the assertion that AMI is significantly correlated to HDI.

5.1 Model construction

Simulation models are an important tool in enabling the behaviour of systems to be explored, optimised and understood. The purpose of this simulation model is to check the validity of the model of AMI by calculating values of AMI over a number of iterations and testing to see if there is a correlation between the derived values and the level of development in that country. If the correlation is strong then we may assert the model is more likely to be adequate in describing the adoption of mobile Internet in SSA?

Discrete modelling packages such as “Simul8” were considered to implement this first pass simulation, but these were felt to be too restrictive as they are designed to model process flows rather than model causal influences. Consequently, the model was developed using the Microsoft Excel Programme. The quantified values associated with the AMI SEM model are used as the static values for the simulation model.

		To											
	Standardized Regression Weighting	Adoption of Mobile Internet	Literacy	Digital Literacy	Crowd Adoption	Availability of Electrical Power	Digital Content	Education	Innovation	Service Provider	Income Level	Total Cost of Ownership	Government
From	AMI								0.967				
	Literacy	0.06		0.474									
	Digital Literacy	0.651											
	Crowd Adoption	0.29		0.29									
	Availability of Electrical	0.098											
	Digital Content	0.462											
	Education	0.21	0.268										
	Innovation				0.647						0.736		
	Service Provider						0.57					0.163	
	Income Level							-0.09				-0.165	
	Total Cost of Ownership	0.057											
	Government					0.507		0.825					

Table 5-1: Table of model element influences derived from the Standardized Regression Weights from AMOS

These values are then used in an iterative simulation model that regress the values for each model element using the following formulae:

$$\in_{(T-1)} = \in_{(T0)} - S_{\in} \sum \left\{ \frac{\beta_v}{S_v} \left(\in_v - \bar{\in}_v \right) \right\}$$

Equation 5-1: Equation for the simulation of model elements to regress one step

Explanation of terms used in the equation:

$\in$ is the model element being iterated

$\in_{(T-1)}$ is the value of model element after one regression step

$\in_{(T0)}$ is the value of the model element before the regressive step

$S_{\in}$ is the Global Standard Deviation of the model element

β_{v} is the Standardized Regression Weighting for the connecting model element

S_{v} is the Global Standard Deviation of the connecting model element

$\in_{v}$ is the current value of the connecting model element

$\overline{\in}_{v}$ is the global average value of the connecting model element

The values for the Global Standard Deviations and Global Averages along with the T0 value for each variable are derived from the global data shown in

Appendix Eight: Data used for the simulation mode. A table summarising these values is shown as:

	Global Average	Global StDev	T0
AMI	0.00	2.48	-3.00
Litry	89.48	13.62	91.86
DigLit	41.34	29.95	5.32
ElecPwr	4858.22	6588.00	641.69
Content	5.09	0.89	3.41
Educ	3.80	0.92	4.49
Innov	0.00	1.84	-2.59
Income	16330.29	20300.48	594.50
TCO	0.35	0.22	0.16
CrowdAdop	5.23	0.75	4.10
Government	3.98	0.89	3.06
ServProv	0.35	19.60	80.00

Table 5-2: Initial T0 Value, Global Standard Deviation and averages for each model element

Therefore, as Literacy (Lit) is influenced in the model of AMI by Education (Edu) by a Standardize Regression Weight of 0.268 (see Table 5-1) the T-1 value for Literacy may be calculated as follows:

$$Lit_{(T-1)} = Lit_{(T0)} – (SD_{(LitGlobal)} \times ((SRW_{(Edu)} / SD_{(EduGlobal)}) \times (Edu_{(T0)} – Edu_{(GlobalAverage)})))$$

Equation 5-2: Simulation equation for deriving Literacy at T-1

Looking at the Literacy value in Zimbabwe which has a T0 value of 91.86, we may derive the value of $Lit_{(T-1)}$ as follows:

$Lit_{(T-1)}$ = 91.86 – (13.62 x ((0.268/0.92)x(4.49-3.80)))

$Lit_{(T-1)}$ = -89.52

This indicates that literacy rates reduced as we regress in time. This is an expected result.

Microsoft Excel was used to simulate the casual effect due to connecting model elements as specified by the Standardised Regression Weights in Table 5-1.

As this thesis is concerned with the adoption of mobile Internet in sub-Saharan Africa we will consider the derived values for AMI by applying the standardized regression weighting provided from the SEM analysis and apply this to the 12 model elements for 6 iterations. The calculated AMI values, averaged over the 6 iterations for each of the 113 countries in the data set, are then presented. This yields an Average AMI change per iteration for each country that is derived from calculating the influence of each connected model element as defined by the standardized regression weighting in Table 5-1. The normalised average rate of change of AMI for each country is then calculated using the standard score method, which indicates by how many standard deviations the datum is below or above the mean.

$$z_{AMI} = \frac{x_{AMI-} \mu_{AMI}}{\sigma_{AMI}}$$

Equation 5-3: Calculating the AMI standard score

This standard score is correlated, using the Pearson Product-Moment Correlation Coefficient, with the Human Development Index (UNDP 2011), which is used as an accepted measure of a country's citizens' well-being. This is to determine whether there is a correlation between the rates of change of AMI, as predicted by the model of AMI in SSA, and the development of the country. The equation for calculating the correlation is:

$$Correl\ (X,Y) = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \overline{\overline{x}})^2 \times \sum(y - \overline{\overline{y}})^2}}$$

Equation 5-4: Equation for Pearson Product-Moment Correlation Coefficient

The equation for Pearson Product-Moment Correlation Coefficient (Equation 5-4) may be found in Microsoft Excel within the function of CORREL (array1, array2) - where array1 and array2 are the two datasets being tested for correlation. When the correlation coefficient is near zero we may deduce that there is no linear association between the variables. A strong correlation exists if the correlation coefficient reaches ± 1. The level that the correlation coefficient asserts that the linear association between the two variables is significant, is dependent on the sample size used and the level of significance for the two-tailed test.

	Level of significance for two-tailed test			
DF (N-2)	0.1	0.05	0.02	0.01
1	0.988	0.997	0.9995	0.9999
2	0.9	0.95	0.98	0.99
3	0.805	0.878	0.934	0.959
4	0.729	0.811	0.882	0.917
5	0.669	0.754	0.833	0.874
6	0.622	0.707	0.789	0.834
7	0.582	0.666	0.75	0.798
8	0.549	0.632	0.716	0.765
9	0.521	0.602	0.685	0.735
10	0.497	0.576	0.658	0.708
11	0.476	0.553	0.634	0.684
12	0.458	0.532	0.612	0.661
13	0.441	0.514	0.592	0.641
14	0.426	0.497	0.574	0.628
15	0.412	0.482	0.558	0.606
16	0.4	0.468	0.542	0.59
17	0.389	0.456	0.528	0.575
18	0.378	0.444	0.516	0.561
19	0.369	0.433	0.503	0.549
20	0.36	0.423	0.492	0.537
21	0.352	0.413	0.482	0.526
22	0.344	0.404	0.472	0.515
23	0.337	0.396	0.462	0.505
24	0.33	0.388	0.453	0.495
25	0.323	0.381	0.445	0.487
26	0.317	0.374	0.437	0.479
27	0.311	0.367	0.43	0.471
28	0.306	0.361	0.423	0.463
29	0.301	0.355	0.416	0.456
30	0.296	0.349	0.409	0.449
35	0.275	0.325	0.381	0.418
40	0.257	0.304	0.358	0.393
45	0.243	0.288	0.338	0.372
50	0.231	0.273	0.322	0.354
60	0.211	0.25	0.295	0.325
70	0.195	0.232	0.274	0.302
80	0.183	0.217	0.256	0.284
90	0.173	0.205	0.242	0.267

100	0.164	0.195	0.23	0.254

Table 5-3: Table of Critical values for Pearson's test

For a sample size of 113 countries, to demonstrate a significant result, the critical value for the coefficient(r) would be r>0.164 for P=0.9 or r>0.254 for P=0.99.

5.2 Results

The Standardized Regression Weights shown in Table 5-1 were applied to each model element as detailed in Equation 5-1. A table of the weight of each variable for each country over 6 iterations was derived using Microsoft Excel programme. These indicators for AMI for each country were then aggregated to find an AMI/iteration rate of change over 6 iterations. The results are presented in the Table 5-4 on the second column marked AMI.

The third column of Table 5-4 shows the AMI standard score (normalised) which was derived from Equation 5-3. The Mean and the Standard Deviation for the AMI normalised for all 113 countries were calculated to be:

Mean of $AMI_{normalised}$ = 0.177

SD of $AMI_{normalised}$ = 38.864

Country	AMI	Normalised	HDI	Country	AMI	Normalised	HDI
AGO	5.78	0.14	0.49	LTU	-1.32	-0.04	0.81
ARE	-8.39	-0.22	0.85	LUX	-7.44	-0.20	0.87
ARG	4.40	0.11	0.80	LVA	0.27	0.00	0.81
ARM	9.59	0.24	0.72	MAR	-4.40	-0.12	0.58
AUS	-7.28	-0.19	0.93	MDA	3.59	0.09	0.65
AUT	-5.77	-0.15	0.89	MDG	3.66	0.09	0.48
AZE	9.27	0.23	0.70	MEX	3.73	0.09	0.77
BEL	-10.07	-0.26	0.89	MKD	-0.89	-0.03	0.73
BGR	3.91	0.10	0.77	MLT	-9.28	-0.24	0.83
BHR	-9.88	-0.26	0.81	MNE	4.94	0.12	0.77
BOL	6.99	0.18	0.66	MNG	6.14	0.15	0.65
BRA	3.00	0.07	0.72	MOZ	-2.68	-0.07	0.32
BWA	4.76	0.12	0.63	MRT	2.69	0.06	0.45
CAN	-10.70	-0.28	0.91	MUS	-0.03	-0.01	0.73
CHE	-11.17	-0.29	0.90	MWI	-1.51	-0.04	0.40
CHL	3.49	0.09	0.81	MYS	-1.09	-0.03	0.76
CHN	-1.86	-0.05	0.69	NAM	5.31	0.13	0.63
CMR	4.11	0.10	0.48	NGA	-2.07	-0.06	0.46
COL	4.49	0.11	0.71	NIC	5.40	0.13	0.59
CYP	-3.90	-0.10	0.84	NLD	-10.38	-0.27	0.91
CZE	-3.69	-0.10	0.87	NOR	-8.91	-0.23	0.94
DEU	-7.02	-0.19	0.91	NPL	0.20	0.00	0.46
DOM	6.72	0.17	0.69	NZL	-8.41	-0.22	0.91
ECU	4.57	0.11	0.72	OMN	-0.80	-0.03	0.71
EGY	2.50	0.06	0.64	PAN	10.89	0.28	0.77
ESP	-1.35	-0.04	0.88	PER	5.33	0.13	0.73
EST	-4.09	-0.11	0.84	PHL	5.95	0.15	0.64
ETH	-6.63	-0.18	0.36	POL	0.27	0.00	0.81
FIN	-5.20	-0.14	0.88	PRT	-1.26	-0.04	0.81
FRA	-4.08	-0.11	0.88	PRY	9.57	0.24	0.67
GBR	-5.35	-0.14	0.86	QAT	-10.65	-0.28	0.83
GEO	8.85	0.22	0.73	ROU	1.21	0.03	0.78
GHA	1.15	0.03	0.54	RUS	2.21	0.05	0.76
GMB	-7.90	-0.21	0.42	RWA	-0.19	-0.01	0.43
GRC	1.31	0.03	0.86	SAU	-3.60	-0.10	0.77
GTM	3.01	0.07	0.57	SEN	-6.47	-0.17	0.46
HKG	-3.28	-0.09	0.90	SGP	-9.25	-0.24	0.87
HND	7.43	0.19	0.63	SLV	6.16	0.15	0.67
HRV	1.47	0.03	0.80	SRB	3.62	0.09	0.77
HUN	-3.20	-0.09	0.82	SVK	-2.02	-0.06	0.83
IDN	4.51	0.11	0.62	SVN	-3.09	-0.08	0.88
IND	-3.58	-0.10	0.55	SWE	-6.75	-0.18	0.90
IRL	-4.93	-0.13	0.91	SYR	-1.28	-0.04	0.63
ISL	-16.24	-0.42	0.90	THA	5.03	0.12	0.68
ISR	-1.18	-0.03	0.89	TJK	7.81	0.20	0.61
ITA	2.82	0.07	0.87	TUN	1.48	0.03	0.70
JAM	3.21	0.08	0.73	TUR	-0.25	-0.01	0.70
JOR	-1.87	-0.05	0.70	TZA	4.01	0.10	0.47
JPN	6.42	0.16	0.90	UGA	2.52	0.06	0.45
KAZ	6.02	0.15	0.75	UKR	3.21	0.08	0.73
KEN	3.40	0.08	0.51	URY	0.32	0.00	0.78
KGZ	6.14	0.15	0.62	USA	-3.98	-0.11	0.91
KHM	1.97	0.05	0.52	VEN	8.65	0.22	0.74
KOR	-1.80	-0.05	0.90	VNM	4.39	0.11	0.59
KWT	3.08	0.07	0.76	ZAF	7.10	0.18	0.62
LKA	3.69	0.09	0.69	ZWE	6.21	0.16	0.38
LSO	8.53	0.21	0.45				

Table 5-4: Average Rate of change of AMI, standardised with HDI for 113 countries.

To test the assertion that the simulated rate of change of AMI, as influenced by the factors in the model (Figure 4-8), has a linear associate with the Human Development Index - an indicator for the development within a country, we must calculate the Pearson Product-Moment Correlation Coefficient between the two data sets as described in Equation 5-4. For a sample size of 113 countries, to demonstrate a significant result the critical value for the coefficient(r) would be r>±0.164 for P=0.9 or r>±0.254 for P=0.99 (Table 5-3).

The equation for Pearson Product-Moment Correlation Coefficient (Equation 5-4) may be found in Microsoft Excel within the function of CORREL (array1, array2) where array1 was defined as the dataset for the AMI standard score (normalised) and array2 defined as the dataset for the Human Development Index.

The result of the Pearson Product-Moment Correlation Coefficient between AMI and HDI was -0.407. Given the sample size of 113 and a P value of 0.99, the coefficient must be greater than ±0.254. As the result gave an r value of -0.407 we can assert that there is a significant correlation between the derived AMI values and the development of a country.

5.3 Predictions from the model

Predictions will now be made for the adoption of mobile Internet by adapting Equation 5-1 to extrapolate rather than regress:

$$\in_{(T+1)} = \in_{(T0)} + S_{\in} \sum \left\{ \frac{\beta_v}{S_v} \left(\in_v - \overline{\in}_v \right) \right\}$$

Equation 5-5: AMI Predictive Algorithm

Explanation of terms used in the equation:

$\in$ is the model element being iterated

$\in_{(T+1)}$ is the value of model element after one progressive step

$\in_{(T0)}$ is the value of the model element before the progressive step

$S_{\in}$ is the Global Standard Deviation of the model element

β_v is the Standardized Regression Weighting for the connecting model element

S_v is the Global Standard Deviation of the connecting model element

$\in_v$ is the current value of the connecting model element

$\overline{\in}_v$ is the global average value of the connecting model element

Using normalised data from Appendix Five: Data used to refine the model of AMI, which presents values for globally accepted indices for the 114 countries which are mapped to the model, we are able to produce the table in Appendix 9 with values for T-6 to T+6 values of derived AMI.

The model indicates that the countries with the highest AMI index are currently Finland, Sweden, Republic of Korea, Norway and Hong Kong. The model predicts that in 6-years time that Iceland, Switzerland will join the countries with the highest AMI index with the Republic of Korea falling to 22nd and Hong Kong falling to 19th. It is interesting to note that countries that are encouraging innovation and the creation of digital content appear high on the AMI index.

The model indicates that the countries with the lowest AMI index are currently Ethiopia, Malawi, Mozambique, Madagascar, Nepal. The model predicts that in 6-years time that Mauritius, Colombia, Kingdom of Thailand, Philippines and Indonesia will replace the countries with the lowest AMI index. It is interesting to note that generally countries that have low regulatory frameworks appear on low on the AMI index. It is also worthy of mention that the huge CAGR of mobile Internet usage in SSA is consistent with the model's predictions as Ethiopia, Malawi, Mozambique and Madagascar all significantly improve their position.

Another finding from the predictions is that countries that score low on the innovations index are predicted to have low AMI ratings in 6 years time.

5.4 Summary

The model of AMI using the causal association of linked elements derived from the value of the standardized regression weighting indicated by SEM analysis (Figure 4-8) was successfully used to create a simulation model. The simulated model regressed the values of each of the model elements, under the influence of its connecting constructs in order to derive a standard score of the average rate of change of AMI for each of the 113 countries over 6 iterations. These standard scores were correlated against the Human Development Index (HDI) to successfully assert that AMI is significantly correlated to HDI at a P=0.99 level. This finding is a significant first use of the simulation model, although further refining of the model would be needed to broaden the scope of the model's inferred deductions.

Chapter 6. **Discussion and Conclusions**

The mobile phone is decreasing the traditional digital divide, increasing agency and has the potential to empower people and improved their livelihoods. Through SMS and other textually based communication methods, mobile phones are improving literacy rates for people in SSA. Mobile phones have potentially transformational powers in communities and bring the potential for global connectivity. They are changing spending patterns and cross boundaries of gender, age, education and wealth. This unprecedented adoption of mobile phones is revolutionising how societies operate and interact.

6.1 Discussion

This Chapter gathers and discusses the findings from a model that seeks to adequately describe the adoption of mobile Internet (AMI) in sub-Saharan Africa (SSA).

The model constructs of AMI in SSA were identified through a triangulation of a literature review (Chapter 2), field work (Chapter 3.3.1) and expert comment (Chapter 3.3.2). They were defined as: literacy; education; crowd adoption; innovation; income level; digital literacy; total cost of ownership; government regulation; electrical power; digital content; content creation tools, internet enabled handsets and service provision (Figure 3-8).

By using Structural Equation Modelling (Chapter 4), Standardized Regression Weightings were derived to quantify both the significance and the effect of the causal links between the model elements shown to influence AMI (Figure 4-5 and Figure 4-6). A measure of the “goodness-of-fit” of the overall model of AMI to published datasets was investigated. A revised model of AMI in SSA was created that omitted “Internet enabled handsets” and “content creation tools” as these were found to be already represented in existing model elements (Figure 4-8).

The new model of AMI in SSA informed a rudimentary simulation model (Chapter 5) which was used to test the assertion that the rate of AMI is correlated to the development status of the country.

A summary of the research methodology is shown below:

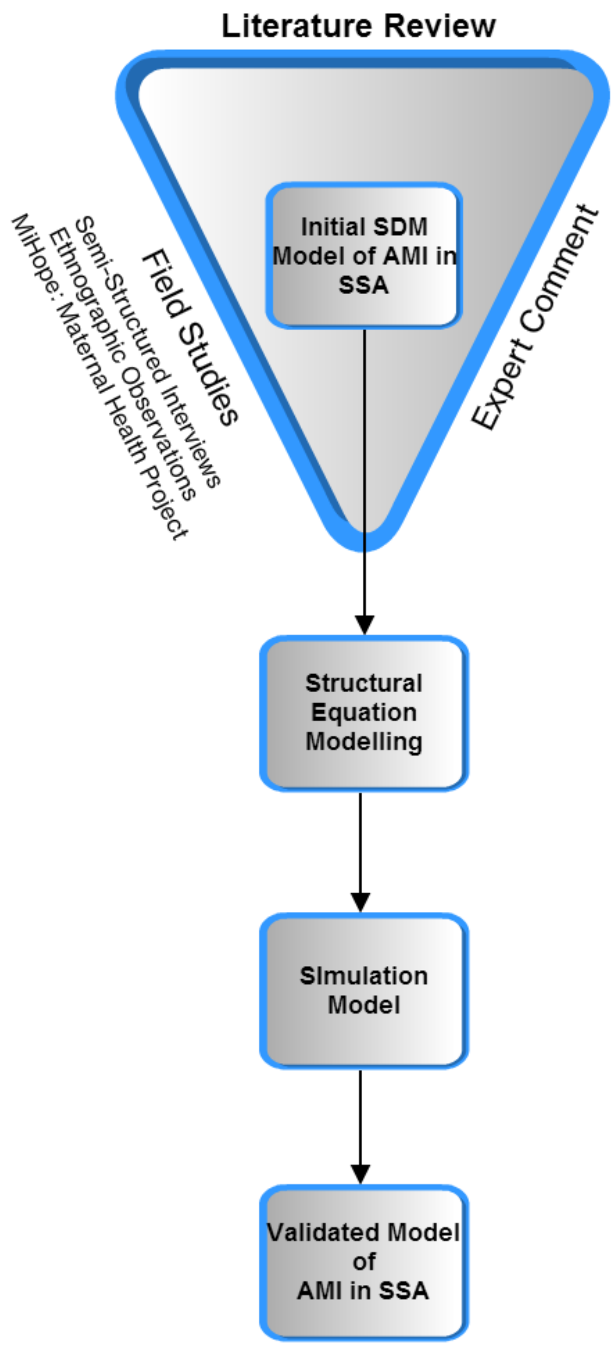


Figure 6-1: Summary of methods for investigating the research question.

6.2 Summary of the results and findings

A review of the main results and findings of the previous Chapters is included here to enable a rigorous review and discussion of the post-hoc validity of the posited model of the adoption of mobile Internet in sub-Saharan Africa.

A review of the literature suggested the following model elements

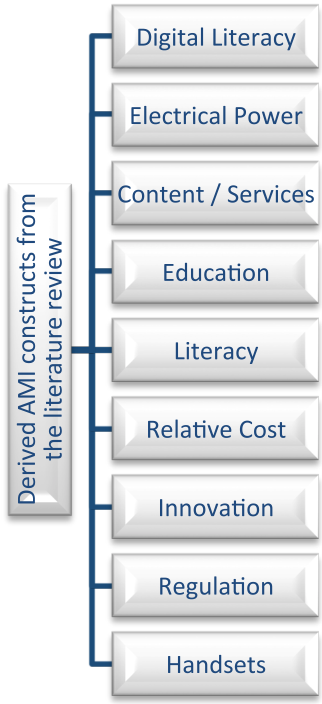


Figure 6-2: Constructed for a model of the adoption of mobile Internet in sub-Saharan Africa derived from the literature review

Field work findings confirmed that mobile phone usage is widespread in SSA amongst all generations in both rural and peri-urban communities. Purchase of airtime credit has changed spending priorities, but the lack of finances means that handsets are without credit for up to 50% of the week or month. People feel more empowered by using mobile phones and feel they have a voice. Mobile phones are used amongst all age groups for blogging, emailing, Mxit, Facebook, music, taking photographs, alarms, calling, and listening to the radio. People in South Africa, where the adoption of mobile Internet is high, are more likely to use data communication than voice communication. In the investigation, many of the young adults in rural South Africa use their airtime to research information online for assignments.

The South African context has a high uptake of mobile Internet usage which has been driven by social media platforms such as Mxit, the availability of handsets which afford Internet connectivity and the low cost of airtime/data. Barriers to the adoption of mobile

Internet were identified as the difficulty in setting up the handsets to connect to the Internet. This was adoption was not observed in Malawi or Zambia, although some evidence was found for a growing adoption in Kenya.

Comments from the experts highlighted the disparity of the cost of handsets between Zambia, Malawi and Kenya. Battery life was stated as one of the limiting factors on mobile phone adoption, given the intermittent provision of electricity in SSA. People ration their use of the phone because of the battery running out of charge. The pricing models of mobile phone operators are not good for encouraging poor people to purchase data as the data chunks are very large to buy and difficult to understand.

The East African field work confirmed that people are no less likely to have a mobile phone if they live in a poorly connected rural context than in a peri-uban or urban context. Even the acutely poor will strive to own a mobile phone. Service providers in the various countries offer differing levels of support and competency in enabling customers to connect to mobile Internet using appropriate handsets.

The cost of usage of mobile devices in SSA is proportionately very high compared to income levels, but this does not seem to dampen mobile related spending with many of the rural people spoken to spending between 40% - 70% of their money on airtime. Very few people had post pay contracts with most people topping up with airtime vouchers. The pricing models for Internet data are not easy to understand for the average East-African and for the acutely poor; this is a barrier to using the Internet on their mobile devices. Many handsets in rural East-Africa are not yet Internet capable, but there was anecdotal evidence that this is changing.

Four 2-week visits were made during 2010-11 to the MiHope participants in rural Zambia and Malawi. During the field visits I observed that there are long periods of “down-time” in countries where mobile services are not available. This is almost expected by the people, as it is true for many of the things in their lives such as water, electricity and the provision of medicines. Digital Literacy, or more specifically mobile literacy, was low and significant help was needed to train people in using the mobile phone solution developed for the project and embracing the new technology of a touch screen device. People found it easiest when trained by one of their peers in a social setting rather than in the class room. In Zambia you have to register every month to continue to use the data services on a mobile phone, even if you have used it the previous month and have credit on your pay-as-you-go SIM. This presents a serious barrier to AMI in SSA. Most mobile phone applications are developed in the global north, where relatively cheap, reliable and ubiquitous Internet connections are available. However, any application or service deployed in SSA needs to be able to support a sometimes-connected environment. Off-line caching is essential as is synchronization when the device is reconnected. People generally are ill-informed and therefore nervous about using data because they neither understand the measure of a MB or how much they are using to access information or services. The deployment of solar panels to charge the cell phones was a success, enabling the phones (plus three others) to remain charged without needing to have them charged at an outlet. The robustness of handsets was a challenge, with a 15% failure rate during the course of the 6-month pilot project. The phone was a recognized status symbol that motivated the project participants to work harder, be happier and feel valued. Having a phone also gave the project participants status within their communities and afforded them opportunities they did not have before to speak with groups and people. People seemed to trust information presented on a mobile phone more than printed or verbal communication. Low Digital Literacy rates were not a barrier for the project participants in using the technology, but the language of the information content was an issue for those who could not read English . Using mobile chat rather than SMS was so cheap that the supplied airtime enabled volunteers to communicate freely and often.

Drawing together the findings from the literature review, field work and expert comment informed an initial model to describe the adoption of mobile Internet in sub-Saharan Africa as follows:

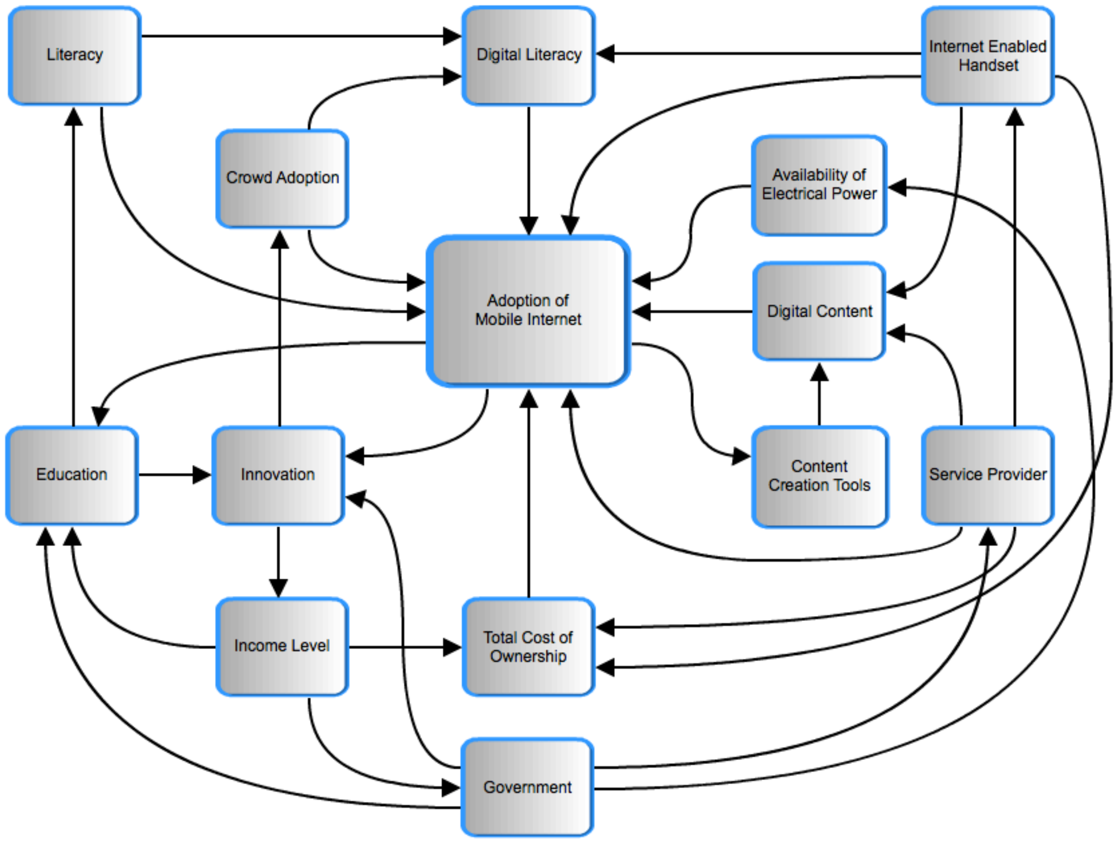


Figure 6-3: Initial Model to predict the adoption of Mobile Internet in SSA

The SEM analysis of the initial model of AMI shows that the model is a good exploratory step towards a robust model of the Adoption of Mobile Internet in SSA. It has a reasonable goodness-of-fit to the data (60-70%), but falls short of being a statistically good fit. However, given that this research is exploratory, this level of association between the model and data is adequate and encourages model refinement in the future. The direct connector between ServProv and AMI has been removed from the model as this was not supported by the data. ServProv still maintains an influence on AMI through a strong causal link with Digital Content. Similarly, the link between crowd adoption and AMI was removed with an indirect influence existing through Digital Literacy. The link between Income and Education was also not supported in the data as a significant influence on AMI.

The SEM analysis has also shown that the "total cost of ownership" model element has less impact on AMI than first contended. This is somewhat counter intuitive but supported in observations during the field work, where the motivation for mobile phone ownership and usage seemed to outweigh other considerations.

Through considering the standardised regression weights and confidence of each causal link in the model, a new iteration is presented as follows:

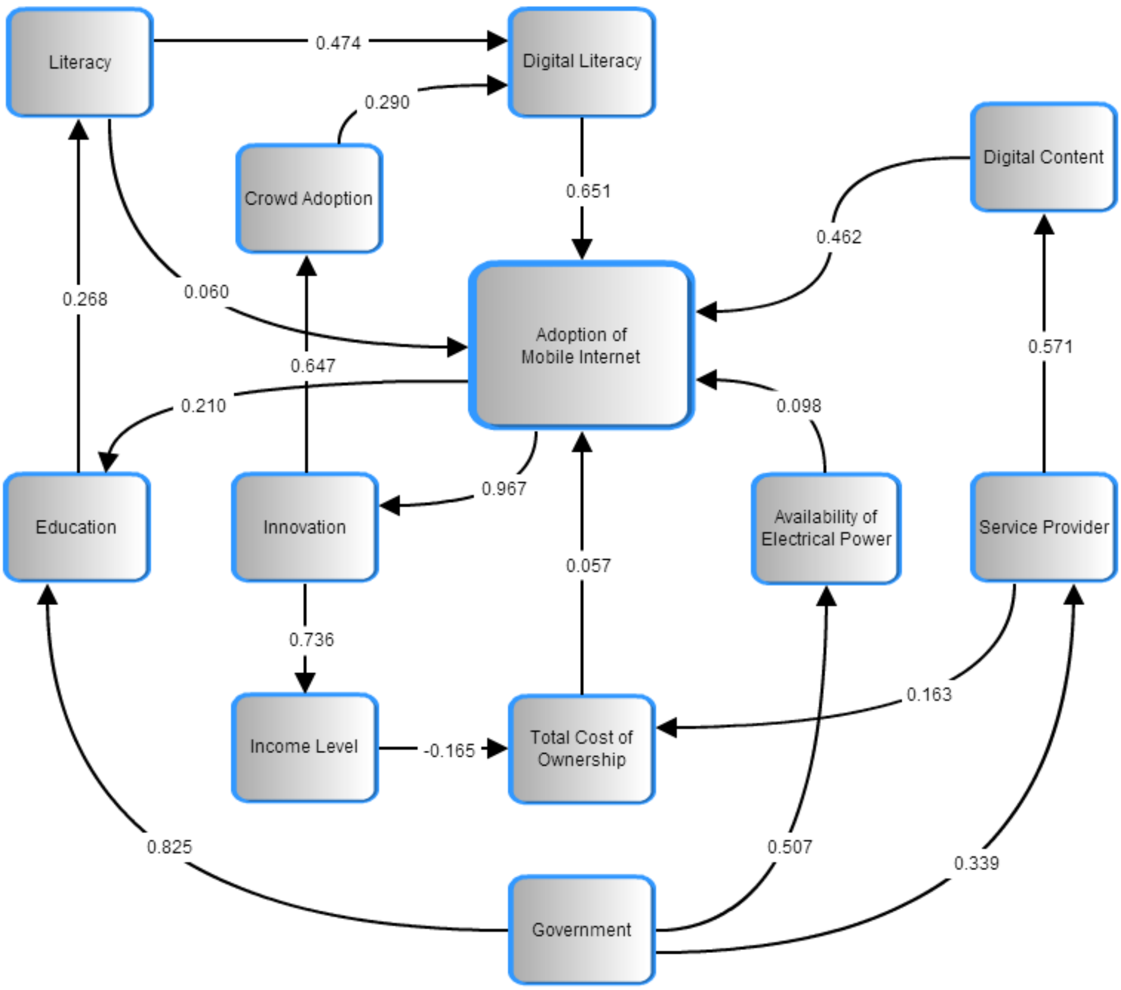


Figure 6-4: Final model of AMI post SEM with standardized regression weights

The model of AMI using the causal association of linked elements derived from the value of the standardized regression weighting indicated by SEM analysis (Figure 4-8), was successfully used to create a simulation model. The simulated model regressed the values of each of the model elements to derive a standard score of the average rate of change of AMI for each of the 113 countries over 6 iterations. These standard scores were correlated against the Human Development Index (HDI) to successfully assert that AMI is significantly correlated to HDI at a P=0.99 level. This finding is a significant first use of the simulation model, although further refining of the model would be needed to broaden the scope of the model's inferred deductions.

The strongest Standard Regression Weighting directly influencing AMI are Digital Literacy (0.651) and Digital Content (0.462). The model would suggest that addressing these two factors would yield the greatest impact on AMI. Digital Literacy is best gained through social learning rather than formal learning and is likely to be naturally emergent , however a catalyst is needed to provide relevant services and content for the people of SSA. As smart phone devices, mainly Android variants, begin to become adopted in SSA, applications that are mindful of the energy, cost and speed constraints of using mobile phones in SSA are needed. These applications will be likely to come from the number of growing mobile innovation hubs such as iHub in Nairobi and Rlabs in Cape Town.

The largest indirect influence on AMI is Literacy (0.474 x 0.651 = 0.309). This is not surprising as the majority of digital content that is accessible to people in a constrained environment would be of a textual nature. Being able to read and understand the information is an intrinsic requirement and explains why this is the largest indirect influence on AMI. As the price of data and the class of handset improves, mobile Internet users will be able to access multimedia content which will reduce the need for literacy over time.

The second largest indirect influence on AMI is Service Providers (0.571 x 0.462=0.194). The role of Service Providers is crucial in ensuring that the adoption of mobile Internet reaches those at the base of the pyramid in sub-Saharan Africa. Ensuring that low-income appropriate data tariffs are offered alongside affordable, robust handsets is essential in ensuring the general populous of SSA is afforded the benefits of being online. In order to encourage AMI, Service Providers must make the process of setting up the mobile phone and SIM card for data an automated process rather than a cumbersome and fragile process that needs to be completed monthly in some countries in SSA.

It is interesting to note that AMI strongly influences the Innovation and Educational levels the model. Both of these model elements then impact AMI indirectly: for Innovation through a route of Income level > Total Cost of Ownership > AMI and Crowd Adoption > Digital Literacy > AMI; and for Education through a route of Literacy > Digital Literacy > AMI. One would expect the opportunity of increased adoption of mobile Internet to yield greater innovation across multiple business segments and the availability of information to increase educational levels.

6.3 Conclusions

Mobile phones in SSA are beginning to afford ordinary people the opportunity to connect to the Internet to access both information and services. Whilst the provision of mobile Internet has arrived in SSA the adoption of this technology has been variable from country to country.

From a triangulation of a literature review, field work and expert comment, a model was defined and then refined through structural equation modelling. As this research is of a exploratory nature, this model of AMI was shown to have an adequate goodness-of-fit to published datasets. Standardized Regression Weightings were calculated for each of the statistically significant connections which could then be used to run a simulation where the model predicted AMI values which where correlated with the Human Development Index to show that there is a strong correlation between AMI and the development context.

The posited model for AMI in SSA is given as:

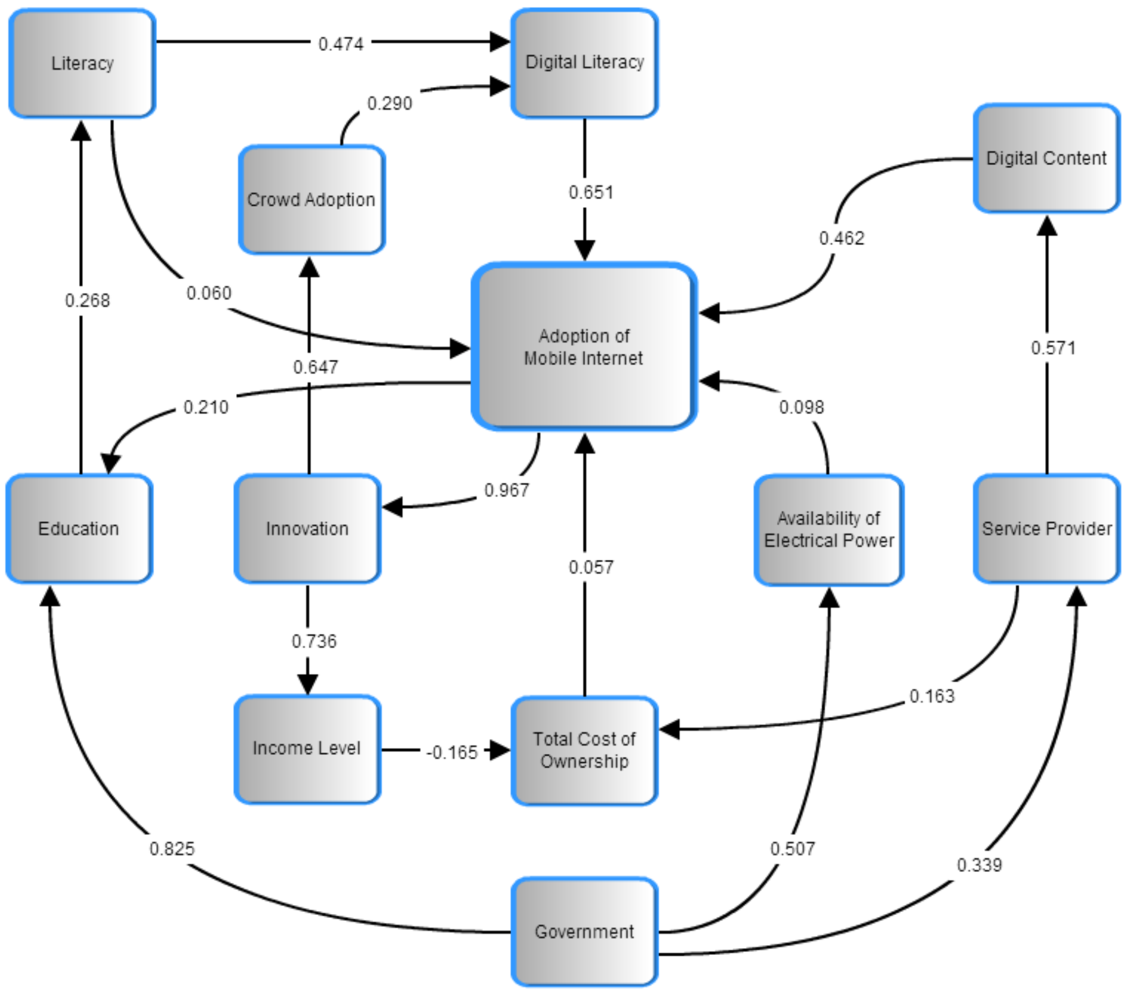


Figure 6-5: Final model of AMI post SEM with standardized regression weights

The two key influences for the adoption of mobile Internet in SSA are Digital Literacy and Digital Content.

The two key indirect influences of AMI in SSA are Literacy and Service Provider which in turn is strongly influenced by government legislation and the regulatory framework.

The model predicts that both Education and Innovation are significantly impacted by an increase in the Adoption of Mobile Internet.

The importance of Digital Content reinforces the conviction that the proposed BluPoint solution which offers free digital content to people living in constrained environments would be a suitable technology to offer in SSA (Appendix 2).

6.4 Contribution

The unique contribution of this thesis is to posit a model that describes the key components that influence the adoption of mobile Internet in sub-Saharan Africa. The model is derived through a mixed methods approach and refined through structural equation modelling to produce a model of exploratory significance. The model elements causal influences that are of statistical significance are then quantified which informs a simulation model. This simulation model shows a strong correlation between AMI and the degree of development of a country. The author is not aware of any model of this type and so offers this work as a unique contribution. It is expected that the model will act as a strategic tool for government policy makers in sub-Saharan Africa seeking to encourage their citizens to use their mobile phones to join the growing global on-line community.

6.5 Future Work

Future work is split into three distinct areas:

Developing the Model

Further work refining the model of Adoption of mobile Internet in sub-Saharan Africa is required to achieve a statistically significant good-fit-to-data. This refining should involve a reassessing of the data used to map to the model. The analysis should also consider restricting the data set to countries in sub-Saharan Africa or those that are defined as least developed. A balance on restricting the sample size is required, as reducing the sample size will impact the Power of the analysis and may cause uncertainty in the derived result.

In order to refine the simulation, care must be taken to ensure the data used is absolute rather than relative as this can cause issues in making predictions of scale rather than of relative impact.

The connection between the Service Provider (ServProv) and Adoption of Mobile Internet (AMI) did not achieve a 95% confidence rate and received the lowest confidence rate of all the connections of less than 10%. As this connection has very poor support from the analysis it was dropped in the revised model. However, this result is so strongly countered in the triangulation research that further investigation into the failure of the data to support the hypothesis is required. It is perhaps a function of either the countries chosen in the dataset or the proxy data used to present these model elements.

Using the elements in the AMI model a comprehensive survey that tests the hypothesis that this is an adequate model should be conducted. Results would need to be gathered across a variety of countries and contexts in sub-Saharan Africa.

If the model is thought to hold for a wider context than sub-Saharan Africa, the survey should be gathered from countries outside of Africa.

BluPoint

An ever-growing reliance on the Internet is marginalising many people in rural LDC settings who may have Internet enable mobile phones but due to the relatively high cost of airtime they are unable to download data intensive materials and also spend up to 50% of their time without airtime credit. This results in potentially life changing information not getting to the people that need it the most. For example, there is a powerful South African advert for ARVs featuring a lady, Selinah who has HIV and agreed to film herself for 90 days to help others. The advert begins with a woman of healthy weight lying down in a bed and then the time-lapse begins. Her weight drops until she is near skeletal and hollow-eyed, a shell of her former self; AIDS taking its toll on her body, you think. It is only at the very end that you realise the reveal: it was all in reverse and shows the life-changing impact of taking regular HIV medicine (Antiretroviral drugs). With regular ARVs people are able to live with HIV rather than die from it. For people in LDCs who do not have access to TVs or even stable electricity supplies, this advert, and much digital information like it would never be viewed.

Development has been started on BluPoint, which is a solution to create an off-grid Bluetooth content server which deliveries free digital content in highly constrained environments. BluPoint, provides a physical content provisioning access point that is solar powered, to enable people in off-grid low-resource communities to access free digital materials (text, pictures and videos) free of charge on their mobile phones and create/share their own digital content. BluPoint uses Bluetooth as the main data transit as is it supported on both smart and non-smart phones alike. It is envisioned that BluPoint will be located in rural health centres, schools, commercial centres, taxis, water wells and other places that people naturally gather, and in time would create a mesh network. BluPoint will be used for content / service provision for commercial, health, government, local-community and entertainment sectors amongst these base-of-the-pyramid users. A transformational impact is made when digital materials are made available to people in general, but this effect is amplified for people living in low-income off-grid situations that have not readily had access to this content. The purpose of BluPoint is to make access to locally, nationally and internationally created digital content easy and free to users.

In 2010, 9 students (4 hardware and 5 software developers) undertook to develop a desk-based prototype of BluPoint as their final year project for the award of Master of Engineering to create a desktop proto-type of the BluPoint. Given the successful creation of a desktop prototype, future work includes developing BluPoint into a field based prototype and conducting a pilot study to determine the usefulness of the innovation in creating, sharing and distributing digital content in highly constrained environments. Funding for this development and a pilot program is needed.

Following the pilot project, exploring the notion of creating a mesh network of these devices across a wider area could be explored along with engaging the developer community to create applications that exploit this innovation.

A key part of any development of the BluPoint innovation would be to define a sustainable business plan to support the production, proliferation and maintenance of BluPoint. A place has been offered at the University of Southampton's Chilworth Business Park to develop both the technical specification and business plan for BluPoint.

Further information on BluPoint may be found http://www.blupoint.org/research

Influencing Policy

Further work needs to be undertaken to investigate the impact on the governmental policy and regulatory frameworks needed to encourage to grass roots adoption of citizen access to the Internet using mobile devices. The model of AMI presented in this thesis provides a good starting point to kick off discussions about the ecosystem of constructs that amplify and dampen people's engagement and uses of mobile Internet in LDCs. Further work needs to be done to develop a co-created charter of best practice that resonates with all the major stakeholders in the AMI ecosystem such as Mobile Service Providers, Educational Providers, Content providers, Business, Governmental Organisations, NGO's and of course the people themselves.

Encouraging easy affordable access to information is only part of the solution. Consideration should also be given to developing innovative methods to encourage the general populous to generate digital content pertinent to the contexts that they are part of. Ensuring Mobile Operators within countries are not engaged in oligarchy-type price fixing and suppression of the data services is vital. Encouraging innovation hubs where applications and content is locally derived, will help ensure that notions of digital imperialism are contained if not eradicated. Just as in the example of the Roman Roads which was touched on in the introduction, exploration of new business models and services that fit with this new age of international-connectivity and local-delivery should be investigated. Sub-Saharan Africa with its culture of high innovation and entrepreneurial spirit is well placed to dream a new dream that is mobile and cloud focused. Using open data to increase transparency and accountability is only transformatory if the information is translated into a form that people can both understand and access.

Without doubt, mobile technology and specifically mobile Internet has already had, and will continue to have, a dramatic impact on the lives of every global citizen. The policy and regulatory frameworks of AMI used in LDCs will determine in part the societal impact.

6.6 Concluding comments

This thesis posits a tested but exploratory model to describe the adoption of mobile Internet in sub-Saharan Africa. AMI is directly impacted by Digital Literacy levels and the availability of Digital Content. Large Indirect influences to AMI include the Service Providers and Literacy rates. AMI is shown to have a significant impact on Innovation and Education.

Further work is needed to refine the model and its predictive qualities but it serves a useful role in defining a starting point for future work. It is expected that the model will act as a strategic tool for government policy makers in sub-Saharan Africa seeking to encourage their citizens to use mobile Internet.

It is the authors sincere hope that the idea of BluPoint may be developed to serve the next 3 billion users of the Internet, who are likely to be mobile only users, to create and consume digital content for the betterment of themselves, their communities and their countries.

Appendix One: Field Work Summary Notes

Observations

In Cape Town CBD and Shopping Mall

In the Central Business District of Cape Town people were using their cell phones in a similar manner to people within the UK. Anecdotal observations were conducted of people freely using email, SMS, MIM and voice calls in cafés, shopping malls and other public areas. Evidence of connectivity using mobile phones and laptops using cellular networks was widespread. A discreet presence of security guards was noted in this area.

Mum 2.0 Group in Athlone, Cape Town

9th April 2010: A focus group of 20 ladies, who meet in a local coffee shop to attend a course called Mum 2.0 run by RLabs

1. 20 ladies are meeting weekly to learn how to use social media through their cell phone. The ladies range from their late 20s to early 70s, with many of them not being able to read or write. Literacy does not seem to hold back. These women use their cell phones to create and respond to social media. In the course the ladies are taught how to e-mail, Facebook, Twitter, blog and use Mxit, all from their cell phones. They are also taught how to download software, including Opera mini, on to their cell phones.

2. The key driver for the ladies engaging with social media is the ability for them to communicate with others about how they are feeling. Great value is placed on the fact that people will hear them and understand what they are saying. Previously, they did not think their opinions counted. The ladies related that they felt the Internet gave them equality through having a voice. They felt encouraged and saw the transformational potential of the Internet. They want to learn to use it so that they can communicate better with the kids in their community.

3. I spoke with two grandmothers: Cathy Pike, born in 1941 and Felicity of a similar age. They have both had mobile phones since 1990 and primarily use them to keep in touch with everyone else that has mobile phones. They also communicated that they use their cell phones to engage in the community.

Focus Group

A focus group discussion was held in Idutywa, comprising of 20 people of mainly Xhosa race, age range 17-70 and mixed gender. All gathered had a cell phone except one 17 year old girl. She seemed very shy and embarrassed that she did not have one.

For the context of this Focus Group I will use the following terms to group the recipients:

- Gender: Male [M], Female [F]
- Age : 12-20 [1], 20-50 [2], 50-100 [3]

For example a M2 is a Male aged 20-50

Question 1: What do you use your Cell phone to do?

- F2 - two cell phones to ensure she has coverage due to poor signal.
- M1 - Facebook, Internet, Games and voice calls
- M2 has one phone for SMS, games, Please Call Me, voice calls
- F2 – Calls, SMS, Games. Spend R5 a month
- F2 – Call, SMS, MMS, Music, Radio, Facebook, Internet, Email, Browsing, Pictures, Videos. Has a N70. Spends R30 a month although had spent R180 due to wedding arrangements
- M1 – Calls, SMS, MMS, Email, Facebook (2 accounts), Photos, Videos, games. Did not use Mxit.

- M1 – SMS (3 a day), Calls (30 minutes a time)
- M2 – Calls, SMS, pictures, videos, alarm clock, reminders
- F2 – Calls (5 per day), R30/month. First cell in 2000
- M3 – Calls, SMS, Please Call Me
- M2 – Calls (work and parents)
- M1 – Calls, SMS, Calculator, Alarm, Reminders (birthdays)
- F2 – Torch, Calls R10-R20/month
- F2 – Calls, Calendar, SMS, Music, Bluetooth
- F2 – Calls, SMS, Time, Music, Calculator, alarm, read news
- M1 – Calls, SMS, research, calculator, music, photos, video
- M2 – Calls, SMS, Clock, Alarm

Question 2: What do you value most about your cell phone?

- F2 – Communication
- F2 – Emergencies if someone is sick
- F2 – Getting information
- F2 – Radio
- M2 – Camera
- F2 - Feel connected to the world and connected with friends through Facebook
- M1 – Feel connected and always in contact

Other Notes

- Only two people in the group have access to a computer that has Internet.

- M1 “It is cheaper to get online with a Mobile phone than with a computer”. It costs R145 a month just to have a dial up account.

- People use Internet Cafés

- F3 left during the introduction to take a call on her cell phone. This did not raise an issue in the gathered group.

- Majority has used their cell phones to get access to banking facilities and to purchase airtime

- 10% had transferred airtime to other people

- Some had topped up electricity using their cell phone

- One person uses their cell phone to blog and two people had used their cell phone to Twitter.

- One person uses Facebook on their cell phone to communicate with youth leaders in his area

Interviews

Cape Town

Clive is 25 years old and lives in the Athlon region of Cape Town. Clive is currently in his 2^{nd} year of study in Software Development at CPUT. He was deeply involved in the drug scene in the area for 6 years and has been free from drug use and addiction for 4-years. He is currently taking a year off from his studies to assist RLabs as a social media trainer.

1. First cell phone in 2003 when 18 years old. Some of his friends had a cell phone. It was bought as a gift by his parents. He wanted one because many of his friends had one.

2. Currently has a Nokia N80 but would like a Blackberry.
   Uses the phone mainly to communicate and social media.

   a. Accessing the web – Facebook, Twitter, Mxit (friends, socialize, events, projects). Spends 45mins a day on Mxit. Has a self-imposed curfew of 12 midnight.

   b. SMS but this is out-dated. Costs too much airtime (75c). Cheaper on Mxit.

   c. Very few calls and games.

3. R200/month pre-paid. Opera mini cost 20c a page and is considered good value.

4. Thinks community has become LESS social as people use social media even if they are in a group. People are always looking down using Mxit. In some ways having a cell phone makes you feel less safe. He has had one cell phone stolen when he was mugged at 19 years old.

5. none

6. Would not be able to choose between a mobile and laptop computer. He has a desktop at home, but it is not connected 50% of the time.

7. Clive works with RLabs, which help to reconstruct and empower people within the Athlon community, in Cape Town. When asked how social media might empower people. He replied that social media helped people get their feelings out there, help them to get over drugs, help them connect with people in their community.

Male, 34 in Athlon, Cape Town.

Clinton is a married man with three children living in the Athlon area of Cape Town. Clinton was a gangster and leader of the infamous Americans gang in the Cape Flats. Clinton now works for RLabs, training others in their use of social media and also offering his services as an online counsellor.

1. Clinton got his first cell phone in 1997 when he was 20 years old. His first cell phone was a Nokia. His motivation for getting a cell phone was because everyone had one and it was seen as a status symbol. He now has a Nokia E 63+1 holds cell phone. He has more than two cell phones to separate out business and personal matters.
2. Clinton uses his cell phone for Twitter, receiving calls, Facebook, e-mail, Mxit (not too much), calendar, tasks, games, photos and video.
3. Clinton spends about 200 Rand a month on airtime. He only uses cause if he absolutely needs to, spending most of his airtime on data with the intent of always being online and available. Clinton manages his airtime to ensure that he is never off-line through lack of credit.
4. Clinton feels that cell phones have changed the life of the community. Mxit has caused schoolchildren in particular to become withdrawn and become easily distracted with online materials. It is also enabled children to research on the Internet for school projects and assignments. Cell phones have also increased fear within the community with many people being concerned about theft, and being mugged. Clinton has had one cell phone stolen through theft. He reported that is common practice to keep cell phones on silent and not to use them in public places. When walking down the street people would ask you to transfer airtime to their cell phone if they had run out. Clinton described this as similar to when somebody walked down the street smoking, and was stopped and asked for a spare cigarette or a drag of the cigarette you're smoking. Some eight or nine-year-olds within the community would have cell phones. It is more common for children to receive cell phones when they are 12 years old. Clinton has an eight-year-old, a four-year-old and a six-month-year-old baby. The eight-year-old enjoys using Clinton's cell phone for gaming - he does not own his own one yet.

5. Clinton looked very nervous when it was suggested that he did not have a cell phone, and merely implied that he would feel disconnected. Clinton's dream phone would be a Nokia N 900 or a Nexus One. Most young people aspire to own a smart phone, whereas seniors purely want a phone for connectivity.
6. Illiterate people are well able to use cell phones and Clinton has helped a number of seniors within the community in their cell phone usage. This includes making calls, sending SMSs and even engaging with Facebook and Twitter through their cell phones.

Interview business leader in Atherlon

On average teenagers in Cape Town spend R100 –R150 a month on airtime.

38% of disposable income in South Africa is spent on airtime.

There are 7 billion "please call me" messages sent on Vodacom.

There are four main mobile operators in South Africa currently: MTN which is mainly for middle and lower class people; Cell C, which are mainly prepaid (they offer a lot of innovative deals for example, midnight to midnight weekends free calling and free data to use Mxit); Virgin Mobile and Vodacom.

The vast majority of people within South Africa would be on prepaid rather than contract deals with mobile operators.

Mxit has a huge following within the South African market. It is used mainly by young people, although not exclusively. Many parents are very concerned about the use of Mxit as it opens up the possibility of undesirable online chat. Evidence of online languages IS emerging, which are a blend of the many dialects within South Africa.

Most children receive their first mobile between the age of 10 and 12 years old in South Africa. The main driver for having a mobile at that age would be connectivity and camera functionality.

Appendix Two: BLUPOINT – Community based hubs for transformation

Background

An ever-growing reliance on the Internet is marginalising many people in rural LDC settings who probably have Internet enable mobile phones but due to the relatively high cost of airtime are unable to download data intensive materials such as videos and also spend up to 50% of their time without airtime credit. This results in potentially life change information not getting to the people that need it the most. For example, a powerful South African advert for ARVs featuring a lady, Selinah who has HIV and agreed to film herself for 90 days to help others. The advert begins with a woman with healthy weight lying down in a bed and then the time-lapse begins. Her weight drops until she is near skeletal and hollow-eyed, a shell of her former self, AIDS taking its toll on her body. It's only at the very end that you realise the reveal, it was all in reverse. For people in LDCs who do not TVs or even stable electricity supplies, this advert, and much digital information like it would never be viewed.

In order to transform communities in poverty Nimbus[4] has developed the following framework.

[4] www.nimbus.mobi

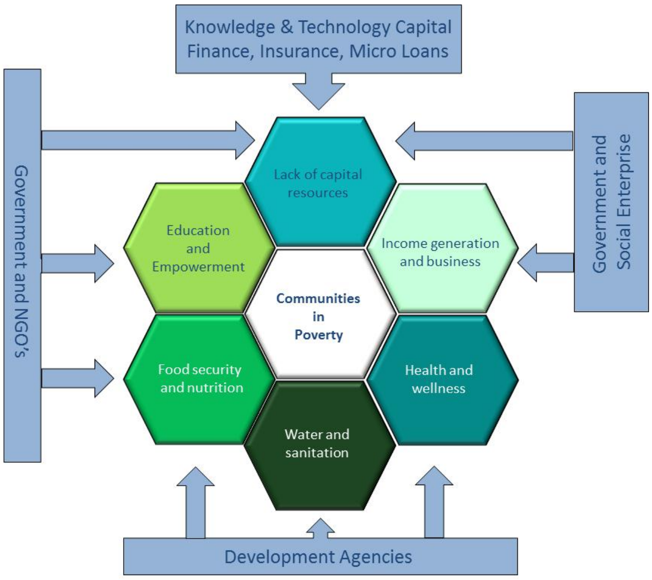


Figure 0-1: Nimbus Framework for empowering communities in poverty

BluPoint will allow young people to access information, free of charge, from their mobile phones, even when out of credit. The Bluetooth unit will have a cache memory to store information so that users are not reliant on continuous connectivity. To manage content and updates, the Bluetooth unit can be connected to the Internet via either 3G, GPRS, or Broadband. Should none of these modes of connectivity be available, information can be accessed and transferred manually using a USB memory stick.

Concept

The BluPoint concept is scalable and will be utilised for enabling behavioural change within the host community. It will engage with people using mobile phones, and provide free access using Bluetooth, to relevant and culturally sensitive information. Our application will contain a platform for peer-to-peer social networking using Mobile Instant Messaging (MIM), which will be harnessed to encourage people to make changes to their behaviour.

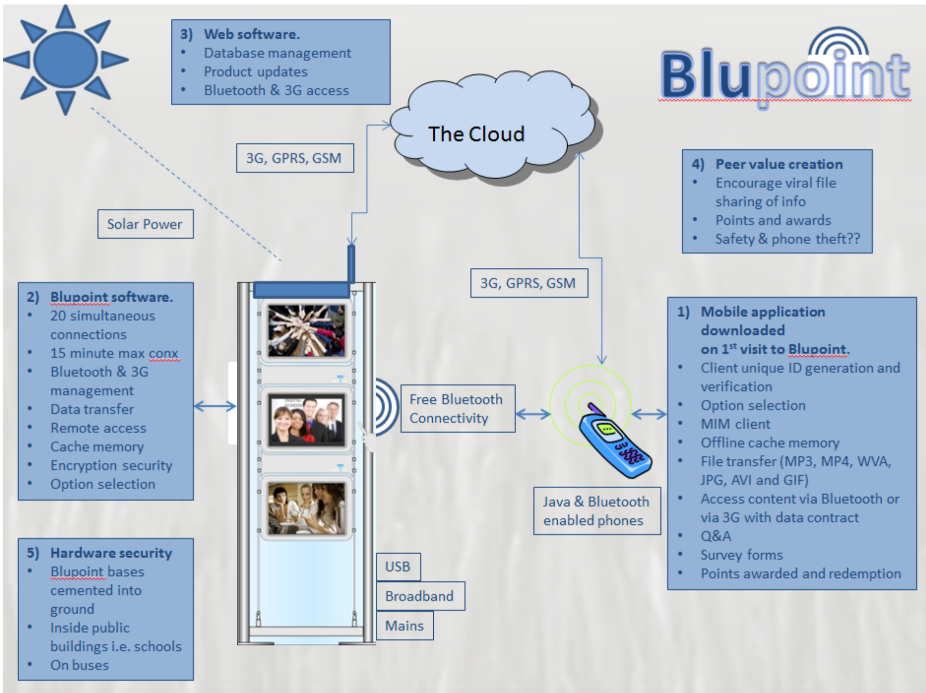


Figure 0-2: BluPoint Concept

The innovative approach of using a Bluetooth unit will enable the cell phone application to be downloaded free of charge. The Bluetooth unit would thus enable participants to receive file up-dates and allow them to submit information without the cost of cell phone airtime, which otherwise would be a significant barrier to adoption. We will provide economic and health information making it fun and interactive, for example, by supplying content in short audio files or animations that can be shared. This creative approach would actively encourage file sharing and we see the viral nature of such information transfer as a positive asset to the programme. Each interaction will allow participants the opportunity to accumulate points which may be redeemed against ringtones, video clips, animations, games, music tracks, and airtime. This rewards positive engagement and encourages the viral spread within a community.

1. Environmental conditions

The areas in which BluPoints are likely to be deployed are both rural and areas with high levels of depravation. The initial locations will be in Sub-Saharan Africa and will therefore be hot and dusty, with heavy seasonal rainfall. Units must therefore operate under extreme conditions and be waterproof and dustproof.

1.1 Outer casing to meet IP65 environmental.

1.2 Outer casing must be provided with a secure permanent method of fixing to allow it to be affixed either into the ground or to a wall.

1.3 Units must have tamperproof opening mechanisms, for use by service personnel only

1.4 Operating temperature range of -5°C to 45°C.

1.5 There should be space on the exterior BluPoint casing for vendor advertising.

1.6 The system must be designed to have low power consumption. Provision is to be made for mains electricity power at both 220-240v and 110v systems. (Pilot units to suit South Africa power supply systems)

1.7 The alternative of solar power using PV panels is to be considered and we would welcome proposals on the cost/viability of this alternative.

Connectivity

The unit is to be provided with multiple means of connectivity for sending and receiving information updates.

2.1 A cellular modem for connectivity via GPRS or 3G depending on network availability.

2.2 Fixed broadband capability using telephone network or LAN facilities.

2.3 USB ports

2.4 Port to allow service personnel to connect to the BluPoint using a laptop for diagnostics and updates.

Hardware components

3.1 Bluetooth transmitter & receiver, capable of 20 concurrent connections The unit should have a minimum range of 75m but, where required, this can be boosted to a range of 200m.

3.2 Optional Wi-Fi transmitter for some situations to enhance the replace Bluetooth unit.

3.3 Computer system with processor and memory storage compatible with software and storage requirements.

3.4 Hardware components are to be constructed so that in field exchange of modules is easy to accomplish

BluPoint software

4.1 The BluPoint must be easily accessible via a wide range of mobile devices. In developing countries handset capabilities could be up to 5 years behind those of more highly developed countries such as the UK. Therefore the BluPoint software must be backwards compatible as well as future proof as new releases of Bluetooth technology become available.

4.2 The software should be able to identify first time users within range of a BluPoint and send them a welcome message with an option to download an application (BluMobi) to enable them to interact with the information panels. On subsequent visits, users should be identified as returning customers and given the options menu.

4.3 The BluPoint software should be compatible with the BluMobi application and therefore enable users to fully interact; it should recognise unique users and understand what information they have previously accessed.

4.4 The software should be enabled to send to multiple users (up to 20) at any one time. It should also allow information to be received and stored from users. This information could be, for example, in the form of articles for social journalism or responses to surveys.

4.5 The BluPoint software needs to work in harmony with the BluMobi application to remember and recognise what menu modules a customer has taken and thus how many points they have accrued. Points can then be redeemed against items such as ringtones and audio tracks. The software needs to identify how many points have been accrued by the customer and if they have sufficient to make there desired purchase. After the purchase the point's balance should be adjusted. This system is to be linked to the user ID and the information should also be available on the website.

4.6 The software will need to operate a cache memory to store information on customers and to upload it to the website. It must also be able to store information downloads from the website and software updates etc.

4.7 User data will need to be protected and secure. It is envisaged that encryption of data will be required for any data transfers between the BluPoint and the website.

4.8 The software in the BluPoint will need to automatically detect which is the fastest form of connectivity to send and receive information from the BluPoint website, or should none be available be manually configured and updated using the USB port.

4.9 Where access is available via a cellular network connection or fixed broadband connection then the BluPoint software will need to offer the functionality for OTA (Over the air) configuration and updates.

4.10 Each user session will be "timed out" after a period of 20 minutes. Users may not start more than 2 sequential sessions.

Website and Web application

5.1 The website should contain all the information and content that will be available via BluPoint to allow customers to also access it from their computers. It should also have an IM capability to encourage peer-to-peer discussion and information sharing.

5.2 In the background, the web application should be able to receive information from all BluPoint units, via any of the connectivity means, and use it to update the central database. For example, data on surveys should be received and collated by the web application. Data security is a critical issue, as the database will include some personal information. Approved users only will be able to access this data and will wish to use it for producing reports.

5.3 An individual BluPoint should be able to be located from the web application and information or updates sent to them OTA. (Information will therefore be pushed out to field units).

5.4 The website should also be accessible for mobile phone users if they have a compatible device and airtime package.

Mobile application

6.1 The BluMobi application should be downloadable on the first visit to BluPoint. It needs to be small enough to enable a quick transfer via Bluetooth to a new user's phone but also powerful enough to manage a wide range of functions as follows:

6.2 The application must first check that the receiving handset is able to use the application, e.g. it is a Java enabled handset. If the handset is not suitable the user must be sent a message explaining the problem.

6.3 The application will allow a new user to set up a unique ID to allow them to partake in surveys without giving their full name and personal details.

6.3 At each subsequent visit the customer should be verified and this process will need to be quick and seamless between the BluMobi app and the BluPoint.

6.4 The BluMobi application should have a menu selection option, this will allow users to automatically access the point in the menu where they last finished or make a new selection.

6.5 The application should interface with a MIM client to allow users to talk discreetly to each other over Bluetooth free of charge but also to talk to a mentor or group moderator. The MIM client should also be able to work over a mobile data connection if users are out of range of a BluPoint and have an appropriate airtime plan.

6.6 Customers should be able to access website content not only with Bluetooth but also using GPRS/3G with an appropriate airtime plan.

6.7 The BluMobi application must access the telephone memory to enable customers to store and retrieve information, forms, and files they have downloaded even when they are out of range of the BluPoint.

6.8 The range of files likely to be downloaded includes MP3, MP4, WVA, JPG, AVI and GIF. The BluMobi applications must be compatible with all these formats to ensure maximum compatibility and usability for customers.

6.9 The BluPoint software needs to work in harmony with the BluMobi application to remember and recognise what menu modules a customer has taken and thus how many points they have accrued. Points can then be redeemed against items such as ringtones and audio tracks. The software needs to identify how many points have been accrued by the customer and if they have sufficient to make there desired purchase. After the purchase the point's balance should be adjusted. This system is to be linked to the user ID and the information should also be available on the website.

Appendix Three: Pilot Study Ethics Approval

Full ECS Ethics approval under reference ES/11/05/004.

Participation Information Sheet

Study Title: A study of the agency gained through using mobile Internet by people in Africa

Researcher: Mike Santer Ethics number: ES/11/05/004.

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to sign a consent form.

What is the research about?

I am a Computer Science 2nd year Ph.D. Candate at the University of Southampton in England. As part of my research, I am investigating the impact that accessing the Internet through mobile phones has on people in Africa. Africa has been selected as the primary focus due to the rapid introduction of mobile technology and latterly the introduction of the Internet through 2G and 3G GSM networks. This leads to a leapfrogging and I am keen to understand what affordances are offered and how the notion of the "Digital Divide" is impacted.

What will happen to me if I take part?

You have been invited to participate in answer a questionnaire as part of a focus group session with other community members. This focus group session will run for approximately an hour and a half, and will have the following schedule:

Welcome and Introduction

Questionnaire and discussion

Are there any benefits in my taking part?

Your responses will help researchers and policy makers understand better how mobile Internet can help you and people like you.

Will my participation be confidential?

Your participation will be kept in the strictest confidence. Feedback and opinions will be taken in the form of written notes, audio recording and care will be taken to ensure that any names or identifying information will be omitted. The questionnaire will not ask you to give information by which you can be personally identified. This study follows university policy.

Are there any risks involved?

There is a risk that you may reveal personal information during the session, or that the meeting may take a distressing turn. I will try to maintain civility and direction during the session, and I will ensure that all notes are carefully censored.

What happens if I change my mind?

You have the right to withdraw from this study at any time before or during the session. I cannot promise that your data can be destroyed after the session, since it will be difficult to identify your specific contributions, so if you wish to withdraw, please let me know as soon as possible.

Where can I get more information?

For further details, please contact either myself or my project supervisor, G.B. Wills: Mike Santer: mhds@ecs,.soton.ac.uk G.B. Wills: gbw@ecs.soton.ac.uk

Protocol

TITLE: A STUDY OF THE AGENCY GAINED THROUGH USING MOBILE INTERNET BY PEOPLE IN AFRICA RESEARCHER: MIKE SANTER

Background

I am a 2nd year Computer Science Ph.D. Candidate applying for ethical review of a field based trial to test my framework for agency / empowerment through mobile Internet in Africa. My research is investigating the impact of people in developing countries accessing the Internet through their mobile phones. Africa has been selected as the primary focus due to the rapid introduction of mobile technology and latterly the introduction of the Internet through 2G and 3G GSM networks. This leads to a leapfrogging and I am keen to understand what affordances are offered and how the notion of the "Digital Divide" is impacted.

Method

I intend to carry out a semi---structured interviews and focus---group session. The sessions will be recorded using a Live Scribe pen recorder for later transcribing and analysis. No defining personal details will be stored with the collected data. An outline of the questions to be asked can be found in Appendix One.

Materials

During the semi---structured interview, I wish to distribute a questionnaire amongst the participants to acquire written opinions, suggestions, and quantitative data for statistical analysis. This questionnaire shall be completed and returned before the end of the interview. A plan for this questionnaire can be found in Appendix Two.

Participants

I intend to interview people during my trips to Africa in rural, peri---urban and urban settings. The participants will be invited at random to participate from the various communities I visit. Usually the local contact will invite participation from local community members. Participants will be informed of the reason for the questionnaire and that they are not obliged to take part in this investigation in any way, and may withdraw at any time.

Session

At the start of the session, the participants will be asked to fill out a form giving their consent for participation in this study. The consent form can be found enclosed.

The interviews will follow this basic agenda:

- Welcome & Introduction
- Use the questionnaire as an informal structure for the discussion
- Conclude and thank the participants

Data protection and anonymity

The participants' contact details will be collected if they are willing to enable a longitudinal comparison on their mobile Internet usage. All contact information will be stored separately from the collected data on a server at The University of Southampton. Contact data will not be shared with any third party. The session will be recorded in the form of hand---written notes and a voice recorder, and any names will be censored to protect the anonymity of all participants. The data will be analysed using the NVivo and SPSS software packages. Resulting data files will be stored on an ECS machine.

Ethical issues

The focus group session does carry associated risks. Participants may accidentally divulge personal or sensitive information. Should this happen, I will request that such information not be shared with anyone outside of the meeting, and I will thoroughly check my notes at the end of the session to censor any offending information. There is a risk that some participants in the investigation may not have a chance to share their opinions, or may feel uncomfortable or distressed by the other participants. At every stage in the session, the participants will have the opportunity to ask questions. I will try to regulate the meeting to maintain civility and ensure that no opinions are left unvoiced.

Semi Structured Interviews

Pre---script

Thank you for agreeing to attend this session and discuss what you do with your Mobile / Cell---phone and how it has changed your life.

My name is Mike Santer and I come from The University of Southampton in England. I will be looking at your answers when I get back to England and they will help me understand how Africa is using Mobile Internet and might use it in the future. Did you know that Africa has one of the highest adoption rates of Mobile Internet in the world! I am here to learn from you.

To help me capture what you say I will take notes using a pen and paper, record what is said using this special pen and also ask you to fill out a short questionnaire. Your identity will be protected so I encourage you to tell me your honest thoughts and comments.

You are also free to leave at any time or choice not to answer any question. Do you have any questions for me?

Semi---Structured Interview

1. Do you have your own cell phone? If so, when did you first acquire a cell phone, how old were you and why did you to get it?

2. Why do people have more than one SIM card?

3. How much do you spend per month on airtime and how long does this last?

4. What are you currently using your cell phone for?

5. Do you think life is better for your community with cell phones and what has changed?

6. What would you most miss if you did not have a cell phone?

7. Would you choose to have a connected computer or a cell phone?

Post---script

Once again, thank you for your time – it has been very helpful. Please feel free to take one of my cards and you may contact me is you have any further thoughts or want to ask me a question about the study.

Questionnaire

Hi, my name is Mike Santer, from The University of Southampton in England. Thank you for agreeing to take part in this study of Cell Phone's in Africa. Please could you fill in this questionnaire that I would like to use as part of this study.

Date: ____________________

Location: ____________________

Age: ____________________

□ I am willing for you to use this information as part of the study of Cell Phone Usage in Africa.

Section 1: Your cell phone

Please tick all boxes that apply to you:

□ I do not have my own Cell---phone

□ I use a friends cell---phone

□ I use a family members cell---phone

□ I sometimes use a strangers cell---phone

□ I have my own cell---phone.

If you have your own cell---phone

1.2 How old were you when you got you first phone

___________?

1.3 What Cell phone do you have:

Nokia / Samsung / Other ________________ (please state)

Model ______________ (please state)

Section 2: SIM Cards

2.1 How many SIM cards do you have?

____

2.2 What networks are the SIM cards on?

____

Section 3: Airtime / Talktime

3.1 How much airtime do you buy each time you top up?

____

3.2 How often do you top up?

___________ times a WEEK / MONTH (please circle)

3.3 How much time do you spend without credit on your phone?

NEVER / SOMETIMES / OFTEN / MOST OF THE TIME / ALL THE TIME

3.4 Do you use "Please call me" or call and hang up people you want to talk to?

NEVER / SOMETIMES / OFTEN / MOST OF THE TIME / ALL THE TIME

How many times a week do you do this? _____________

3.5 Where do you get your airtime/talktime? (Please rank)

____ Shop

____ Street seller (voucher)

____ Street Seller (airtime transfer)

____ Friend / Family Member (airtime transfer)

____ Other Please state ________________ 3.6 How much money do you get in a typical week or month? _________ per week / month (please indicate)

Section 4: Cell phone usage

4.1 What do you use your cell phone for? (Please tick all that apply)

□ Making calls

□ SMS / Text messages

□ Mxit or other Instant Message Platform _________________ (please specify)

□ Taking pictures

□ Calendar and reminders

□ Taking pictures

□ Taking Videos

□ Accessing the Internet

□ Torch

□ Music

□ Radio

□ Connect to WIFI

□ Use Bluetooth to transfer things to other cell phones

□ Pay bills

□ Transfer money

□ Other

4.2 Please highlight the most important three things you do on your cell phone above

4.3 Do you use you phone for social or work activity?

Just social / Mainly social with some work / Social and Work / Mainly work with some Social / Just Work

4.4 Do you use the Internet on your phone? □ No my cell phone can not use the Internet

□ My cell phone could access the Internet but it is not set up

□ I could access the Internet but I choose not to Why? ___________________________

□ I use the Internet on my cell phone never / sometimes / every week / every day / many times in a day

□ Don't know If YES then what do you use it for? □ Email

□ Twitter

□ Facebook (Do you use 0.facebook.com?)

□ Mobile Instant Messaging (Mxit, Google Chat, MSN) etc.)

□ Browsing Web Pages

What type of pages do you browse? _____________________________

News / Health Information / Sport / Entertainment / Study / Work / other

□ Downloading music / video

□ Reading books

□ Play games

□ Other ..... please state ____________________________

4.5 Do you use you the Internet on your phone for social or work activity?

Just social / Mainly social with some work / Social and Work / Mainly work with some Social / Just Work

4.6 Do you use or have any of the following?

□ A computer connected to the Internet at home

□ A computer not connected to the Internet at home

□ Access to a friend’s computer that is connected to the Internet

4.8 How often do you use an Internet Café?

never / sometimes / every week / every day / many times in a day

Weekly spend ________________

Section 5: How has life changed since people got cell phones?

5.1 How have cell phones impacted your life?

A lot worse / A little worse / Same / Better / Much Better

Why? _________________________

5.2 Have your spending patterns changed?

A lot / A little / The same

What are you spending more on? __________________

What are you not spending as much on? ________________

5.3 Do you think cell phones give you good value?

No / Don’t Know / Yes

5.4 Do you feel safer with a cell phone?

A lot / A little / The same

5.5 Are there any negative things that cell phones have caused in your life or the community?

5.6 What are the positive things that cell phones have done?

5.7 Have you ever had you cell phone stolen?

Yes / No (if yes how many) ________

5.8 Do other people use your cell phone?

Appendix Four: Transcripts of Pilot Interviews

Focus Group

Q.1: How many of you have cell phones?

A: Everyone present - it then transpires that two people have two phones.

When asked why, one lady says that she needs connectivity in two areas and for that needs two networks, hence 2 phones.

The other person says that he uses his phones for Internet and Facebook and likes a spare for use when the battery runs out on the other.

Q.2: How many years have you had your cell phone?

A: 2 years - 1 person (none prior to that), 3 years - 2 persons, 6 years - 5 persons. Therefore it would seem that the majority have had their phone for 6 years.

Two people then say that they have had theirs even longer, one from 1997 and one from 1999. The 1997 phone was a Motorola, bought, as it was new and fashionable at the time.

Q.3: How many people use Internet on their phone?

A: 6 or 7 people reply in the affirmative. However some people do have Internet facility but cannot access it through lack of knowledge. The younger people have a better understanding.

Q.4: Could you think what you actually do with your mobile phone?

Suggestions: phone calls, SMS, instant messaging, email, web browsing, Google chat, MSN, Facebook, Twitter, photography, music etc. The question can go round the room.

A: One person answers that he phones, sends messages, plays games, and with much laughter says that he 'just keeps on pressing it!' It is suggested that everyone will have a similar answer, but Mike and Gary need to know the different reasons that people have as regards their usage.

Q.5: Continuing from the last question, do you use your phone e.g. to keep in contact with family, including your children, do you use Facebook to keep up to date with friends in the village? (The question continues round the floor) What are your own personal reasons?

A: The first person says he uses it to send messages, receive calls and play games, and when his son 'buzzes' to call him back; he makes local and 'out of town' calls.

Another uses her phone to call parents, send messages, and play games. She tops up (airtime) 5r, 10r or 15r,

The next lady uses her phone for calls, SMS, MMS, music, radio, Facebook, Internet browsing, photography, recording videos; she has topped up a great deal recently because of extra usage. She does not like chatting or Mxit and prefers to use Facebook to chat.

Q.6: What are younger people doing with their phones?

A: The first young man to answer uses his phone for calls, SMS, MMS, email, 2 accounts on Facebook, downloading music and pictures, taking pictures and playing games. He used to use his old phone to chat, but cannot chat on his current phone, which is a Sony Ericsson.

The first young lady to answer says she uses her phone for calling and receiving calls and messaging. She usually spends 20 minutes speaking to friends and sends 3 SMS a day. She does not use Facebook or Mxit, as her phone does not allow either.

The next man says that he uses his in a similar way; taking and receiving calls, messages, taking pictures and videos; he also uses it for the alarm clock, reminders and small jobs.

Mark said that he uses his phone to make and receive calls, usually making 5 calls per day. He has had his current phone since December 2009, but had his first one in 2000, since when he has lost 3 or 4. Another man uses his phone to make and receive calls, send and receive text messages and do callbacks.

At this point it is agreed that a generational gap is beginning to be identified.

Q.7: Who uses their phone for work?

A: One lady uses her phone at work for the calculator. Another person uses the phone for the alarm and for reminders. Another uses it for a torch and for calls and tops up 10r each time. Another uses the calendar, SMS and plays music.

Q.8: How do you get music onto your phone?

A: I download or copy from the computer.

Q.9: Do you use Blue Tooth?

A: Yes - USB/Blue Tooth

Q.10: How many people have access to a computer to download - and to download things on to their phone?

A: 2

Q.11: Who uses a computer for any reason?

A: 7

There follows general chat about usage: calls, messaging, music, calculator, web browsing, reading news, calendar, but in particular the use of the phone as their main timepiece, which would seem to apply to everyone present. A young man then joins in the conversation, explaining that he uses his phone for research, music and messages - and a question is put to him;

Q.12: When you use it to search information for assignments, do you use Google or similar?

A: It seemed from what he was saying that he uses a computer for research, again it was unclear, but he appears to work in some form of development.

The local doctor was mentioned at this point; it was unclear, but it did follow on from the last question. There followed a discussion on costs, Internet/broadband contracts being very expensive; a phone contract can cost R135 per month and Telecom seems to be the most competitive. There remained one man who had not explained his usage of the phone. He was then questioned:

Q.13: How do you use your phone?

A: For making and receiving calls, messaging, time watching and the alarm - that is all, as he doesn't have a fancy phone.

Q.14: If you had a fancy phone would you spend more time doing things on your phone, do you think?

A: All say 'Yes'

Q.15: Earlier I asked who has access to a computer - so how many of you have access to a computer with the Internet?

A: Some do not own a computer, but use local Internet Cafes - there are some around.

Q.16: How have mobile phones changed your life; what benefits have they brought to you; what things can you do now that you couldn't do before or what things are easier now than they were before?

A: The first lady says she can easily communicate with someone, whereas before she couldn't.

If someone is sick and needs attention, you can quickly phone them in a case of emergency.

It gives information.

Listening to the radio on the phone.

You don't have to buy a camera, it can take a picture.

You can reach many lost friends using Facebook.

I can connect with friends.

I can connect with someone who is queuing in the bank.

The bank tells you (automatically) when money goes in or out of your account.

Q.17: Does it help in the workplace - can you still do the same job without the phone?

A: It improves it - I can reach the office, various benefits (unclear) and send messages to the office.

Q.18: How many of you use the mobile phone to check with their bank?

A: 6

Q.19: Who actually uses their phone to transfer money?

A: 2 - and they say you can buy airtime from the bank.

Q.20: Do all banks do that?

A: They think so - and say you can also top up electricity using the cell phone.

Q.21: Once you have bought airtime from the bank - once you've got airtime on your phone, can you transfer it back into cash in the bank?

A: No - it is one-way.

Comment: So you could not accept payment in airtime and then transfer it to cash in your bank account.

Q.22: In Capetown, they have people blogging about what is going on in the community. Would you be interested in knowing about those sorts of things as well? They are talking about people in the community using their mobile phones to record what's going on, to share information around the community. Are you interested in that sort of thing?

A: Generally yes - but one lady was concerned about it becoming gossip.

Q.23: Does anyone have a blog?

A: 1 person

Comment: It is one way of sharing news.

Q.24: I have seen in India, that ladies have collected useful bits of information about farming, agriculture, government, healthcare, new laws, new child benefit, new medicines and shared that. Would you be interested?

A: Yes

Comment: They have to do this themselves; find it on the web, collate it and share it - what they are interested in themselves.

Q.25: Does anyone use Twitter?

A: No - but two people have heard of Twitter.

(Twitter is clarified to everyone - eg that you can send one tweet instead of a thousand messages - and the differences between using Twitter and using SMS, particularly cost - they offer to help one lady who has tried it. One man is interested and is told how to set up Twitter)

Q.26: Are there any projects or community initiatives that are using mobile phones, that you are aware of here? For example in Capetown, one church that we work with

use instant messaging to provide advice to people who have got drug issues or alcohol abuse or are in debt.

A: As youth leaders, we had decided to connect on Facebook, not knowing there are other things we can use, like Twitter, where we can send one tweet, which gets spread to everybody.

Q.27: So you connect your youth together on Facebook - how many youth do you connect with?

A: About 12 (leaders)

A lady tells about a Facebook group set up by a local church, which anyone can join with. It was noted however, that not everyone can access Facebook. They spoke of the number of drug addicts and added that most people will be able to get SMS - an example was given of a man who uses texts to contact everybody.

Summary:

Mike - Most people, even in rural areas here, have a mobile phone, but maybe only just use it for voice and for messaging (SMS). Mike expresses their great appreciation and assures everyone that if they want to talk more, they will be around for a couple of day. He tells them that in S Africa, they have the fastest-growing rate of mobile phone usage in the world, and that is one of the reasons why they have come here, to the experts, to get their opinion and advice and find out what they are using them for - and how they are of benefit. He thanks them for their time.

Interview 1: 14 year old boy in Dutywa, South Africa

Q.1: What do you use your mobile phone for?

A: Research and Mxit

Q.2: How long do you think you spend each day on Mxit?

A: From 8pm till 2am.

Q.3: What sort of things do you talk about on Mxit

A: Everything

Q.4: Do you just talk to those you know - or to anyone who's on line?

A: I talk to different people I don't know.

Q.5: So what do you mostly use your phone for - and Mxit - and anything else?

A: Games.

Q.6: What sort of games?

A: Need for Speed

Q.7: So Research, Mxit, Games - Calls?

A: Not really.

Q.8: What about SMS?

A: No - I do SMSs in Mxit.

Q.9: So can you actually send SMSs in Mxit - I thought it was....Well they're like SMSs aren't they?

A: Yes.

Q.10: Roughly how much do you think you speak a week or a month on airtime?

A: 30r per week

Q.11: How long does that R30 last you?

A: 5 days.

Q, 12: Do you buy things online, like ring-tones or music?

A: Yes

Q.13: So what about using your cell phone for taking pictures or videos?

A: Videos.

Q.14: Do you do that very often?

A: Yes.

Interview 2: 13 year old boy in Dutywa, South Africa

Q.1 Please introduce yourself?

A: I am 13 and I don't have a cell phone.

Q.2 How many of your friends, the people with you, don't have a cell phone - or are you the only one?

A: I am the only one.

Q.3: How does that make you feel?

A: I don't need one.

Q.4: So what sort of things do you see your friends using their cell phones for?

A: Internet, sending messages, playing games and photo-shooting.

Q.5: Do your family have cell phones?

A: Yes, all of my family, except me - I am the youngest.

Q.6: Do you think you will get a cell phone later?

A: Yes, when I pass Grade 12.

Comment: A reward for passing Grade 12 - thank you.

Interview 3: 14 year old boy in Dutywa, South Africa

Q.1: Do you have a cell phone?

A: I am 14 - and I have a cell phone.

Q.2: How long have you had a phone?

A: The current one - last year; the first, I think, when I was 11.

Q.3: Is that quite young to have a cell phone; were you one of the first amongst your friends?

A: Yes to both.

Q.4: At what age do people usually get cell phones?

A: Normally at teenage stage.

Q.5: What do you use your cell phone for?

A: Mostly I play games.

Q.6: Do you play Need for Speed as well?

A: Yes - and other mind games.

Q.7 How many hours a day do you think you spend playing games?

A: About an hour and a half.

Q.8: What else do you use your cell phone for?

A: Twitter and Facebook - I don't make calls that much.

Q.9: Anything else - do you use Mxit?

A: No.

Q.10: It's interesting that you mentioned Twitter - when did you start using it?

A: The middle of last year.

Q.11: What made you start using Twitter?

A: I first heard of Twitter on a television show that I watch and they encouraged us to join.

Q.12: What sort of television shows do you watch?

A: Cartoons, kids' stuff.

Q.13: Do you actually post Twitters as well as reading other people's Twitter streams?

A: Yes.

Q.14: How many Twitter posts do you do in a week, do you think?

A: About 3.

Comment: The reason I'm so interested is that I've spoken to quite a lot of people here, including adults and those in business, and no-one else has mentioned Twitter - so you are the first. There are possibly other people who use it - very interesting.

Q.15: Why don't you use Mxit?

A: I don't like Mxit because a lot of people use it, so I thought I shouldn't join what many people use.

Q.16: But you use Facebook as well?

A: Yes.

Q.17: Roughly - How much do you spend a week on air time?

A: About 15r per week.

Q.18: How long does it last you -does it last you the whole week or do you often run out?

A: I run out, maybe in the middle of the week - so it lasts 3 or 4 days.

Q.19: So what do you do when you run out of credit on your cell phone – 'Please call me'?

A: Yes

Q.20: Which cell phone do you have?

A: Nokia 61 - 03

Q.21: (to all) Even if you do not have a cell phone yourself, how do you think cell phones have affected this place? How do you think they've changed things here - both positive and negative things; e.g. I asked some other people and they said that cell phones made them feel less safe, because when they have their cell phone with them

they're scared of being mugged or robbed. Maybe you can think of some positive/negative things mobile phones have brought to this place?

A: We get connected easily with family and friends if they are in another town and you are here.

(Comment: Especially when rains come.)

A: (cont) You can get here in time

When you want to meet with someone you can call them and ask where they are; you can meet there or somewhere else - arrange meeting up, mostly with friends rather than family.

You are less worried when you are out, as you can easily call someone

Q.22: What would you miss most if you didn't have a cell phone - can you think of four things you would miss most if cell phones weren't around?

A: Chatting with friends - maybe about what happened at school; how you feel right now.

Q.23: Could you not do that face-to-face?

A: They may be somewhere else.

Comment: I guess because you all come from different parts around here, it's not easy to see people as it takes a long time to walk there – (people agree).

Q.24: (cont) Is there anything else you can think of - if you couldn't have one for three months, how would you feel?

A: I would miss playing games.

Q.25: Do you think mobile phones have helped you in your studies?

A: One says: Yes I can download information for a project.

Another says: No - When you have to study you might chat and play games - so that would have a negative effect,

Q.26: When you text do you use English or your own language, or a blend or slang....?

A: A blend - it depends on the situation - maybe you have to use English if your friend doesn't understand your language.....

Q.27: Is there anything you want to ask me- about England - or about anything we've chatted about?

Do kids like us have cell phones like we do?

Mike’s reply: Yes - very much. I have two sons; the first one is 12 years old and he had his first phone when he was about ten. My youngest son is 10 and he got his phone when he was about 9.My elder son uses his mainly for SMSing his friends, but he doesn't really do an awful lot more than that - sometimes an odd telephone call - and he puts his music on there as well.. Whereas my younger son loves technology, so he does much, much more on his cell phone. He updates the operating system on ours, puts different skins on there and backgrounds. He does some programming and he really uses the cell phone totally. Regarding the type of phone - in the UK there is a move towards more touch-screen - let me show you.

Interview 4: 14 year old girl in Dutywa

Mike introduces himself and explains that he is studying with Gary at Southampton University and that what he's come here to study is how you they using mobile phones. He wants to know what they and their friends are using them for - and whether that's a good thing or a bad thing, what it helps them to do and also what some of the difficulties are. With their permission he wants to ask questions and suggests that they might like to ask him questions, maybe about England or studying and education; he explains that he has quite a mixed background and details his career to date. Mike reassures them that he will not be keeping a record of their names and would appreciate if they could tell him exactly what they use their mobile phones for. The first question is to a young lady of 14.

Q.1: Do you have a cell phone?

A: Yes since I was 13

Q.2: What sort of things do you use your cell phone for - the most and the least?

A: Sending messages, SMS, music, ipod, just having fun with it.

Q.3: Can you think of anything else you use it for?

A: I record and do videos, use the camera - I use all these features.

Q.4: What about things like games?

A: I'm not a person who likes playing games. I like to do something to do with my knowledge that will perfect it.

Q.5: When do you do your texting etc?

A: I do it almost every day.

Q.6: So how long do you think you spend on your cell phone?

A: I spend time on it before and after school and in bed.

Q.7: How much do you spend on airtime?

A: R50 per month.

Q.8: Do you ever run out of airtime?

A: Yes - we do anything to get more airtime.

Q.9: Do you transfer airtime to each other - the minimum is R30, is that right?

A: Yes to both, but with a particular card you can do R10 (unclear).

Q.10: Do you borrow each other's phones?

A: Yes (Two girls are speaking and one says that the other's is a better phone for her to use).

Q.11: Do you think cell phones make you feel safer or less safe....?

A: On your own you feel safe because you know you can call someone, but if you are around a lot of people you feel less safe as you think someone may steal it.

There follows a chat about safety etc - one of the girls had her phone stolen at one time.

Q.12: So your phone was stolen - what happened?

A: I was walking home from church on a Friday afternoon and my mother phoned; some schoolchildren saw this, took my phone and then teased me and made insulting remarks.

Mike sympathises and she tells him she was able to get another phone.

Q.13: What happens to these stolen phones - do they sell them?

A: Yes but if the police trace them they can close them down remotely.

There follows conversation about how the thieves sell expensive phones cheaply - and the money is used to buy drugs.

Q.14: Is that a big problem here?

A: Yes - there is a place that sells drugs (14 and 15 year olds are mentioned) and they want you to work for them and offer you money. They tell you that if you take the drugs, it will make your problems go away.

Q.15: Do ladies and girls take drugs as well?

A: Yes 45% of schoolgirls here take drugs - they live in a hostel.

The girls being questioned speak at length on this and other (sometimes) related subjects, with a reminder not to give out your phone numbers to people you don't know, eg on Mxit, and to be alert to the dangers of this type of social networking. Mike tells them that anything they do online leaves a trace that stays with them for the rest of their lives. Moving on, he then tells them that there are 6.5 billion people on this earth; there are 4.7 billion mobile phones with live SIM cards operating. Therefore nearly everyone on the planet has a mobile phone – he says: 'We've never been here before, so we're learning together how to safely reap the benefit'. Mike now puts a question to another young person.

Interview 5: 15 year old girl in Idutywa

Q.1: When did you get your first cell phone?

A: I am 15 and I had my first phone when I was 12.

Q.2: What do you use your cell phone for?

A: Mxit, communicating with people, watching and making videos, listening to music, voice recording at church.

Q.3: How much do you spend per week on airtime?

A: About 15r which lasts me the whole week.

The first young person now joins in again and adds to the first answer that she uses her phone for the Internet: Google, websites for information for studies, Wikipedia, also for celebrities (her friend concurs) video, Twitter (her friend does not). They discuss celebrities whom they follow, one being a member of their church who works as a presenter. They discuss language differences and similarities, the point that some people, when they become famous don't speak Corsa anymore. The difficulties of the past between Zulu and Corsa seem to be resolved. They tell Mike that they speak several languages, amongst them English, Corsa, Afrikaans, Zulu...(the rest unclear). Mike returns to questioning.

Q.4: Which cell phone do you have?

A: Nokia 27....

Q. 5: How old are you and when did you have your first cell phone?

A: I am 15 and my parents bought my first cell phone when I was 13 so they would know where I was and if I was in trouble (to stress the importance she once left her phone at home and could not contact anyone at home which upset her - someone else used their cell phone to contact her mother).

Q.6: What do you use your cell phone for?

A: Mostly for Mxit, sending messages and taking pictures and music.

Q.7: So do you use airtime to download music - and is it expensive?

A: Yes I do - the cost depends on the type of music you download - it also depends on how long it takes.

Q.8: Do you Bluetooth music to each other?

A: Yes

Q.9: How did you learn to do all of this?

A: They explore and follow instructions.

Q.10: So how much do you spend per week on airtime?

A: I only have my cell phone in the holidays and last week I spent 40r.

Q.11: So you only have your cell phone in holiday time?

A: It's not allowed in a hostel (where she stays).

Interview 6: 15 year old girl in Dutywa

Q.1: Which cell phone do you have?

A: Samsung J700

Q.2: How old are you - and when did you get your first cell phone?

A: I am 15 and my dad bought it for me when I was 12.

Q.3: What do you use your cell phone for?

A: Mxit, To Go, a chatroom on Mxit, all our people are on it, all South Africa. (Facebook is also mentioned, but it is unclear). I also use it for music and taking pictures.

Q.4: How much do you spend on airtime?

A: 120r per week.

Q.5: Do you spend all your money on airtime?

A: Yes, all my family buy me airtime - I am very talkative.

Comment: I think you are all very talkative.

Group (Interview 4, 5 and 6)

Mike then addresses the whole group:

Q.1: How do you think Idutywa has changed through having cell phones, e.g. in business, older people, younger people?

A: They think it is a good business to have created the Internet – (some of this answer is very unclear).

Q.2: Do you think Idutywa is a better place for having cell phones?

A: No - People don't want to work for themselves - they just want to check on other people.

Q.3: Why do you think that is?

A: Robbery - there is general discussion about various scams and unpleasant situations which arise, much of which is unclear.

Q.4: So you don't think cell phones are good news for Idutywa; would you prefer it if there were no cell phones?

A: They all like their cell phones; they go on to mention that Mxit freezes after some time.

There follows a somewhat 'philosophical' discussion between the youngsters about robbery, threats, violence, technology, prison sentencing - some of which is unclear. Mike thanks them and tells them they have been incredibly helpful.

Interview 7: Rene from RLabs 32 years old

Q.1: The question was not recorded; the title of the establishment is unclear.

A: We use social media, looking at social networks; but the core is the people, making an impact. We use social media to empower our community. We have a group of women, housewives from the community, aged between 25 and 65, which is a large group. We start off by introducing them to email; they all open an email account - everyone has email - we use Gmail, as it is easier and cheap. We then introduce them to Facebook, Twitter, videos, YouTube, photos. We show them how to use Skype so they can contact family members overseas – they have their own accounts.

A: (cont) Yes, especially when you tell them what you are going to do, and, with the knowledge - what they will be able to do. They say: 'I can't do that; I won't be able to!'

Q.2: So they have fear?

A: Yes, before any session, when we are going to do something new, something they have never done before. (The next parts is rather unclear) She speaks of their most professional lady, a social worker with a Master's degree; everyone else who joined this particular group was a senior citizen - one was in her early 70s whose name was Frances.

Q.3: So she had not used technology before?

A: No - she received a mobile from someone in another country, someone she used to look after when they were little. This lady had left school at a very early age; so she's always had a phobia when it comes to reading or writing anything down. You'll see her walking with a Bible for instance; she can't read it, but feels comforted by it. One of the ladies reads it to her. So she learned what we were doing when we made an announcement about it. I'm not sure if it was all explained, but people knew there were computers involved and that was about it.

Frances came to the opening session - there was a presentation - and some of the ladies who graduated last year explained how they were using technology now in their everyday lives. After the sessions, she came back and said she didn't think it was for her; it was not what she thought it would be. She was asked to come back to the next sessions - they decided to use a different approach for her. The nice thing about this course is that they can really do anything they want to as nothing is set in stone. We just need someone to be eager and interested and excited about it - we can always work around how we are actually going to get this person to use it. So we started separate sessions with her and a young man on our program started sitting with her and the first time she sat at the computer, she wasn't sure what to do; we decided it was too overwhelming.

One of the ladies, who graduated last year, sits with this senior lady now. They talk through what it is about and the graduate would show her but she will be typing and using the keypad and the mouse. This was just to see what social media looks like, looking at it on the computer screen. She's also doing literacy classes now - another lady comes in to teach her to read and write. So she is concentrating on reading and writing and will come back to the sessions next year - someone will sit with her and give her special attention. She doesn't have to keep up, we can take things more slowly and when she is *more confident, she can be introduced into the class, or she is more than welcome to come to a class and sit next to someone.*

Q.4: Did she find mobile devices difficult to use because she is illiterate?

A: Yes - because on the keypad there are numbers and when she needs to dial the numbers she can look at a page and key it in - but obviously texting is a bit different. There are problems with keying in letters, particularly how many times you need to press the keys, to get e.g. the letter 'c' or the letter 'e'. To get over problems they are encouraged to use shorthand, saying 'Hi' instead of 'Hello' or 'Good morning'; using 'r' for 'are' and 'u' for 'you'. They are using young people's text - that is what they are doing. At our first sessions for seniors, all the shorthand was explained, but they were all worried about grammar - it was too overwhelming for them and I think that's why most people don't bother. At the moment we have about 50 seniors, a large group; sometimes we have to split them into two. One week we have half of the group and the next week the second half. The seniors really take for granted everything at the end of their lives, and they don't have to learn anything new, but for some reason, they find the mobile phone fascinating.

People mostly use phones to communicate with their children when their children don't live with them anymore. People will go to a shop to buy airtime, but don't actually know how to load it on to their phones; they ask for it to be done for them. Through the sessions we had, they said that is one of the things they want to learn how to do themselves put airtime on their own phones, so they don't have to ask someone to do it for them. So that is one of the things that we taught them. We teach them everything that is new to the seniors: screen, predictive text, various things, it is very challenging for us - on the Motorola's you guess the numbers! Texting is all they want to do.

Comment: Mike reflects how he felt, using a basic handset when he came to S Africa, being used to Google phone or iPhone and the QWERTY touch keypad. Things took an awful lot longer, but he is speeding up again.

Q.5: With regard to you mobile phone usage (he asks her age); at what age did you have your first mobile phone?

A: I am 32 and I was 19 years old.

Q.6: Were you one of the first to have a mobile phone among your peers?

A: Maybe - I had only started working - so my dad had the contract in his name, so I could get the mobile phone. In those days it wasn't easy to buy a mobile phone for cash - most people had their mobile phones on contract, and even then we had to pray something in, to get the mobile phone.

Q.7: So what was your reason for getting a mobile phone?

A: I was working quite far from home and I couldn't drive, didn't have my own car, so I had to use public transport. The reason I got the phone was to let my parents know if the buses or taxis were late or let my work know. One day when there was a strike, I was in a taxi in a traffic jam, as there was also marching and there was no way I could tell anybody where I was or what I was doing, or get to a public phone to phone where I worked at the bank. I finally got to work a few hours later, but the bank phoned my parents to see where I was, and they were worried as they knew about the strike which was happening. So my dad said: 'You are going to have a phone.'

Q.8: So you had a landline in your home - was that quite usual?

A: Yes most people would, because that is the only way to communicate. If you don't specifically have a phone in your own home, somebody in the street would have a landline. If we had a phone and our neighbour did not, then they would give their relations our number and if they rang, we would call them to answer.

Q.9: Did you find that sort of sharing happening with your mobile handset, so when you are on the bus and there is a strike, people are looking and saying 'Can I borrow your phone?'

A: Yes - and especially when you are out with your peers and they need to phone someone. If you can't top-up, if you have a contract, then at the end of the month your phone bill is sky high. And it was in my dad's name.....after 2 years it was in my name.

Q.10: What do you currently use your mobile phone for?

A: Just recently I got an iphone and it does much more than making calls and texting. The previous phone I had was a Nokia E65; I only ever used Nokia

Comment: So it must have seemed strange moving away from it.

A: (cont) Calls, emails - I always need to be in contact with the office - I need to know if someone has sent an email and I reply to the email. Recently I've been using it for blogging.

Q.11: so you use your phone to blog - you wouldn't do that at a computer - or maybe a mixture of both?

A: Not necessarily at a computer - kind of a mixture of both. I created a blog in the office in 2008 and the only thing that was stopping me getting to do that in the office, opening it up, thinking about it - was that I was not that uncomfortable with it. At home in bed I would think of something that would make a good blog, but was too lazy to go and switch my machine on. But now I've downloaded (unclear) on my iphone, I can lie on my bed - I have micro-photos on my phone so I can insert a picture, type a blog for a few minutes and upload it, edit it, and people will comment and I'm able to respond. It's also connected to my ....Facebook(?).......... (this last sentence is unclear) So it feeds into that and people will comment there as well.

Q.12: How do you think life has changed in Capetown or for you, with mobile phones, because obviously, going back 20 years there were certainly very few around, and now it appears that nearly everyone has a mobile; would that be true?

A: Yes, that is true. Let's say I take a group of fifteen that's closest to me - there would probably be only one who does not have a mobile phone, and that would be because it fell in the water, broke or was stolen.

Q.13: Is that a big issue - people stealing mobiles?

A: I've had two of my phones stolen already.

Q.14: At knifepoint, or just stolen?

A: One was in my handbag, hanging over my chair at MacDonalds, which is not a good idea - I should have known better; they just took my handbag with everything in. Two weeks after that, I was in the office next door and we had someone come in with a gun - they had followed one of the people that went to the bank, back to the centre. My phone was on the table. There was only myself and one girl in the office - they just walked in and closed the door and pointed the gun at us and demanded the money - so they must have followed the girl from the bank. They asked us to kneel, which we did, and by the time I got up to push the button for the alarm, they were gone already. Afterwards I realised they had taken my mobile phone.

Q.15: In terms of people's lives being changed, it seems pretty much all the people you hang out with have mobile handsets; you've said that they empower people - how do you think that is?

A: I think to be connected is empowering; to be able to use your mobile phone. Most of the people I know are on Twitter, and most of us follow the news feeds because I don't read a newspaper any more or watch the news on the television any more. I read the news on my phone, so I'm seeing highlights of what's happening. I make a point in the day to go through all those articles, using the links and I'll go through it all and read it. So that's how I read the news and there's also Twitter, because we are a close community and all of us are on to it - always talking about what we are doing for the day - always knowing what is happening. So if there is anything happening in the church or happening in our community or happening in which town, or a sale at the shop, you get to hear about it. One day there was a Capetown fashion sale and everyone was speaking about it. It was interesting just to read about it - what people were actually saying.

Q.16: I heard a story from Brent, where he saw an incident where some police were ambushed, and for me that story did show some of the other interesting factors about tweeting and community stories. So do you want to say anything about that?

A: This was two weeks ago. There was a shooting in an area close to two families. Two policemen had been shot as part of the gang violence that is happening. There are two *gangs fighting each other and it is always over drugs and power. The fighting is between 'The Playboys' and 'The Americans' (?). Someone told him that two policemen were shot and Brent tweeted the news that two policemen had been shot dead. So people all across the world who know this place were responding and asking what was happening and people from the area were sending messages, phoning and asking about it - there were close to a hundred messages. Later on, in the online news we were reading, it was said that the policemen were not dead, but injured, so he was told he should be sure of his information. He then had to change his blog and re-tweet the correct news. Big lesson learnt.....*

Q.17: I think Brent also announced his engagement on April fool's Day - and that was a joke. Perhaps there is an integrity issue about Brent's postings?

A: I think he needs a moderator before he can publish anything.

Q.18: So regarding airtime, how much do you think you spend a month or week?

A: Since I had my iPhone, I can't surf the Internet, can't access the web without paying for data on my phone; whereas on a normal phone you just need to have airtime - you can use it for the web or SMSs or anything. On the iPhone I can't - I have to buy data and normal calling.

Q.19: So is that a little bit like the 3G card, where you can buy airtime and then convert it to data?

A: Yes - that is what I have to do now. And because the Internet lasts all the time on my phone, as soon as there is a message, it pushes it through. So all my emails come through - I am always connected. So my data usage is higher than when I was on a normal phone, the phone I had before.

Q.20: So how much do you think you spend a month on airtime and data?

A: On data (what she uses is unclear) it costs 289r. On airtime for calls and text - I prefer to text - I use about 300/350r.

Q.21: What would you most miss if you had no mobile phone?

A: I think it would definitely be to be connected to what is happening - through Twitter, on Facebook, reading the news; I think that's the big one. I could handle not phoning or texting anyone, as most people are on Twitter or Facebook, so I would need to have access to.....(unclear).

Q.22: One of two things I am to going take from you - your laptop or mobile?

A: You can take my laptop, but don't touch the mobile.

Q.23: That's fantastic; I know there's a whole heap of other stuff we could talk about in terms of mobile counselling that you do. There's also the drug advisory stuff, which is absolutely awesome. You're also doing social journalism as well, using mobile phones and teaching school children. Is that correct?

A: That's a new project we started very much in faith, so it's in partnership with the local independent newspaper. The editor is in partnership specifically because she is (doing something which is unclear0) when it comes to using mobile phones and social media to get your message and story across. So they've taken three schools from an (unclear) area. They opened up for four students from each school to come; it was open to anyone but only females applied, which is interesting.

Q.24: That is interesting - why do you think that was?

A: I'm not sure, I don't know. Either it's because females like to talk, or to share or to tell their story.

Q.25: I guess it would have been easier with that age group to have single sex teaching anyway, as people probably focus on the class rather than other things.

A: Yes it will work out. The journalist, the editor from the newspaper is teaching them about journalism, how to be a good journalist. Obviously it is not an in-depth course. Over the last four weeks, she's taken them through what makes a good journalist: about *writing style, choosing headings, even taking photos, looking at the light and the shadows on people's faces, that type of thing.*

It's actually been very good - and because they are from different schools we are having to do a team-building exercise, which they will be doing tomorrow. So it's actually getting them to work together because at the moment they are so very cliquey. Even though four are from each school, when they are at school they don't talk to each other, but here they are a clique.

So the course will take place over a year and there will be a scholarship to study journalism. Their stories at the moment will be: They need to capture what is happening in the environment, their school, the community, their families, and they want people to upload it. The newspaper will actually print it. So their stories will be online and they will be in print. So every week they will be able to go and pick up a newspaper and show someone their story or their picture. It will be in a special column in the newspaper.

Mike thanks the lady for her time, is very appreciative, and tells her she is doing a great job; that there is so much of interest that they are doing here, academically and in the real world.

Interview 8: 14 year old girl in Dutywa

Q.1: What age children generally have mobile ?

A: From the age of 7.

Comment: That is very young, younger than it would be in the UK.

Q.2: Why did you get your first cell phone?

A: Because everybody else had one..... (unclear)

Q.3: Who bought your cell phone?

A: My mummy.

Q.4: What handset do you have now?

A: Nokia 870 - it's good fun.

Q.5: What do you use your cell phone to do?

A: Chat, Mxit, Facebook and Twitter (unclear), email - that's about it.

Q.6: How long do you think you spend on Mxit each day?

A: An hour or so.

Q.7: Is that mainly with your friends?

A: My friends and my family.

Q.8: Are your parents or aunts or uncles on Mxit as well?

A: No - mostly young people.

Q.9: Do you talk mainly with people you already know on Mxit or do you talk with strangers as well?

A: Only people that I know.

Q.10: How much do you think you spend a week on airtime?

A: 20r per week.

Q.11: Do you normally pay for a month or do you pay for it each week - 5r at a time?

A: Yes 5r at a time, topping up four times per week.

Q.12: Does 20r last you the whole week?

A: Not always - sometimes it does.

Q.13: And then you maybe use 'Please call me'?

A: Yes.

Comment: You use your friend's credit; my sons do that - they ring my phone and ring off quickly - so I call them back. Mike discusses the family and they compare marriage and family make-up in England and S Africa. They discuss the various things you can do at certain ages, e.g. get married, drive a car etc. and find some similarities and differences, particularly the need for ID documents....Mike tells how he was amazed when he came to Cape Town when he wanted to buy a simple mobile phone to use whilst here, and had to have a passport, a letter…. He is told you need all that to buy a SIM card. He then questions the next young lady:

Interview 9: 16 year old girl in Dutywa

Q.1: How old are you?

A: I am 16.

Q.2: When did you get your first cell phone?

A: Grade 7 - I was 13.

Q.3: What handset do you have?

A: Type of Nokia. (unclear)

Q.4: Is it a good phone?

A: Yes.

Q.5: What do you use your phone for?

A: Email, Mxit, (now deleted) text messages, calls- that's all. (a little unclear)

Q.6: Why did you delete Mxit?

A: I don't like it.

Q.7: Did you have trouble on it?

A: Yes.

Q.8: What sort of trouble - bullying?

A: No - gossiping.........

Q.9: Did you find it difficult to delete it?

A: No

Q.10: Did you still feel connected to your friends - even without Mxit?

A: I call them.

Comment: It's difficult with Mxit at times; anyone can say anything.

Q.11: How much do you spend per week or month, do you think?

A: 15r per week.

Q.12: Does that last you all week?

A: No - 4 days.

Interview 10: 17 year old girl from Dutywa, South Africa

Q.1: When did you get your first cell phone?

A: I am 17 and I had my first phone when I was 14.

Q.2: Which handset do you have?

A: At the moment I don't have a phone.

Q.3: How do you feel?

A: It's OK; I've got over it.

Q.4: It's strange when you have something like that - and then you don't, isn't it?

A: Yes, you feel lost without it,

Q.5: What did you use your cell phone for?

A: Mxit and SMSs....(unclear)

Q.6: How much did you top up?

A: Answer unclear.

Q.7: Do you feel safer with a mobile phone?

A: Yes.

Q.8: When I was in Idutywa, girls said they felt more vulnerable with a mobile handset because of people stealing them and robbing them at knife point. Is that a problem here in Cape Town?

A: Yes.

Q.9: What do you do if you are walking in the street and your cell phone rings?

A: I always keep it on 'silent'. (Another girl joins the conversation and agrees)

Q.10: Have any of you ever had your phone stolen from you?

A: A girl was chased as someone saw the phone in her pocket - but she realised who he was and he came back and apologised. There was talk that the phone (a Nokia) would have been sold for 500r.

Q.11: Is which handset you have important to you; do people, or your friends, look at your handset at school?

A: Sometimes - but as long as you can use Mxit, stuff like that......

Q.12: Do you have computers as well; do you use computers at home?

A: Yes

Q.13: Are the computers connected to the Internet?

A: One says 'Yes', the other 'No'.

Q.14: What do you prefer to use - computer or mobile phone?

A: The phone.

Q.15: Do you blog, use Facebook etc.?

A: Yes.

Q.16: So if you didn't have a cell phone what are the things you would miss the most?

A: Music.

Q.17: Do you download the music?

A: We use Blue-tooth - share it amongst each other.

Q.18: Do you spend any of your airtime on music?

A: Blue Tooth is free.

Q.19: Yes but someone needs to download the music - have you ever down-loaded music and paid for it?

A: The reply is unclear, but it would seem that they take turns every now and then.

Q.20: What sort of music are you in to?

A: Girls like love songs; but boys like rap.

Q.21: Have you any questions for me?

They reply:

How have mobile phones made life easier for you?

Mike's reply: When I grew up in England, we didn't even have a telephone at home. I am 42 - I was born in 1968. So as we had no telephone, we had to go out in the street to queue up and make calls from a telephone box. Then when we had a telephone at home, we had a lock on it; my parents had the key, so you could only make a call if you could get the key from them. The call had to be really short.

Now, if I come to S Africa or if I am in England, or anywhere, I have my cell phone so I can always make calls and get my email. It's really good, because I can be connected all the time. But In some ways, it is really bad as well, because I'm always working. An email comes through and I check it and think: 'I've got to respond to that'.

So it's made many things a lot easier but also it means that I'm always available; to have time to think and have uninterrupted time with my family is more difficult. Sometimes we go out for some food and my wife has her cell phone, my two sons have their cell phones and I have mine - it's different.

They ask about the boys' cell phones and Mike tells that Zachary has an HTC Titan and describes it for them and explains how he really enjoys technology and details what he can do with his phone. He explains that Reuben has an LG, which was Caroline’s phone which she has passed on to him. He tells them that he has a Google Nexus One, which is quite new - he shows them and explains why he is not using it in S Africa (it has no SIM card in Africa) and there follows a discussion about the properties of the phone as he shows them how to use it.

He tells them that airtime is much cheaper in England than it is here in S Africa and that his home broadband is very fast with unlimited data. He tells them about how they use it: what they can use it for, particularly mentioning family video conferencing, and explains that broadband is cheap. He also tells them that his phone contract is just £20 per month (about 200r) and what it covers. It is clear from the girls that it costs a great deal more to use mobile phones in S Africa than it does in England.

They discuss top-up and how time-consuming it is in S Africa compared to requesting top-up in England by simply sending a message, as they have all bank details recorded.

Mike concludes that young people in S Africa use their airtime better than those in Europe, who send many SMSs - and tells them that one of his sons would send 30 or 40 SMSs a day to his friends. Mike then thanks them and tells them how he appreciates the time they have given him.

Interview 11: 16 year old boy in Dutywa, South Africa

Mike begins by introducing himself and telling his audience about his family and where he comes from and goes on to say:

'My research is looking at how you are using mobile phones and technology. I don't know if you realise it but in S Africa you have the fastest growing use of mobile phone technology on the face of the planet; did you know that? You are world leaders. It's amazing - there are 6.5 billion people living today and 4.7 billion mobile phones with SIM cards. So nearly everybody on the face of the planet has a mobile phone. For the first time in human history, you could call someone pretty much anywhere in the world and talk to them - if you've got enough airtime; yes, this is the problem.

So I thought it would be really good to come to S Africa to talk to you to see how you are using mobile phones, whether they've actually helped you at all, what you think of them, what you are using them for. Also, if there are any sort of things where you think: ‘Yes, it's great to have mobile phones, but it's made life more difficult because of this, that and the other’. Does that make sense? Yes? So are you up for my asking a few questions?

Q.1: How old are you?

A: 16.

Q.2: When did you get your first cell phone?

A: I can't remember - I've had one for a few years.

Q.3: What mobile phone do you have?

A: Sony Ericsson.

Q.4: That's quite an unusual handset - do many people have them?

A: Yes.

Comment: I've spoken to quite a few people and usually it's Samsung or Nokia, but Sony is a very good cell phone.

Q.5: What model of Sony is it?

A: Sony 550i.

Q.6: It's a good music phone, isn't it?

A: Yes - it plays loudly.

Q.7: This is important is it - that you have a phone that plays louder than anyone else's?

A: Yes.

Q.8: What do you use your cell phone for?

A: Mxit, SMSs, phone calls and to go on the web.

Q.9: So what do you do on the web?

A: I just download music and other things.

Q.10: How long do you spend on Mxit per day?

A: One or two hours.

Q.11: Do you chat mainly with your friends and your gang - or parents or uncles?

A: It's just youth.

Q.12: Are you on Pay-as-you-go or Contract?

A: Pay-as-you-go - I buy airtime.

Q.13: How much do you spend on airtime?

A: I spend 50r per week.

Comment: That's a lot of Mxit - or a lot of music.

Q.14: Do you share the music through Blue tooth?

A: Yes.

Q.15: What would you miss most if you had no cell phone?

A: Staying in touch with my parents - and music.

Interview 12: 17 year old boy in Dutywa, South Africa

Q.1: How old are you and when did you have your first cell phone?

A: I am 17 and I had my first cell phone when I was 13.

Q.2: What sort of age do you think people have cell phones?

A: Usually 14.

Q.3: Why did you get your cell phone when you were 13?

A: My parents got it.

Q.4: Did your parents buy it for you?

A: Yes.

Q.5: What do you do with your cell phone?

A: I go on the web and phone people - I keep in touch with other people.

Q.6: What sort of thing do you do on the web?

A: I download games and music.

Q.7: What sort of games are you into?

A: Cars - Need for Speed.

Q.8: Do you think girls play games on their cell phones?

A: No they are just interested in Facebook and Mxit.

Q.9: Are you on Facebook as well?

A: Yes - and Mxit.

Q.10: How do you split things between Facebook and Mxit?

A: I research on Facebook and talk to people on Mxit.

Q.11: Do you just talk to people on Mxit who are your friends?

A: Yes.

Q.12: How much do you spend per month on air time?

A: 50R.

Q.13: Do you run out of airtime or does it last the whole month?

A: No – I don't run out.

Q.14: So you don't use 'Please call me'?

A: Now and then.

Comment: They don't have 'Please call me' in England - I think it's a good idea.

Q.15: What would you most miss if you did not have a cell phone?

A: Phoning people - being in contact.

Interview 13: 17 year old boy in Dutywa

Q.1: And how old are you?

A: I am 17.

Q.2: When did you get your first cell phone?

A: I was 14.

Q.3: Which handset do you have?

A: Samsung.

Q.4: What sort of things do you use your mobile for?

A: Mxit, phone calls, games.

Q.5: Do any of you use your phones for study for school?

A: Some do - mixed response.

Q.6: What about the torch - is that useful?

A: Yes - and the flash for photos. I have Acrobat reader.

Q.7: So you read things in PDF?

A: Yes I download from the Internet.

Q.8: Do you all have computers at home as well?

A: Yes - most do.

Q. 9: So is it connected to the Internet?

A: Mine was - but my mother took it.

Q: 10: Was it too expensive?

A: Unclear - Novelle mentioned.

Q. 11: What would you prefer if I said you could have a cell phone or a computer?

A: One says cell phone, the other a computer as you can do more on a computer.

Q.12: What sorts of things interest you - reading - writing?

A: I just think you can do things easier on a computer.

Q.13: What do you prefer?

A: Cell phone.

Q. 14: Do you have any questions for me about England or anything else?

A: The interviewee asks about the recorder.

The interviews end as Mike shows it to them.

Interview 14: Mikey, 26 year old man in Cape Town

Q.1: Mikey, how old are you?

A: I am 26 years old.

Q.2: How long have you had a cell phone - when did you have your first one?

A: I was 19.

Q.3: Why did you get one?

A: I just wanted it.

Q.4: What do you currently use your cell phone to do?

A: Social media, Facebook, Twitter, photos, videos.

Q.5: Do you use any other social media sites apart from Facebook and Twitter?

A: Numbers (Message), email.

Q.6: Do you use your phone for music and games?

A: I have some music on my phone, but it is not a major interest - and not games.

Q.7: How much do you think you spend per week on airtime?

A: About 12R per week and it lasts me all week.

Q.8: Does your phone have wi-fi?

A: Yes it does.

Comment: That makes it easier when you are in the centre.

Q.9: So your real costs are higher than 12R maybe?

A: Yes

Q.10: How do you think cell phones have benefited the community - do you think it has been a positive thing?

A: Yes, you can use it as a device that can capture moments - people tell their stories (he indicates the wall).

Q.11: What is your particular role - what do you do?

A: I work at RLABS - doing social media and also the technical side of things: ensuring that pcs are up and running and working fine - and networkings.

Q.12: And you go out and do consultancy as well?

A: No I don't do the consultancy.

Q.13: If I could say to you - you can have a computer or cell phone but not both, which would you choose?

A: Cell phone.

Q.14: Very interesting - why is that?

A: Because it is more portable than a computer.

Q.15: Why is that important to you?

A: When something exciting is happening, I can just take my cell phone and capture it.

Q.16: How do you feel when you don't have your cell phone with you, or does that never happen?

A: I would feel lost, but wherever I am I would go back for it.

Q.17: So you check for your keys, cell phone and money and that is it?

A: Yes.

Q.18: If you were not to have your cell phone any more what would you miss the most?

A: Mxit and the IM platform.

Q. 19: So it's textual - do you use your mobile for calling?

A: Not much - it is mainly texting.

Interview 15: Monique in Cape Town (Social Networker)

Q.1: What made you start 'She's the Geek' - what was the reason, the driving force?

A: Because in October last year, for a women's conference, we needed a website - for life streaming/life blogging from the conference.

Q.2: Will you tell me a little about your background and history?

A: When I left school and starting working I called myself Geek

Q3: When did you get your first computer at home?

A; When I was 10 - it was a 486 - the CPU was massive.

Q.4: What was your father's profession?

A: A graphic designer.

Q.5: Did you have the Internet at home?

A: Yes - I remember PlayStation 1.

Q. 6: When did you have your Epiphany moment - from a lifestyle of drug and alcohol abuse and that sort of thing - things changed for you?

A: No-one knew how I was living - I received help when I was in Bridgetown.

Q.7: Have you told your parents since?

A: Yes they were shocked and I moved out for 4 years and had no contact with them.

Q.8: Your cell phone and playing games became your contact with the outside world - and a leveller?

A: Yes, and listening to music.

Q.9: When did you have your first cell phone?

A: It was a Sony Ericssen and I was 14 - I also used an old Nokia Matrix, but it wasn't mine. That was in 1996.

Q.10: Did your friends have cell phones then, or were you one of the first?

A: My cousin did, yes; some of us had cell phones; we used to change the covers.

Q.11: What sort of things do you do on your cell phone now?

A: I check my emails, I don't use my phone, a Nokia, for blogging, as text is hard to do. I use it for calls and SMS.

Q.12: Do you still use it for games?

A: No, there are none on my phone.

Q.13: Do you use it for Calendar?

A: Yes I do - and for Alarm.

Q.14: And photos?

A: Yes - and video and music; I also use it often for a torch.

Q.15: How much do you spend on airtime - are you on a contract?

A: I have a contract for 2 phones – with MTN and Vodaphone - MTN costs 100r per month and I use it within 2 weeks and Vodaphone costs 200R per month.

Q.16: Why do you have 2 phones?

A: One is for clients and one is personal (one is a Nokia N80) and I like both equally.

Q.17: Does your mobile phone make you feel safer?

A: Yes, it does.

Q.18: How do you feel when you are not connected - do you ever leave your phone at home?

A: I always have it with me - I have to remember my charger - but my Internet is down today.

Q.19: Does that happen often?

A: Sometimes.

Comment: There is a lot of work being done at the moment because of the world cup.

Q. 20: Do you have your phone on silent?

A: No I let it ring.

Comment: I have spoken to quite a few young people and they feel quite nervous of using their phones in public - so keep them on silent.

Q.21: Do you feel comfortable with that in public?

A; Yes I do - in shopping malls there is good security.

Q.22: what would you miss the most if you could only have a laptop, computer or a cell phone - if all of them were connected to the Internet?

A: I would keep the cell phone, as everything about it is easier - and it is small to carry around.

Q.23: If you couldn't have a mobile, what would you miss the most?

A: Internet - data

Q.24: Remind me what you do?

A: I work for a councillor - we negotiate - and I manage the systems - PCs etc.

Mike confirms with Monique that their company connects by cable to a satellite and thanks her for her time.

Interview 16: Clinton at RLabs, 25 years old male.

Mike is with Clinton and explains that his research is into mobile phone usage in S Africa and that they are particularly looking at the sorts of things that people do with mobile handsets, how much they spend on airtime, and how they think mobile phones are helping. He tells Clinton that this is initial research and asks permission to put questions to him. He suggests that he might do a second interview regarding what he is doing with RLABS.

Q.1: When did you get your first mobile handset - can you remember that far back?

A: In 1992 when I was about 20 years old - it was a Nokia 21/10.

Q.2: Why did you get your first cell phone?

A: My dad had one first - so we could be in contact all the time - we could call if we were not at home. It was the status as well - I was one of the first guys to have a phone in S Africa. It was important to me.

Q.3: Is that important now?

A: Not status - it is more about having a nice phone.

Q.4: Which phone do you have now?

A: A Nokia E62 and I have another with my old number in case I didn't get the number to people; but I don't really use that phone.

Q.5: Is it quite normal for people to have more than one phone?

A: It is - I've seen people with more than one cell phone - for different reasons. Some have a personal phone and another for other reasons.

Q.6: How much do you spend on airtime per month?

A: About 200R.

Q.7: Does it last you the whole month?

A: That was only roughly - I don't set aside 200R - I don't call people much.

Q.8: Can you list me what you use your cell phone for?

A: Twitter, receiving calls, Facebook.

Q.9: Mxit?

A: I do have a Mxit account, but I don't really use it that much - I used to in the past.

Q.10: Calendaring?

A: Yes - definitely - I only use a diary when I have to write notes.

Q.11: What about task management?

A: Yes - I check for ones that aren't done.

Q.12: What about gaming?

A: Not at all.

Q.13: What about photos and videos?

A: Yes.

Q.14: Do you think that mobile phones have changed life in Cape Flats, Bridgetown...?

A: Definitely, some for good, some not. Some young people - all they do is Mxit - it has had an effect on the way they interact. For the good you have access to things we could not before. You can Google and research school projects - you don't have to go to the library or carry around encyclopaedias- it's on the phone.

Q.15: Do you think that people feel safe in the area because they have a cell phone or less safe as they are fearful that they may get mugged?

A: I think getting mugged is a given - but people are smart in this area.

Q.16: Have you had any phone stolen yourself?

A: Once.

Q.17: A number of women I have spoken to have their phone on silent the whole time, so if someone phones they will not draw attention to themselves; do you think that is common practice?

A: Yes it is; I keep my phone on silent for that reason, unless I am in a group.

Q.18: Does your wife have just one cell phone?

A: She just has one.

Q.19: And your children - how old are they?

A: My eldest is 8 years old so does not have his own cell phone.

Q.20: How old do you think children tend to be before they have their own cell phone - eg do his friends have them?

A: I know of people who let them have them at 8 or 9 years old. Although I'd love to see my son have one, I don't think he is responsible enough yet. (some of this unclear)

Q.21: If he has one he may be a target for theft?

A: Yes that is possible.

Q.22: At what age would you be happy for him to have a cell phone?

A: Around 18/19 (unclear - but he speaks of his 4 year old who is very interested in cell phones and can play games, take photos and delete information - all this he has picked up himself on his father's phone)

Comment: Nobody taught him - he is a digital native.

Q.23: So if I took your cell phone away from you how would you feel?

A: I'd die!!! (he comments on how he would feel and summarises that he would feel panic and disconnected)

Q.24: So in real terms, what difference would it make if you had no phone?

A: At the places where I go, people know they can get hold of me on my cell phone. When I am at home, at the centre, or at my parents' home I can be reached without my cell phone. The cell phone is part of my life, not a status symbol, but a necessity.

Q.25: I guess it's the way you share your life with others, connect with others, keep up with their stories?

A: Anything - I can just pick up my phone.

Q.26: If you had to choose between a cell phone or a laptop, which would it be?

A: I think I would probably say a very nice phone - almost anything I do on the laptop I can do on the phone.

Q.27: So what would your dream phone be?

A: There are so many out there - some very nice ones. He mentions several (unclear) and talks about phones which specialise, mentioning his brother-in-law who has a Sony Ericsson which he finds perfect for taking pictures. He says: For me, it is social media and tools, so I need a phone with multiple applications. I want to be able to minimise so I don't have to log off and log back in. I would want the latest software so I would go for the latest that suits my needs. At the moment my phone services my needs.

Comment: It's interesting - since coming to S Africa I have put my Nexus phone away and I'm using a very basic handset that can do email, web browser etc. on a really small screen, just using the number keypad. Clinton likes his new phone that records the voice and comments that he would not want to go back to using a number keypad, having got used to the new phone over the last four months. Clinton confirms that he like the iphone and the Nokia 900.

Q.28: In Idutywa and E London we found that school children were doing favours to raise money for airtime. Is that common in Cape Town as well?

A: I haven't come across that in Cape Town - he speaks about people who offer some kind of service in the street to obtain money (this is unclear)

Q.29: What about older people - I know you are doing some projects at RLABS with seniors: helping them to get online and use mobile phones. Do you think most seniors have a cell phone in the community?

A: Middle aged and youngsters have the upmarket phones, smart phones. Older people have a simpler phone.

Q.30; Do you think that if people have difficulty in reading and writing that the text culture is difficult for them?

A: Even if they can't read and write they are very interested in learning how to text; though they can't spell words they can put something together in a creative way.

They discuss text language, as opposed to correct spelling and grammar. They both agree that predictive text can offer the wrong word which can cause problems. Mike thanks Clinton for his time.

Interview 17: Roger Petersen, Businessman 60 years old.

This begins with a discussion between Mike and Roger Petersen a businessman.

He is telling Mike that it is cheaper to use the iI rather than 'voice'. People are looking for an alternative to voice in order to communicate. He states that if you have a contract for calls and SMSs with Blackberry, your Internet is completely free. So when people use up their allocated airtime for the month, the Internet is free for them to use. People are realising that the Internet is cheaper, so if you can use mobile Internet it is a cheap option, using Facebook or Skype.

Roger is planning to take out a Blackberry contract and Mike confirms that with Blackberry, he will be connected, he will get email, BBM, chat etc. Roger tells of a colleague in a senior position who is also using Blackberry as voice is expensive. He talks of economics, where, when competing projects are expensive. People are pushed towards alternatives and will be drawn to mobile Internet as a cheaper alternative.

Mike states that he was in Malawi and Zambia a few weeks previously doing work alongside Tearfund (he explains the involvement and the vital work with Aids sufferers), putting in a mobile solution using Jamiix and some other African innovation. Mike and the team were bringing that together into one consolidated platform so that can educate, chat, mentor etc. and explains that they also have all their training resources on cell phones.

They have a general discussion about the work that Mike is doing in these areas, recognising all the environmental changes, particularly de-forestation and related problems. Mike feels, from a very cursory outside perspective, that he whole notion of regulation within Malawi is not good on Telecoms, forestation management and possibly other areas. They comment on private Internet providers doing what they want to; disparities in education where schools and universities are individually doing different things.

They go on to speak of the general instability of the country. Mike refers to the fact that technologically they have the capability for mobile Internet, but people are still using voice and SMS and blames the mobile phone operators as they have some wonderful 3G towers – the latest technology with high-powered antennae but people are not using mobile Internet.

People who Mike spoke to were spending 40-70% of their income on airtime and cutting down on buying good food and making choices around their children's education with deference to airtime. It was mooted that in some areas teenagers were selling sexual favours to fund airtime. Malawi has one of the highest ICT price-baskets in Africa - similarly in Zambia; there is such disparity - a phone in Zambia would be 30% cheaper in Malawi.

Appendix Five: Data used to refine the model of AMI

Metadata of the indices

Indicator	Description	Reference
Innov1	*Business and innovation* Index description: "An enabling environment determines the capacity of an economy and society to benefit from the use of ICT. The success of a country in leveraging ICT and achieving the desired economic and social benefits will depend on its overall environment—including market conditions, the regulatory framework, and innovation-prone conditions—to boost innovation and entrepreneurship."	(World Economic Forum 2012)
Innov2	*Capacity for innovation* "In your country, how do companies obtain technology? [1 = exclusively from licensing or imitating foreign companies; 7 = by conducting formal research and pioneering their own new products and processes] | 2010–2011 weighted average."	(WORLD ECONOMIC FORUM 2010)
Edu	*Quality of the educational system* "How well does the educational system in your country meet the needs of a competitive economy? [1 = not well at all; 7 = very well] | 2010–2011 weighted average.	(WORLD ECONOMIC FORUM 2010)
Lit	*Adult literacy* "Adult literacy is defined as the percentage of the population aged 15 years and over who can both read and write with understanding a short, simple statement on his/her everyday life. Whenever data come from economies classified by the World Bank as high income, we assume a rate of 99%, in accordance with the approach adopted by the United Nations	(UNESCO 2011; The World Bank 2011a)

	Development Programme (UNDP) in calculating the 2009 edition of the Human Development Index.”	
DigLit	*Percentage of households equipped with a personal computer, 2010* “The proportion of households with a computer is calculated by dividing the number of households with a computer by the total number of households. A computer refers to a desktop or a laptop computer. It does not include equipment with some embedded computing abilities such as mobile cellular phones, personal digital assistants (PDAs), or television sets.”	(ITU Telecom World 2011a)
CrowdAdop	*Use of virtual social networks* “How widely used are virtual social networks (e.g., Facebook, Twitter, LinkedIn) for professional and personal communication in your country? [1 = not used at all; 7 = used widely] 2010– 2011 weighted average”	(WORLD ECONOMIC FORUM 2010)
Income	*GDP/capita* Gross domestic product per capita in current US dollars 2009. This is a proxy measure of income as actual figures were not available for all countries covered.	(International Monetry Fund 2010)
AMI1	*Mobile phone subscriptions* “A mobile telephone subscription refers to a subscription to a public mobile telephone service that provides access to the Public Switched Telephone Network using cellular technology, including number of pre-paid SIM cards active during the past three months. This includes both analog and digital cellular systems (IMT-2000, Third Generation, 3G) and 4G subscriptions, but excludes mobile broadband subscriptions via data cards or USB modems. Subscriptions to public mobile data services, private trunked mobile radio, telepoint or radio paging, and telemetry services are also excluded. It includes all mobile cellular subscriptions that offer voice communications."	(ITU Telecom World 2011a)
AMI2	*Mobile broadband Internet subscriptions per 100 population |2010* “Mobile broadband subscriptions refers to active SIM cards or, on CDMA	(ITU Telecom World 2011a)

	networks, connections accessing the Internet at consistent broadband speeds of over 512 kb/s, which includes cellular technologies such as HSPA, EV-DO, and above. This includes connections being used in any type of device able to access mobile broadband networks, including smartphones, USB modems, mobile hotspots, or other mobile-broadband connected devices."	
AMI 3	*Percentage of individuals using the Internet | 2010* "Internet users are people with access to the worldwide network."	(ITU Telecom World 2011a)
GovReg	*Political and Regulation* "An index that is derived from the following indices: effectiveness of law-making bodies, laws relating to ICT, judicial independence, efficiency of legal framework in settling disputes, efficiency of legal framework in challenging regulations, intellectual property protection, software piracy rate, number of procedures to enforce a contract, time to enforce a contract"	(World Economic Forum 2012)
ElecPow	"Electricity production is measured at the terminals of all alternator sets in a station. In addition to hydropower, coal, oil, gas, and nuclear power generation, it covers generation by geothermal, solar, wind, and tide and wave energy as well as that from combustible renewables and waste. Production includes the output of electricity plants designed to produce electricity only, as well as that of combined heat and power plants. Total electricity production is then divided by total population. Population figures are from the United Nations Division of Economic and Social Affairs (retrieved November 10, 2011)."	(The World Bank 2011b)
ServProv	*Mobile network coverage* "This indicator measures the percentage of inhabitants who are within range of a mobile cellular signal, irrespective of whether or not they are subscribers. This is calculated by dividing the number of inhabitants within range of a mobile cellular signal by the total population. Note that this is not the same as the mobile subscription density or penetration."	(ITU Telecom World 2011a)
DigCon	*Accessibilty of digital content*	(WORLD ECONOMIC

	“In your country, how accessible is digital content (e.g., text and audiovisual content, software products) via multiple platforms (e.g., fixed-line Internet, wireless Internet, mobile network, satellite, etc.)? [1 = not accessible at all; 7 = widely accessible] | 2010–2011 weighted average"	FORUM 2010)
TCO	*Mobile cellular tariffs* Average per-minute cost of different types of mobile cellular calls (PPP $) | 2010 Index description: “This measure is constructed by first taking the average per-minute cost of a local call to another mobile cellular phone on the same network (on-net) and on another network (off-net). This amount is then averaged with the per-minute cost of a local call to a fixed telephone line. All the tariffs are for calls placed during peak hours and based on a basic, representative mobile cellular pre- paid subscription service. The amount is adjusted for purchasing power parity (PPP) and expressed in current international dollars. PPP figures were sourced from the World Bank’s World Development Indicators Online (retrieved November 13, 2011) and the International Monetary Fund’s World Economic Outlook (September 2011 edition)."	(International Monetry Fund 2010)

Table Appendix 5: 1: Meta Data for the indices used for SEM

Country	AMI1	AMI2	AMI3	DigLit	ServProv	ElecPow	DigCon	TCO	GovReg	Income	Innov1	Innov2	Educ	CrowdAdop	Lit
AGO	46.69	1.48	10.00	7.14	40.00	221.26	3.22	0.34	2.69	4328.51	2.57	1.58	1.94	3.92	69.96
ARE	145.45	3.46	78.00	76.00	100.00	13898.06	5.93	0.09	4.66	57884.23	5.00	3.78	4.61	5.87	90.03
ARG	141.79	6.14	36.00	40.00	94.10	3057.44	4.69	0.71	2.94	9131.33	3.57	2.95	3.37	5.39	97.73
ARM	125.01	3.71	44.00	21.00	98.90	1874.58	4.43	0.17	3.06	2840.43	3.77	3.14	3.22	4.66	99.53
AUS	101.04	53.12	76.00	81.10	99.10	11240.60	6.06	0.64	5.48	55671.62	5.07	3.98	5.12	6.10	99.00
AUT	145.84	24.93	72.70	76.19	99.00	7830.92	6.44	0.08	5.33	44988.16	4.53	4.83	4.72	6.13	99.00
AZE	99.05	0.63	46.00	21.50	100.00	2669.51	4.81	0.15	3.60	6008.25	3.86	3.24	3.04	5.80	99.50
BEL	113.46	8.03	75.00	76.72	99.90	8412.11	6.34	0.58	4.84	42844.77	5.01	4.75	5.48	5.96	99.00
BGR	136.10	3.76	46.23	35.07	99.99	5873.02	5.23	0.80	3.30	6356.12	4.27	2.88	3.19	5.36	98.32
BHR	124.18	27.09	55.00	87.00	100.00	11339.29	6.09	0.16	4.53	20474.82	5.14	2.41	4.56	6.07	91.36
BOL	72.30	2.68	20.00	17.03	45.90	648.75	3.64	0.52	2.99	1900.00	2.98	2.99	3.14	4.20	90.70
BRA	104.10	6.31	40.65	34.86	99.89	2419.14	4.93	0.73	3.59	10816.49	3.46	3.79	3.01	5.45	90.04
BWA	117.76	10.40	6.00	6.45	99.00	322.79	4.31	0.49	4.33	8116.87	3.88	2.61	3.87	4.53	84.12
CAN	70.66	30.36	81.60	83.87	99.00	18485.84	6.25	0.33	5.36	46302.67	5.30	4.14	5.42	6.28	99.00
CHE	124.30	31.01	83.90	86.85	100.00	8766.32	6.58	0.51	5.61	67778.53	5.13	5.77	5.94	6.20	99.00
CHL	116.00	9.03	45.00	46.80	100.00	3554.74	5.33	0.29	4.45	11826.57	4.99	3.04	3.36	5.83	98.55
CHN	64.04	1.79	34.30	35.39	99.46	2602.55	5.63	0.15	4.07	4382.14	3.69	4.23	3.97	4.95	93.98
CMR	44.07	0.15	4.00	5.36	58.00	295.91	3.35	0.42	2.98	1102.74	3.61	2.50	3.51	3.99	75.90
COL	96.07	3.67	36.50	26.10	83.00	1244.82	4.66	0.29	3.51	6359.56	3.76	3.17	3.68	5.15	93.24
CYP	93.70	5.90	52.99	60.53	99.98	4714.94	5.44	0.10	4.53	28854.41	4.86	3.17	4.59	5.25	97.93
CZE	137.17	3.84	68.82	64.06	99.80	7825.87	6.06	0.40	4.00	18276.67	4.21	4.04	4.09	5.79	99.00
DEU	127.04	15.39	82.00	85.74	99.00	7168.74	6.07	0.15	5.34	40273.52	4.63	5.73	4.93	5.75	99.00
DOM	89.58	5.12	39.53	16.42	81.16	1594.84	4.98	0.46	3.19	5226.77	3.98	2.32	2.31	5.31	88.24
ECU	102.18	8.25	29.00	27.00	93.30	1323.85	4.12	0.39	2.98	3920.80	3.62	2.78	3.16	4.70	84.21
EGY	87.11	0.72	26.74	34.00	99.70	1673.07	4.47	0.09	3.59	2808.04	3.76	2.83	2.32	5.44	74.00
ESP	111.99	18.57	65.80	68.72	99.80	6387.03	5.62	0.73	4.12	30639.30	4.67	3.52	3.21	5.39	97.68
EST	123.24	25.90	74.10	69.25	99.99	7883.65	6.34	0.36	4.85	14404.74	4.54	3.73	4.28	6.12	99.79
ETH	8.26	0.02	0.75	1.38	10.00	47.54	3.07	0.17	3.64	350.44	3.75	2.34	3.86	3.19	35.90
FIN	156.40	60.70	86.89	81.99	99.50	13398.18	6.19	0.07	5.80	44495.69	5.32	5.55	5.85	6.13	99.00
FRA	100.66	18.08	80.10	76.41	99.00	8600.03	5.55	0.57	5.17	40704.35	4.57	5.13	4.46	5.91	99.00
GBR	130.76	38.19	85.00	82.57	99.80	5970.43	6.43	0.31	5.51	36164.10	5.05	4.75	4.83	6.54	99.00
GEO	91.45	11.28	26.90	18.20	99.00	1921.02	4.85	0.31	3.31	2629.44	4.23	2.62	3.00	5.47	99.72
GHA	71.49	0.57	9.55	9.14	77.00	359.31	3.93	0.12	3.94	1363.85	3.85	2.73	3.64	4.49	66.62
GMB	85.53	0.72	9.20	5.72	85.00	134.47	4.64	0.49	4.61	611.77	3.51	3.07	4.53	5.05	46.50
GRC	108.22	4.89	44.40	53.39	99.90	4848.41	5.02	0.50	3.49	27310.68	4.21	2.71	2.85	5.05	97.16

Country	AMI1	AMI2	AMI3	DigLit	ServProv	ElecPow	DigCon	TCO	GovReg	Income	Innov1	Innov2	Educ	CrowdAdop	Lit
GTM	125.57	3.04	10.50	15.81	76.00	636.70	5.10	0.17	2.81	2867.23	3.84	2.99	2.60	5.35	74.47
HKG	195.57	29.43	72.00	77.94	100.00	5485.41	6.23	0.02	5.32	31514.20	5.36	3.46	4.82	6.23	99.00
HND	125.06	4.17	11.09	12.91	89.93	895.14	4.48	0.32	3.28	1908.28	3.60	2.77	2.58	5.21	83.59
HRV	144.48	15.53	60.32	60.01	100.00	2764.81	5.39	0.23	3.53	13775.90	4.17	3.06	3.30	5.09	98.76
HUN	120.32	10.06	65.27	66.44	99.00	3589.99	6.08	0.31	4.10	13023.86	4.27	3.42	3.45	5.06	99.37
IDN	91.72	1.53	9.90	10.80	90.00	636.03	5.00	0.18	3.48	2974.03	4.09	3.80	4.23	5.67	92.19
IND	61.42	0.11	7.50	6.12	83.00	697.08	4.76	0.06	3.65	1370.80	3.80	3.60	4.38	4.93	62.75
IRL	105.18	35.40	69.85	76.46	99.00	6188.55	5.42	0.35	5.16	46298.08	4.75	3.77	5.18	5.80	99.00
ISL	106.54	12.66	95.00	93.00	99.00	53352.47	6.53	0.15	4.98	39025.70	5.06	4.37	5.63	6.75	99.00
ISR	133.11	55.76	67.20	77.00	100.00	7955.08	6.00	0.31	4.79	29264.07	5.16	5.28	4.10	5.74	99.00
ITA	149.63	16.82	53.68	64.85	99.00	4742.10	4.93	0.23	3.50	34058.72	3.99	4.01	3.34	5.56	98.87
JAM	116.09	2.42	26.10	20.00	95.00	2860.37	5.12	0.29	3.91	4914.83	3.95	2.71	3.18	5.21	86.36
JOR	106.99	0.33	38.00	51.41	99.00	2365.89	5.31	0.15	3.87	4326.38	4.45	2.73	3.99	5.59	92.20
JPN	95.39	64.63	78.20	83.38	99.90	8215.78	6.32	0.81	5.18	42782.52	4.53	5.84	4.41	5.23	99.00
KAZ	121.07	0.02	34.00	25.10	95.00	5130.90	4.83	0.29	3.42	9008.70	3.99	2.64	3.05	4.43	99.68
KEN	61.63	0.86	25.90	4.10	89.00	183.46	4.52	0.29	3.38	807.50	3.73	3.33	4.66	5.22	87.01
KGZ	98.90	0.02	20.00	3.98	96.00	2282.24	5.21	0.18	2.73	842.58	3.25	2.01	3.26	4.63	99.24
KHM	57.65	0.74	1.26	4.33	99.00	105.70	4.35	0.21	3.64	813.80	3.69	2.81	3.75	4.58	77.59
KOR	105.36	78.04	83.70	81.80	99.90	9239.74	6.24	0.35	4.14	20756.25	5.12	4.33	3.93	5.81	99.00
KWT	160.78	5.88	38.25	37.53	100.00	20306.86	4.96	0.14	3.81	37009.26	4.17	2.75	3.11	5.38	93.91
LKA	83.22	1.85	12.00	12.28	98.00	451.41	4.51	0.04	3.75	2428.09	3.84	3.28	4.32	4.59	90.56
LSO	45.48	0.52	3.86	4.98	55.00	92.11	3.24	0.42	3.03	911.08	3.54	2.10	3.29	4.14	89.66
LTU	147.16	12.02	62.12	59.23	100.00	3966.31	6.17	0.26	3.95	11045.77	4.39	3.31	3.80	5.82	99.70
LUX	143.27	17.59	90.00	90.21	99.90	6293.74	6.08	0.25	5.79	108951.72	4.75	4.49	4.46	6.01	99.00
LVA	102.40	15.85	71.10	62.78	98.80	2322.12	5.40	0.22	3.87	10680.31	4.42	3.39	3.69	5.25	99.78
MAR	100.10	2.83	49.00	34.23	98.40	664.85	4.61	0.77	3.68	2861.29	4.04	2.56	3.28	5.74	56.08
MDA	88.59	3.16	40.00	36.91	97.98	997.51	4.89	0.32	3.08	1630.45	3.81	2.57	3.18	4.78	98.46
MDG	37.23	0.07	1.70	1.37	23.00	56.79	3.52	0.43	2.68	414.90	3.72	2.51	2.96	4.86	64.48
MEX	80.55	1.47	31.05	29.80	99.90	2256.23	4.79	0.43	3.50	9521.65	3.94	2.96	3.12	5.13	93.44
MKD	104.51	6.51	51.90	60.33	99.90	3074.75	5.25	0.58	3.51	4482.77	4.40	2.81	3.63	5.68	97.12
MLT	109.34	11.66	63.00	73.13	100.00	5585.27	6.02	0.57	4.68	19706.54	4.51	3.06	4.90	6.10	92.36
MNE	185.28	21.99	52.00	31.99	100.00	4227.69	5.39	0.52	3.80	6417.19	4.53	3.24	4.37	5.76	97.70
MNG	91.09	2.34	12.90	22.30	85.00	1553.90	5.23	0.10	3.18	2266.65	4.01	2.98	2.39	4.70	97.49
MOZ	30.88	0.36	4.17	7.48	32.23	677.34	3.63	0.51	3.34	439.88	3.52	2.31	3.20	3.80	55.06
MRT	79.34	0.01	3.00	2.99	62.00	166.00	3.52	0.50	3.01	1141.37	2.69	2.41	1.99	3.71	57.45
MUS	91.67	7.92	28.33	37.71	99.00	1870.94	4.85	0.20	4.36	7589.57	4.40	2.77	4.01	5.17	87.90
MWI	20.38	0.21	2.26	4.49	85.00	119.67	4.22	0.67	4.05	343.48	3.56	2.88	4.13	4.52	73.69

Country	AMI1	AMI2	AMI3	DigLit	ServProv	ElecPow	DigCon	TCO	GovReg	Income	Innov1	Innov2	Educ	CrowdAdop	Lit
MYS	119.22	10.37	56.30	41.02	95.00	3541.27	5.66	0.19	4.87	8423.18	4.97	4.35	5.09	5.93	92.46
NAM	67.21	8.78	6.50	15.43	95.00	953.00	4.54	0.28	4.60	5517.73	3.83	2.62	2.78	4.60	88.51
NGA	55.10	1.03	28.43	15.37	90.00	140.11	4.26	0.43	3.45	1298.14	3.71	3.22	3.80	5.25	60.82
NIC	65.14	1.79	10.00	8.16	100.00	596.39	3.96	0.62	2.66	1126.55	2.99	2.52	2.33	4.45	78.00
NLD	115.45	7.48	90.72	91.97	98.00	6777.53	6.39	0.36	5.55	46985.76	5.10	4.99	5.21	6.20	99.00
NOR	115.68	52.53	93.39	90.94	97.00	27298.91	6.35	0.10	5.53	84143.69	5.12	4.49	4.79	6.24	99.00
NPL	30.69	0.02	7.93	4.21	35.13	106.69	3.62	0.07	2.93	557.37	3.46	2.29	3.19	4.05	59.14
NZL	114.92	18.32	83.00	83.85	97.00	10035.56	5.92	0.55	5.84	32162.57	5.12	3.82	5.33	6.15	99.00
OMN	165.54	16.67	62.00	45.55	97.60	5961.78	5.45	0.24	4.59	19405.40	4.67	3.18	4.17	5.21	86.62
PAN	184.72	1.55	42.75	19.83	90.70	1887.58	5.11	0.23	3.51	7601.20	4.39	2.70	2.42	5.88	93.61
PER	100.13	4.51	34.30	22.70	97.10	1139.36	4.64	1.27	3.05	5204.54	4.23	2.68	2.60	5.09	89.59
PHL	85.67	2.26	25.00	13.10	99.00	674.49	4.82	0.30	3.15	2123.01	3.69	2.71	3.83	5.75	95.42
POL	122.67	31.28	62.32	69.02	99.00	3948.39	4.96	0.31	3.75	12322.77	4.22	3.30	3.68	4.39	99.51
PRT	142.33	24.09	51.10	59.49	99.00	4613.51	6.05	0.27	4.20	21541.64	4.74	3.47	3.58	5.80	94.91
PRY	91.73	4.29	19.80	19.30	94.00	8902.38	3.94	0.32	2.63	2878.34	3.72	2.43	2.21	4.47	94.56
QAT	132.43	9.55	81.60	89.60	100.00	15483.58	5.79	0.20	4.82	74901.42	5.37	4.97	5.64	6.12	94.72
ROU	114.68	9.42	39.93	47.89	99.90	3008.68	5.22	0.58	3.37	7542.25	4.02	2.93	3.30	5.14	97.65
RUS	166.26	3.37	43.00	50.00	95.00	7253.48	5.15	0.22	3.24	10355.67	3.84	3.46	3.43	4.76	99.56
RWA	33.40	0.46	13.00	0.48	96.00	15.99	4.38	0.44	5.10	557.96	4.22	2.89	3.98	4.39	70.67
SAU	187.86	11.69	41.00	57.30	99.10	7803.83	5.44	0.23	4.75	16266.74	5.24	4.33	4.71	5.14	86.13
SEN	67.11	0.50	16.00	5.69	90.00	203.70	5.02	0.32	3.18	979.96	4.15	2.97	3.83	4.85	49.70
SGP	145.18	48.36	71.00	84.00	100.00	8741.64	6.35	0.15	5.96	43116.69	5.51	4.30	5.93	6.12	94.71
SLV	124.34	3.60	15.90	13.26	95.00	972.33	4.89	0.29	2.97	3617.92	3.96	2.46	2.67	5.35	84.10
SRB	129.19	4.14	40.90	50.85	96.95	3736.58	4.42	0.21	3.05	5138.91	3.84	2.53	3.09	4.31	97.77
SVK	108.47	7.19	79.42	72.18	99.85	4765.07	5.56	0.82	3.63	16103.99	4.09	2.83	2.98	5.55	99.00
SVN	104.55	15.47	70.00	70.46	99.70	8125.67	5.77	0.28	3.88	23648.37	4.81	3.87	3.82	5.24	99.68
SWE	116.05	71.72	90.00	89.50	99.00	14341.90	6.58	0.08	5.86	49183.02	5.15	5.69	5.34	6.43	99.00
SYR	57.81	0.09	20.70	40.37	97.50	2082.99	3.72	1.09	2.88	2823.11	3.79	2.13	3.25	3.67	84.19
THA	103.62	0.67	21.20	22.84	37.77	2159.53	4.76	0.09	3.67	4992.43	4.24	3.19	3.57	5.00	93.51
TJK	86.37	0.64	11.55	2.87	0.00	2413.09	4.49	0.06	3.97	733.86	3.36	2.99	3.39	3.61	99.67
TUN	106.04	0.04	36.80	17.00	100.00	1494.15	4.83	0.31	4.02	4199.35	4.03	3.39	4.32	6.10	77.56
TUR	84.90	7.09	39.82	44.23	100.00	2701.05	5.26	0.40	3.80	10309.46	4.33	2.98	3.27	5.18	90.82
TZA	46.80	0.11	11.00	2.62	85.00	104.43	3.38	0.70	3.75	545.19	3.28	3.21	3.29	3.83	72.90
UGA	38.38	0.01	12.50	2.12	100.00	69.43	3.62	0.48	3.78	500.65	3.50	2.52	3.76	3.93	74.60
UKR	118.64	0.57	45.00	30.70	99.90	4184.59	5.14	0.07	2.88	3012.80	3.75	3.42	3.82	4.42	99.69
URY	131.71	9.70	47.70	52.79	100.00	2620.77	5.83	0.39	4.01	11997.90	4.42	3.05	3.41	5.81	98.27
USA	89.86	50.56	74.00	75.54	99.80	13524.20	6.02	0.25	4.99	46860.24	5.22	5.19	4.67	6.17	99.00

Country	AMI1	AMI2	AMI3	DigLit	ServProv	ElecPow	DigCon	TCO	GovReg	Income	Innov1	Innov2	Educ	CrowdAdop	Lit
VEN	96.20	7.45	35.67	17.27	90.00	4251.88	4.37	0.57	2.45	10049.19	3.12	2.36	2.83	5.71	95.15
VNM	175.30	0.27	27.56	14.21	70.00	849.88	5.34	0.30	3.55	1173.55	3.62	3.18	3.71	4.53	92.78
ZAF	100.48	5.78	12.30	18.33	99.79	5180.91	4.77	0.35	4.92	7274.42	4.37	3.38	2.33	5.05	89.00
ZWE	61.25	0.05	11.50	5.32	80.00	641.69	3.41	0.16	3.06	594.50	3.21	2.38	4.49	4.10	91.86

Appendix Six: AMOS output report

The AMOS output report of the testing of the AMI model is shown below:

Date: 24 November 2012

Time: 12:22:42

Notes for Group (Group number 1)

The model is nonrecursive.
Sample size = 113

Your model contains the following variables (Group number 1)

Observed, endogenous variables

Innov2

DigLit

Lit

Educ

Income

AMI1

AMI2

AMI3

ServProv

GovReg

CrowdAdop

TCO

ElecPow

DigCon

Innov1

Unobserved, endogenous variables

Innov

AMI

Unobserved, exogenous variables

e9

e13

e14

e15

e1

e2

e3

e12

e6

e7

e11

e10

D1

e5

e8

D2

e4

Variable counts (Group number 1)

Number of variables in your model:	34
Number of observed variables:	15
Number of unobserved variables:	19
Number of exogenous variables:	17
Number of endogenous variables:	17

Parameter summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	19	0	0	0	0	19
Labeled	0	0	0	0	0	0
Unlabeled	24	0	17	0	0	41
Total	43	0	17	0	0	60

Sample Covariances (Group number 1)

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
GovReg	.793														
ServProv	5.901	383.463													
DigCon	.570	9.933	.788												
ElecPow	2968.450	34923.259	3319.139	43173935.378											
TCO	-.033	.429	-.033	-247.972	.050										
CrowdAdop	.418	8.465	.556	2654.446	-.016	.558									
Income	13563.922	129228.943	12322.169	84324448.095	-488.944	9517.514	412065010.901								
Educ	.644	4.698	.502	2987.079	-.043	.381	11755.770	.843							
Lit	3.597	133.737	7.582	33964.441	-.270	5.105	117762.784	2.987	184.994						
DigLit	19.105	288.320	22.624	124884.660	-.308	16.230	488396.662	16.95	246.351	888.947					

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
								6							
Innov1	.458	5.875	.474	2433.062	-.024	.365	9229.939	.412	4.105	15.853	.410				
AMI3	16.938	274.900	21.060	114582.841	-.208	15.881	438391.439	15.537	234.610	772.211	14.008	746.733			
AMI2	9.549	97.229	9.382	50520.390	-.210	6.592	208742.453	7.897	90.230	345.612	7.088	308.501	278.484		
AMI1	10.405	345.093	21.071	75256.417	-1.532	15.636	295490.211	7.356	296.196	595.827	12.232	577.648	199.052	1371.046	
Innov2	.623	6.288	.599	2999.090	-.030	.426	13512.572	.602	5.159	19.768	.405	18.540	10.278	12.510	.830

Condition number = 11669357073.078

Eigenvalues

430428161.307 24812289.341 1443.212 422.949 233.866 123.964 86.952 41.140 .748 .222 .203 .142 .074 .060 .037

Determinant of sample covariance matrix = 53004469152408200000000.000

Sample Correlations (Group number 1)

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
GovReg	1.000														
ServProv	.339	1.000													
DigCon	.722	.571	1.000												
ElecPow	.507	.271	.569	1.000											
TCO	-.164	.098	-.166	-.169	1.000										
CrowdAdop	.628	.579	.838	.541	-.099	1.000									
Income	.751	.325	.684	.632	-.108	.628	1.000								
Educ	.788	.261	.616	.495	-.210	.556	.631	1.000							
Lit	.297	.502	.628	.380	-.089	.502	.427	.239	1.000						
DigLit	.720	.494	.855	.637	-.046	.729	.807	.619	.607	1.000					
Innov1	.803	.468	.834	.578	-.171	.764	.710	.701	.471	.830	1.000				

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
AMI3	.696	.514	.868	.638	-.034	.778	.790	.619	.631	.948	.800	1.000			
AMI2	.643	.298	.633	.461	-.057	.529	.616	.515	.398	.695	.663	.677	1.000		
AMI1	.316	.476	.641	.309	-.186	.565	.393	.216	.588	.540	.516	.571	.322	1.000	
Innov2	.768	.352	.741	.501	-.147	.627	.731	.720	.416	.728	.693	.745	.676	.371	1.000

Condition number = 212.286

Eigenvalues

8.857 1.484 1.075 .685 .580 .442 .401 .311 .276 .274 .194 .177 .120 .083 .042

Computation of degrees of freedom (Default model)

Number of distinct sample moments:	120
Number of distinct parameters to be estimated:	41
Degrees of freedom (120 - 41):	79

Result (Default model)

Minimum was achieved

Chi-square = 511.409

Degrees of freedom = 79

Probability level = .000

Regression Weights:

			Estimate	S.E.	C.R.	P	Label
ServProv	<---	GovReg	7.446	1.956	3.807	***	
ElecPow	<---	GovReg	3745.218	600.928	6.232	***	
DigCon	<---	ServProv	.026	.004	7.366	***	
TCO	<---	ServProv	.002	.001	1.657	.098	
Educ	<---	GovReg	.880	.065	13.609	***	
AMI	<---	ElecPow	.000	.000	2.758	.006	
AMI	<---	ServProv	.005	.039	.122	.903	
AMI	<---	DigCon	9.827	.946	10.390	***	
Innov2	<---	Innov	1.000				
Innov1	<---	Innov	.781	.094	8.312	***	
AMI1	<---	AMI	.819	.156	5.242	***	
AMI2	<---	AMI	.450	.063	7.187	***	
AMI3	<---	AMI	1.000				
DigLit	<---	Lit	.988	.148	6.661	***	
Lit	<---	Educ	3.842	1.341	2.866	.004	
Income	<---	Innov	23065.582	3128.344	7.373	***	
DigLit	<---	CrowdAdop	12.820	3.793	3.379	***	
AMI	<---	CrowdAdop	.986	1.675	.589	.556	
Educ	<---	Income	.000	.000	-1.087	.277	
TCO	<---	Income	.000	.000	-1.604	.109	
CrowdAdop	<---	Innov	.774	.118	6.534	***	
AMI	<---	DigLit	.432	.037	11.538	***	
AMI	<---	Lit	.082	.056	1.478	.139	
AMI	<---	Educ	4.171	.766	5.443	***	
AMI	<---	TCO	4.823	2.888	1.670	.095	

			Estimate	S.E.	C.R.	P	Label
Innov	<---	AMI	.027	.003	9.054	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
ServProv	<---	GovReg	.339
ElecPow	<---	GovReg	.507
DigCon	<---	ServProv	.571
TCO	<---	ServProv	.163
Educ	<---	GovReg	.825
AMI	<---	ElecPow	.098
AMI	<---	ServProv	.005
AMI	<---	DigCon	.462
Innov2	<---	Innov	.700
Innov1	<---	Innov	.818
AMI1	<---	AMI	.455
AMI2	<---	AMI	.582
AMI3	<---	AMI	.915
DigLit	<---	Lit	.474
Lit	<---	Educ	.268
Income	<---	Innov	.736
DigLit	<---	CrowdAdop	.290
AMI	<---	CrowdAdop	.034
Educ	<---	Income	-.070
TCO	<---	Income	-.165

			Estimate
CrowdAdop	<---	Innov	.647
AMI	<---	DigLit	.651
AMI	<---	Lit	.060
AMI	<---	Educ	.210
AMI	<---	TCO	.057
Innov	<---	AMI	.967

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e5	.793	.106	7.483	***	
e8	339.525	45.371	7.483	***	
e7	.531	.071	7.483	***	
e4	32056443.644	4283722.470	7.483	***	
e9	136601169.509	19745910.230	6.918	***	
e13	387.593	60.279	6.430	***	
e14	174.485	23.326	7.480	***	
e15	.328	.045	7.279	***	
e12	.183	.028	6.442	***	
e6	.048	.006	7.465	***	
D1	3.784	7.663	.494	.621	
D2	.015	.013	1.163	.245	
e1	917.242	122.955	7.460	***	
e2	141.100	18.993	7.429	***	
e3	69.513	12.004	5.791	***	

c

	Estimate	S.E.	C.R.	P	Label
e11	.300	.043	7.014	***	
e10	.087	.014	6.235	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
GovReg	.000
ServProv	.115
DigCon	.326
ElecPow	.258
TCO	.023
AMI	.989
CrowdAdop	.557
Income	.517
Educ	.636
Lit	.061
DigLit	.520
Innov	.948
Innov1	.669
AMI3	.837
AMI2	.339
AMI1	.207
Innov2	.490

Implied (for all variables) Covariances (Group number 1 - Default model)

	GovReg	ServProv	DigCon	ElecPow	TCO	AMI	CrowdAdop	Income	Educ	Lit	DigLit	Innov	Innov1	AMI3	AMI2	AMI1	Innov2
GovReg	.793																
ServProv	5.901	383.463															
DigCon	.153	9.933	.788														
ElecPow	2968.450	22101.614	572.527	43173935.378													
TCO	.000	.490	.005	-12.189	.049												
AMI	7.577	159.546	10.044	38569.284	.076	356.378											
CrowdAdop	.161	3.394	.214	820.471	-.001	8.987	.413										
Income	4803.968	101157.903	6368.080	24454335.559	-260.833	222252.460	5884.908	283085818.306									

	GovReg	ServProv	DigCon	ElecPow	TCO	AMI	CrowdAdop	Income	Educ	Lit	DigLit	Innov	Innov1	AMI3	AMI2	AMI1	Innov2
Educ	.679	4.794	.109	2515.720	-.002	8.069	.167	4555.785	.902								
Lit	2.607	18.420	.420	9665.753	-.145	131.670	2.783	81330.633	3.213	185.862							
DigLit	4.641	61.705	3.154	20065.847	-.416	435.015	12.076	276083.454	4.841	217.450	807.144						
Innov	.208	4.386	.276	1060.209	.001	9.868	.260	6498.046	.220	3.614	12.119	.288					
Innov1	.163	3.424	.216	827.801	.001	7.705	.203	5073.610	.172	2.821	9.463	.225	.263				
AMI3	7.577	159.546	10.044	38569.284	.076	356.378	8.987	222252.460	8.069	131.670	435.015	9.868	7.705	425.891			
AMI2	3.413	71.860	4.524	17371.796	.034	160.514	4.048	100103.606	3.634	59.305	195.933	4.445	3.470	160.514	213.396		
AMI	6.20	130.60	8.22	31572.	.06	291.72	7.35	181934.99	6.6	107.	356.	8.0	6.3	291.	131.	115	

	GovReg	ServProv	DigCon	ElecPow	TCO	AMI	CrowdAdop	Income	Educ	Lit	DigLit	Innov	Innov1	AMI3	AMI2	AMI1	Innov2
1	2	4	2	664	2	9	7	0	05	785	101	78	07	729	396	6.050	
Innov2	.208	4.386	.276	1060.209	.001	9.868	.260	6498.046	.220	3.614	12.119	.288	.225	9.868	4.445	8.078	.588

Implied (for all variables) Correlations (Group number 1 - Default model)

	GovReg	ServProv	DigCon	ElecPow	TCO	AMI	CrowdAdop	Income	Educ	Lit	DigLit	Innov	Innov1	AMI3	AMI2	AMI1	Innov2
GovReg	1.000																
ServProv	.339	1.000															
DigCon	.193	.571	1.000														
ElecPow	.507	.172	.098	1.000													
TCO	.002	.113	.023	-.008	1.000												
AMI	.451	.432	.599	.311	.018	1.000											
Cro	.2	.27	.3	.1	-	.7	1.0										

	GovReg	ServProv	DigCon	ElecPow	TCO	AMI	CrowdAdop	Income	Educ	Lit	DigLit	Innov	Innov1	AMI3	AMI2	AMI1	Innov2
wdAdop	82	0	75	94	.006	41	00										
Income	.321	.307	.426	.221	-.070	.700	.544	1.000									
Educ	.803	.258	.130	.403	-.008	.450	.274	.285	1.000								
Lit	.215	.069	.035	.108	-.048	.512	.318	.355	.248	1.000							
DigLit	.184	.111	.125	.107	-.066	.811	.662	.578	.179	.561	1.000						
Innov	.436	.417	.579	.301	.010	.974	.754	.720	.432	.494	.795	1.000					
Innov1	.356	.341	.474	.246	.008	.797	.617	.589	.354	.404	.650	.818	1.000				
AMI3	.412	.395	.548	.284	.016	.915	.678	.640	.412	.468	.742	.891	.729	1.000			
AMI2	.262	.251	.349	.181	.010	.582	.431	.407	.262	.298	.472	.567	.464	.532	1.000		
AMI1	.205	.196	.272	.141	.008	.455	.337	.318	.205	.233	.369	.443	.362	.416	.265	1.000	

	GovReg	ServProv	DigCon	ElecPow	TCO	AMI	CrowdAdop	Income	Educ	Lit	DigLit	Innov	Innov1	AMI3	AMI2	AMI1	Innov2
Innov2	.305	.292	.406	.210	.007	.682	.528	.504	.303	.346	.556	.700	.573	.624	.397	.310	1.000

Implied Covariances (Group number 1 - Default model)

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
GovReg	.793														
ServProv	5.901	383.463													
DigCon	.153	9.933	.788												
ElecPow	2968.450	22101.614	572.527	43173935.378											
TCO	.000	.490	.005	-12.189	.049										
CrowdAdop	.161	3.394	.214	820.471	-.001	.413									
Income	4803.968	101157.903	6368.080	24454335.559	-260.833	5884.908	283085818.306								
Educ	.679	4.794	.109	2515.72	-.0	.167	4555.785	.90							

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
				0	02			2							
Lit	2.607	18.420	.420	9665.753	-.145	2.783	81330.633	3.213	185.862						
DigLit	4.641	61.705	3.154	20065.847	-.416	12.076	276083.454	4.841	217.450	807.144					
Innov1	.163	3.424	.216	827.801	.001	.203	5073.610	.172	2.821	9.463	.263				
AMI3	7.577	159.546	10.044	38569.284	.076	8.987	222252.460	8.069	131.670	435.015	7.705	425.891			
AMI2	3.413	71.860	4.524	17371.796	.034	4.048	100103.606	3.634	59.305	195.933	3.470	160.514	213.396		
AMI1	6.202	130.604	8.222	31572.664	.062	7.357	181934.990	6.605	107.785	356.101	6.307	291.729	131.396	1156.050	
Innov2	.208	4.386	.276	1060.209	.001	.260	6498.046	.220	3.614	12.119	.225	9.868	4.445	8.078	.588

Implied Correlations (Group number 1 - Default model)

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
GovReg	1.000														
ServProv	.339	1.000													
DigCon	.193	.571	1.000												
ElecPow	.507	.172	.098	1.000											
TCO	.002	.113	.023	-.008	1.000										
CrowdAdop	.282	.270	.375	.194	-.006	1.000									
Income	.321	.307	.426	.221	-.070	.544	1.000								
Educ	.803	.258	.130	.403	-.008	.274	.285	1.000							
Lit	.215	.069	.035	.108	-.048	.318	.355	.248	1.000						
DigLit	.184	.111	.125	.107	-.066	.662	.578	.179	.561	1.000					
Innov1	.356	.341	.474	.246	.008	.617	.589	.354	.404	.650	1.000				
AMI	.41	.39	.54	.28	.0	.678	.64	.4	.4	.7	.7	1.			

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
3	2	5	8	4	16		0	12	68	42	29	000			
AMI2	.262	.251	.349	.181	.010	.431	.407	.262	.298	.472	.464	.532	1.000		
AMI1	.205	.196	.272	.141	.008	.337	.318	.205	.233	.369	.362	.416	.265	1.000	
Innov2	.305	.292	.406	.210	.007	.528	.504	.303	.346	.556	.573	.624	.397	.310	1.000

Residual Covariances (Group number 1 - Default model)

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
GovReg	.000														
ServProv	.000	.000													
DigCon	.418	.000	.000												
ElecPow	.000	12821.644	2746.611	.000											
TCO	-.033	-.061	-.037	-235.782	.000										
CrowdAd	.256	5.072	.342	1833.975	-.016	.145									

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
op															
Income	8759.954	28071.040	5954.089	59870112.536	-228.112	3632.605	128979192.596								
Educ	-.035	-.096	.392	471.359	-.041	.214	7199.985	-.059							
Lit	.990	115.317	7.162	24298.688	-.125	2.321	36432.151	-.226	-.868						
DigLit	14.464	226.615	19.470	104818.813	.108	4.154	212313.208	12.115	28.901	81.803					
Innov1	.296	2.450	.259	1605.262	-.025	.162	4156.329	.240	1.283	6.390	.148				
AMI3	9.361	115.354	11.016	76013.557	-.284	6.894	216138.979	7.468	102.940	337.196	6.304	320.842			
AMI2	6.137	25.369	4.859	33148.594	-.244	2.545	108638.847	4.263	30.925	149.679	3.618	147.987	65.087		
AMI1	4.203	214.489	12.849	43683.753	-1.594	8.280	113555.222	.750	188.411	239.726	5.925	285.919	67.655	214.996	
Innov2	.415	1.902	.323	1938.882	-.031	.166	7014.526	.382	1.545	7.649	.180	8.672	5.83	4.432	.242

cx

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
													4		

Standardized Residual Covariances (Group number 1 - Default model)

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
GovReg	.000														
ServProv	.000	.000													
DigCon	5.488	.000	.000												
ElecPow	.000	1.039	4.958	.000											
TCO	-1.773	-.148	-2.011	-1.711	.058										
CrowdAdop	4.567	4.119	5.944	4.514	-1.153	2.633									
Income	5.893	.862	3.880	5.596	-.645	3.124	3.410								
Educ	-.337	-.053	4.885	.742	-2.070	3.586	4.587	-.488							
Lit	.844	4.561	6.257	2.854	-.437	2.673	1.584	-.179	-.035						

	GovReg	ServProv	DigCon	ElecPow	TCO	CrowdAdop	Income	Educ	Lit	DigLit	Innov1	AMI3	AMI2	AMI1	Innov2
DigLit	5.952	4.285	8.105	5.908	.181	2.009	4.070	4.678	.689	.758					
Innov1	6.459	2.446	5.435	4.900	-2.359	4.439	4.397	4.923	1.803	3.895	4.213				
AMI3	4.985	2.810	5.579	5.706	-.656	4.555	5.548	3.729	3.507	4.888	5.099	5.638			
AMI2	4.830	.910	3.743	3.596	-.798	2.635	4.332	3.146	1.575	3.452	4.641	4.586	2.282		
AMI1	1.440	3.346	4.346	2.049	-2.235	3.802	2.002	.241	4.190	2.464	3.384	3.982	1.394	1.392	
Innov2	6.151	1.287	4.655	3.986	-1.933	3.161	5.140	5.317	1.479	3.248	4.203	4.922	5.124	1.719	3.087

Notes for Group/Model (Group number 1 - Default model)

Stability index for the following variables is .337
TCO
AMI
CrowdAdop
Income
Educ
Lit
DigLit
Innov

Minimization History (Default model)

Iteration		Negative eigenvalues	Condition #	Smallest eigenvalue	Diameter	F	NTries	Ratio
0	e	6		-.653	9999.000	1538.096	0	9999.000
1	e	9		-.393	1.450	1124.433	18	.720
2	e*	2		-.948	1.512	710.030	5	.986
3	e	2		-.395	.142	666.896	7	.849
4	e*	0	483.342		.681	549.119	8	.872
5	e	0	1213.359		.581	522.301	1	.715
6	e	0	863.125		.181	512.865	1	1.160
7	e	0	617.024		.060	511.517	1	1.150
8	e	0	550.299		.016	511.410	1	1.069
9	e	0	536.432		.002	511.409	1	1.009
10	e	0	538.229		.000	511.409	1	1.000

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	41	511.409	79	.000	6.474
Saturated model	120	.000	0		
Independence model	15	1670.256	105	.000	15.907

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	12980819.790	.684	.520	.450
Saturated model	.000	1.000		
Independence model	7698076.016	.180	.063	.158

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.694	.593	.728	.633	.724
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.752	.522	.545
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	432.409	364.650	507.660
Saturated model	.000	.000	.000
Independence model	1565.256	1436.590	1701.313

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	4.566	3.861	3.256	4.533
Saturated model	.000	.000	.000	.000
Independence model	14.913	13.975	12.827	15.190

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.221	.203	.240	.000
Independence model	.365	.350	.380	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	593.409	607.075	705.232	746.232
Saturated model	240.000	280.000	567.287	687.287
Independence model	1700.256	1705.256	1741.167	1756.167

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	5.298	4.693	5.970	5.420
Saturated model	2.143	2.143	2.143	2.500
Independence model	15.181	14.032	16.396	15.225

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	23	25
Independence model	9	10

Execution time summary

Minimization: .026

Miscellaneous: .734

Bootstrap: .000

Total: .760

Appendix Seven: Evaluation of MiHope – full report.

The following report on the MiHope project in Malawi and Zambia was produced by David Deakin, Director for HIV unit at Tearfund, with collaborative input and analysis services from myself. Permission was granted by David Deakin from Tearfund for inclusion of this report in the Appendix of this thesis.

MiHope Pilot Project Evaluation

1. Executive Summary

Mobile phone penetration is growing rapidly in many African countries even in the poorest communities. A number of pilot programmes have been reported; mainly using SMS texting showing promising results in a number of development areas including healthcare and agriculture. Tearfund Malawi has already gained some experience of using mobile phones with mixed results.

MiHope – 'mobile interactions bringing hope'– was designed, working with Nimbus (a Christian social enterprise consultancy) as a pilot project and added to an existing HIV project (GOOCH – Guardians of our Children's Health) in Malawi and Zambia. GOOCH is a community mobilisation programme focused on reducing patent to child transmission of HIV and in particular to increase male partner involvement. The programme is delivered by church volunteers who are mentored by GOOCH Master Trainers.

The objective of the MiHope pilot was to see if communications, information provision and data collection could be improved in a cost effective way by the use of mobile phones. The ultimate test would be to see whether they could contribute to improved project outcomes.

Although this project evaluation has been carried out by an 'in house team' (mainly Tearfund's partners, volunteers) independent anonymous quantitative data was collected at baseline and endline from all participants.

The main finding is the project clearly achieved its objectives and there is an overwhelming recommendation by this team for continued use of this technology in development programmes.

There were substantial benefits in improving communication (horizontally and vertically), information provision and data collection. Time was saved by not having to travel to deliver reports, client service improved due to increased confidence of volunteers to deliver information and the chat application was widely used to improve organisation and share knowledge.

In addition to these benefits there were also unexpected 'soft' benefits in terms of increased volunteer motivation. This was a result of a number of factors including saving them time, being recognised as capable and having greater influence with Ministry of Health officials and Clients due to the 'official' nature of the information in the phones.

Management also appeared to improve with the survey showing that the volunteers felt much better supported by Master Trainers and the Master Trainers reporting that this technology would enable them to 'manage' more volunteers.

The GOOCH project outcomes also seemed to improve with an increase in male partner HIV testing as the key indicator. This was thought to be mainly due to the increased motivation of the volunteers and greater efficiency in their working.

The key challenges included setting up phones, training volunteers with a hugely variable understanding and experience of mobiles, some mobile internet connectivity issues and the robustness of the phones.

Other learning points included the importance of having a solution that can easily be scaled up and then frequently updated – i.e. updated content can be easily accessed by volunteers. For this reason an Android platform is now being considered for the next project (IMPACT – HIV, maternal, child health programme with funding for 3 countries). It was also clear that a much more sophisticated data collection application is needed. Past records need to be accessed on the phone and there needs to be the ability for local modification and updating of data fields, together with the ability to have standard reports and local (country, partner) analytical capability. Other aspects where important learning was gained included:

- Phone choice
- Solar charging
- Training of volunteers
- Airtime issues

As part of the evaluation some time was spent on brainstorming future applications – these included a complete mobile M&E system, providing Client services (e.g. clinic reminders), improving knowledge of volunteers and using mobile money for savings/loans.

In terms of sustainability apart from the capital cost the operating costs in this pilot are relatively small – mainly airtime at $2---3 per month – as MIM is so much more cost effective than using SMS texting (1000 chat messages can be sent for the price of 1 SMS text). Both partners were not only very willing to take over the airtime costs of the phones but also wanted to increase the number of phones (extra 140), provision for which will be included in future funding applications.

• The learning from this MiHope pilot is now being applied in the development of the IMPACT programme – this will include testing a 'complete M&E' solution and piloting 'Connected Church' and other feedback mechanisms.

2. Project methodology

Introduction

- MiHope – ‘mobile interactions bringing hope’ is a pilot project to assess the effectiveness and added value of using mobile phones for an existing project.

Nimbus is a Christian social enterprise consultancy specialising in mobile phone use in the development setting. Amongst its Clients Nimbus is currently working for DFID on a mobile-‐based child trafficking project in Asia. Their original experience linked to the use of mobile instant messaging (MIM or ‘chat’) for a drug rehabilitation project in South Africa was the initial catalyst for this MiHope project (connection made during Transformational Business Conference).

The Prevention of Parent to Child transmission of HIV (PPTCT) is a key strategy in Tearfund’s HIV Corporate Strategy to 2015.

GOOCH – Guardians of our Children’s Health is a community mobilisation programme focus on reducing mother to child transmission of HIV. In addition to trying to improve pregnant mother HIV testing rates, the programme also focuses on male partner HIV testing. Male partner involvement and HIV testing has been shown to reduce HIV transmission and child mortality by 40%. GOOCH has been active in 10 countries, including Malawi and Zambia.

The objectives of MiHope were as follows:

- To establish if MiHope can enhance the GOOCH project by improving communication, information provision and data collection

- Ultimately to assess if MiHope technology added to a project like GOOCH can help to save lives. The key outcome measure is increases in HIV testing, particularly male partner testing.

The scope of the MiHope project ended up involving over 30 people each from Malawi and Zambia – a total of 60 handsets) were deployed. Each country had a Project Manager with volunteers from LISAP in Malawi and BICC in Zambia.

Volunteers were provided with:

- Nokia X3 handset including micro SD card
- ToughStuff Solar Panels, 2 batteries
- Software
    - MxIT mobile Instant Messaging
    - Bible
    - GOOCH –90 page manual
    - Tearfund information – including specific PPTCT information
    - Data Collection forms – Activity & Outcome forms
- Country Project Managers were additionally provided with
    - Asus Android Tablet with keyboard –for managing multiple chat sessions. This device was also used for a pilot in survey data collection.
    - A MiFi unit for connecting the Tablet.
    - Chat Exchange software.

3. Evaluation scope and methodology

Evaluation process

To perform an evaluation of MiHope it was decided it was worth spending additional budget on having a 3 day Evaluation workshop in Mzuzu, Malawi. 2 days were spent looking back and assessing experiences and 1 day looking forward focusing on possible improvements

The Evaluation team consists of:

3 people from Zambia: Ginwell Yooma– Country Project Manager, Michelo Siachaya – Master Trainer, Lilian Hang'ombe – Volunteer

4 people from LISAP: Lazarus Harawa (Country Project Manager), Gray Sidira (Program M&E Officer), Humphreys Banda and Glyn Gondwe (Master Trainers)

Aaron Lewani from Tearfund Malawi

Mike Santer from Nimbus

David Deakin from Tearfund UK

In addition 10 MiHope Volunteers joined the workshop for half a day to directly input their experiences of using MiHope.

Quantitative methodologies

i. Baseline, endline surveys of all participants. It was decided as a separate project to use a digital datacapture process to conduct the surveys using the Android tablets

ii. Estimates of volunteer usage. As MxIT chat sessions were not recorded an estimate of usage in the project was given by the 11 volunteers and this was extrapolated to the whole project. Similarly the frequency of accessing information was estimated. The number of activity and outcome forms received on the server was recorded

iii. MiHope Chat Exchange. This messaging service, between volunteers and Country Project Manager was recorded on the server.

d. Qualitative methodologies

Input of experiences from the following stakeholder groups:

- Volunteers
- Master Trainers

- Project Managers
- Tearfund Malawi
- Tearfund UK
- Nimbus

This Evaluation report contains direct input from these groups – notes are included as provided with minimal editing.

4. Key Findings

Project organisation

a. Phone choice

The Nokia X302 was chosen after field testing by Mike Santer. The benefits of this phone included good sized screen with good resolution (important to be able to read information – e.g. 90 page GOOCH manual), good battery life, normal keyboard but with touchscreen in addition. The price of the phone was £110.

b. Coverage checks

As this was the first pilot requiring at least 2G data transmission Mike Santer also checked on phone coverage in all of the project areas in Malawi and Zambia. The go ahead for the software development was subject to satisfactory mobile coverage being available. This proved to be the case. Although patchy most areas had at least minimum coverage apart from Kamwe, Malawi where there was a promise to build a new cell tower by October 2011. This cell tower was built but in the wrong place initially so this did have a detrimental effect on the project in Kamwe.

c. Project Management

A Country Project Manager was appointed in both Malawi (Lazarus Harawa – LISAP) and Zambia (Ginwell Yooma, Tearfund Zambia). Budget was provided to cover a 50% contribution towards their costs for the duration of the project.

Quantitative findings

a. Baseline/endline survey

The results from the endline survey, conducted in April 2012 were compared with the Baseline survey, conducted in October 2011. Although no statistical analysis has been undertaken large differences were found in the data. Graphical results are available in the Appendix and full baseline and endline reports are available on request. The data suggest the following benefits were seen in the project:

- Communication has become less challenging for Volunteers
- Volunteers feel they are better supported by their Master Trainers
- Master Trainers feel they are offering a better level of support to Volunteers.
- In addition Master Trainers believe they can now manage a greater number of volunteers
- Client questions were better able to be answered.

b. Estimates of usage

1. Mobile Instant Messaging

It was estimated by the Evaluation Team that over 5000 ‘conversations’ were held per month.

2. Chat Exchange

The Chat Exchange was used more in Zambia than Malawi – estimated 900 discussions were held [Nimbus to provide actual figures]

3. Information

The key sources – GOOCH, Bible, Tearfund Information was accessed on average about once per day

4. Activity Forms

102 Activity Forms were received from Zambia and 145 from Malawi.

5. Outcome Forms

In Zambia 8 volunteers collected data from different clinics resulting in receipt of 47 forms. In Malawi 2 data collecting volunteers sent in 8 forms.

6. Other uses of phones

It was estimated that on average the phones were used for other things about once a day.

6. GOOCH results

i. Malawi

The background TAPA audit data on male partner testing submitted by LISAP suggest a rate of 3---4% (2 separate audits). Within this pilot, an analysis of the data submitted from Thoza suggest a male partner testing rate of 24% with a HIV prevalence of 17%

ii. Zambia

The background male partner testing rate in Zambia at 40%+ is much higher, probably due to the large PEPFAR funded programme. Even so the MiHope testing rate for Choma (main area for MiHope data collection) was 55%.

The MiHope pilot was never designed as a study to prove whether mobile phones can increase outcomes. In addition the project had some budget provision for GOOCH community mobilisation – in Malawi, Thoza was included in where this was spent, whereas in Zambia new areas were selected. Nevertheless the above results are suggestive of a positive effect of the pilot on outcomes. This can possibly be explained by some of the qualitative findings from volunteers and quantitative findings from the survey that motivation was increased, more time could be spent with Clients, better support provided from Master Trainers etc.

Stakeholder feedback

a. Country Project Managers views

Lazarus (Malawi) Positive points:

- Wi---Fi point and Asus good
- Solar remains charged for three days – saves time and money. Robust.
- Although one phone got stolen it was returned.
- Able to carry all information in one place
- Very cheap in using the chat only use <5KWA for chatting for one day. Very little cost. SMS is 10KWA
- It is a turning point. It changed their status in the community. Gave assurance to the community. Really working and benefitting the community. Status for LISAP increased.
- People are more keen to help as they want a phone too.
- Easy communication with volunteers. Communication changed because you do not need to be at their house. Thoza and Kamwe could communicate together which has not happened before.

- Able to charge clients phones during visits – two batteries was very important. Increasing contacts because clients want their phone charged.

- Able to chat, use information and send data faster. No transport cost.

- Data collection enables project workers to deliver rather than report. E.g. when Malawi are sending report to David about Irish Aid there were delays so Grey used MiHope to communicate with people about the information he needed.

- Facilitators were motivated to work hard to send data – gaining confidence. Enabled them to make new friends and enhance relationships. A lot of peer---to---peer chatting.

- Made it easy for volunteers to teach any topic and at any time. Having GOOCH manual in their pocket was very helpful.

- MiHope country manager was not available most of the time --- work continued without problems. Empowered people to teach and learn. New information was shared. No guide to church on choice of PPTCT facilitators. Created a challenge to absorb new technology – made them work together and meet frequently --- created a strong team.

- Easy to share new information amongst volunteers.

Challenges

- Churches choose volunteers – so little control on choice

- New technology took time to learn. Types of phones used were a challenge.

- 3 phones not working – need repair – extra care. 1 soaked; sat on the phone, stop working. (10%).

- Training did not include the downloading and installation of the software

- Data – need to leave data copy on the phone – no feedback on whether data received. So potential missing information between sender and recipient.

- Problem with network service providers and electricity provider. Kamwe did not have the tower until 24th April. MiHope forced them to put up the tower. Difficulty in contacting technical advisor (Nimbus) during early days of the project implementation.

Results:

- 111 families reached in Kamwe and 51 families in Thoza

- 130 fathers accompanied their wives to ANC at Thoza.

- 10 children born negative from 9 HIV+ women at Thoza and 3 born at Kanwe Oct 11– apr 12. Good progress --- In Thoza 2009, no PCR. In 2010, 5 children born HIV+ from 37 positive mothers. No data for Kanwe --- Issue is that the clinic does not record the data.

- Summary benefits

o Able to coach facilitators

o 19:00 – 21:00 open on Chat Exchange. But used MxIT more than chat exchange. o Improved quality of service / information

o Timely uploading of activity and outcome data

o MoH envy the reporting system and wish to join. Want the HAS to have phones to collect the data to send into them.

o Advocacy to service providers

- Challenges

o Pilot was done in rainy period when volunteers were busy in their fields. o Some health personnel are not friendly to fathers

o Kamwe data does not record if antenatal attended by couple.

Recommendations

- Update information in GOOCH
- Harmonise data collection tools with hospital
- Provide a simple phone that can accommodate all functions.
- Give equipment to all facilitators. Difficult to discuss with79 who were trained in PPTCT and only have 30 phones.
- Engage health service providers on data collection.

Ginwell (Zambia)

- Tablet, MiFi unit worked well.
- Jamiix (Chat Exchange) had initial problems but resolved. Every day Ginwell had 10---15 volunteers on the chat exchange --- between 19.00---20.00 hrs.
- 2 volunteers had problems. 2 people were not able to access the forms on their phones
- Language was a barrier for people.
- There were issues with Airtel up to the first week of February. Subscription for Internet needed to be done monthly.

- Volunteers chatted amongst themselves. Used it a lot. Afternoon – 17:00 chat with at least 5 people. Chat with more than 8 people a day. 50% of people were VERY active. Others chatted at least every week. Ginwell tried to encourage them to chat in English.

LEARNING POINTS

- Technology can change life. Local culture is a talking culture so chat was new. When they were trained they were very excited. They discovered that it was much cheaper and they could communicate well together.

- Volunteers appreciated the information provided on the handsets.

- MoH supportive of the programme but wished they had been given the handsets.

- Church and local leaders were very excited because this technology does not normally come to rural areas.

- Information was accessible.

- Sending reports by mobile saved a lot of money and time. BICC value the reports. It saves a lot of money.

- Having a phone for the first time bought excitement and pride in being a volunteer.

- Volunteers had more time and money from travelling long distances. 20---30% increase in time.

- Solar panels were handy. Never 50,000 = $10 transport one way. He had 10,000 ZKW a month. Local church gives transport money.

Recommendations

Strongly recommend MiHope continues:

- Language, ideally Tonga.

- Health centres to have the mobile set. Help on data quality and also answer questions from volunteers.

- Activity forms can report on follow up activities e.g. Taking medication, using condoms.

- Connect to livelihood support.

BOTH COUNTRY PROJECT MANAGERS RECOMMENDED CONTINUING WITH THE PROGRAMME. b. Master Trainers

Michelo (Zambia)

- Initial training. This was good. The 15 were supposed to train the others but the capabilities of the recipients were not high enough. Michelo had a mobile phone before.

Language was an issue. The caregivers are rural people and the church selected who would participate. Some did not speak English well.

- Two areas: Masopo 16. Divided in groups. One on one talks. Training took 2--- days. Almost everyone has a phone but they do not have feature phones. Most have basic phones. Nokia phone has a lot of features that people do not know. It is also a touch screen, which was new. Training was done in local languages. In time people understood and could use the technology. Two days was okay but three would be better.

- Solar panel --- used them well.

- Training process never ended. If had questions and issues they would come to us. Refresher course to everyone. Questions became less.

- Phone – too complicated at first but people got used to it. Difficult to use the touch screen part. They have mastered it. Now do not want to give it back. Have used internet to check sport, Facebook etc.

- Network provider was not good.

- Language is the key. Read and speak.

- Intended outcome was achieved.

- Key benefits: Send reports, access information, chat with project staff and friends.

- Overall Conclusion: EXTREMELY POSITIVE.

Humphreys/Gray (Malawi)

- Performance monitoring was a key benefit. Provide data reports at low cost in shortest time and without having to clean the data.

- Provide training materials cheaply in peoples pocket

- Provide information sharing through chat. Questions where asked and responses were provided very quickly. Found to be very helpful for the project.

- The following have improved: communications and outcomes.

- Eased communication challenges.

- Had not used the phone before. Using a touch screen was an initial challenge. Suggest need to teach about using a basic phone first.

- Getting into MxIT (chat) was difficult and it took much of the time.

- We assumed people knew phones but few had experience and only one or two had sent an sms text previously.

- Poor network connection made training difficult.

- Participants quickly grasped data forms.

- 4---days of training. By the end of the 4 days most begun to use the phone properly. They agreed to meet every week for the training.

- People were already informed before the terms of reference were given.

- The participant's knowledge of phones was low and now they can use it. Things are going well. Work with people in groups in the communities. Enter data in phones together. Now they are used to touch screen now and like it. Need a big screen. People are confident now although change is difficult.

- Recommendations:

--- Selecting people – low digital literacy need pre learning training on using a

phone. But people got there.

--- At times, Internet connectivity has been an issue.

--- Need local language on the phones.

c. Volunteers views

10 Volunteers from Malawi (within the region of the Evaluation workshop) and one from Zambia gave their individual stories. These were all overall compellingly positive with benefits and drawbacks commonly articulated – as already expressed by Master Trainers and Country

Project Managers. A couple of the volunteers, with permission, were recorded on video giving their experience of MiHope.

From all of the stories the common themes and conclusions were as follows:

Positive drivers within MiHope

- More motivated volunteers – desire/requirement to complete activity report
- Easy access to information
- Saving time – transport of forms, arranging meetings
- Respect increased – opened doors, e.g. using the GOOCH umbrella story with MOH
- Increased attractiveness of service to Clients
- Volunteers more supported – potentially increasing retention rate
- Quality of support – theoretically support more volunteers
- Refer Questions to MT quickly – potentially provide a better service to Clients
- Peer support – MiHope provides a wider network for volunteers to communicate with
- Monitoring costs can be reduced – potentially less face---to---face support will be needed. Unintended Consequences
- Complaints by volunteers –did not get phones [originally it was discussed that there

may be 60 volunteers per country – this was later reduced to 30 per country] –

important lesson about not raising expectations

- External perception – 'if volunteers have phones then they must have money to give to Clients'

- The phones were free – this could lead to dependency
- Solar – potentially these panels could be used to make money to charge others phones

– rather than used for the project. However there was no evidence of this within the project.

- Raised expectations for the future
- Social consequences --- 1 phone was stolen but quickly recovered.

d. Tearfund Malawi (Aaron)

- One of the most innovative projects in Tearfund. Donald (Regional Director) presented it as the

most innovative project in Southern Africa. To improve the lives of people they work with.

- Improvement in knowledge.
- Data collection and management is a big issue.
- Improve project implementation.
- All the people could connect simply no matter where people are. Project was a big encouragement to the volunteers. Felt trusted and empowered. Data collection has been made easy.
- Tearfund Malawi was connected into the system and was able to see the reports. In the future we would like a dashboard of activity.
- Want these projects to continue. Implement this type of project but also could be used for other project e.g. food security projects. Now going to budget for it.

- Country data management – important to have data management and analyses capability in the country.

e. Tearfund UK (David)

- Project ran reasonably smoothly – the duration was extended by 1 month due to the time

needed for training all volunteers and the delay in funds being transferred from Tearfund UK to countries.

- It was clear that the decision to reduce the overall project size from 120 to 60 was a good one as

setting up the phones was exhaustive. A single application is ideally needed rather than setting

up individual elements. In addition it was clear that asking volunteers to set up and update software is problematic – updating in the future will be a requirement that must be accomplished easily.

- It became apparent that the Country Project Managers needed mentoring support in using Chat

Exchange and dealing with problems as they arose. It was decided to pay for Mike Santer to provide half day per week for several weeks for this mentoring service – this was much appreciated by the CPMs.

- The bulk messaging opportunity – to send a message up to 1000 characters to all handsets was little used – purely due to pressure of work. However this facility – to be able to provide news

and updates --- would be a huge benefit particularly over the longer term

- Costs were higher than originally anticipated, mainly because it was decided additional

elements were needed and could be justified – e.g. additional setup visits, mentoring support, baseline/endline surveys etc. The actual operating costs however were in line with expectations. However for a longer term programme a different cost structure will be required.

f. Nimbus (Mike Santer)

- Two initial visits were very important, as this was an initial pilot
- Had timing issues with the developed solution
- Deployment was very labor intensive
- Sometimes it was difficult to resolve issues remotely but 1/2 day mentoring support to Country Project Managers worked well
- Delay in funding in Malawi caused a delay in training roll---out
- Chat exchange was not very well used – batter use in Zambia than Malawi
- Reports and analysis took a lot longer than anticipated
- CMS system needed for content – different languages
- Relationship with Airtel was difficult with reports not being sent.
- Device robustness – questionable in that 10% failed for some reason in 6 months
- Survey data piece was too complex
- Need data reports stored on the phone .

6. Costs

The following costs are the direct costs of the MiHope pilot project.

	Original Budget £	Actual £	Comments
1. Direct MiHope Costs			
Hardware ---Phone handsets, charger, Solar panels, batteries	6000	9570	Phones more expensive in Zambia, plus solar chargers, spare batteries
Software development & Project management fees (Nimbus)	27,000	27,000	Additional spec (e.g. GOOCH manual)
Hosting & server, technical support (Nimbus)	10,000	6,000	Only 6 months billed but extra technical support for MTs
In---country data costs	1000	1000	Data bundle price, extended time period to end of 2012. Equals ~£2
Training & travel costs (local)	16,000	24,000	Additional trainer required (2 rather than 1 person from Nimbus)
Total	60,000	67,570	
2. Additional Costs – Nimbus participation in MiHope		3170	Nimbus involvement not foreseen at outset
3. Tablet Survey – Pilot test of Asus Tablets instead of	10000	10170	As a result his technology is now being routinely used for large scale KAP surveys

There were normal costs for the GOOCH project but in addition there were costs to contribute to the extra time of Country Project Managers involved in all of the development and implementation and a contribution cost to Tearfund Malawi and Zambia. All costs were funded by the Souter Charitable Trust.

7 Improvements for the future

A brainstorming session was undertaken amongst the Evaluation team to consider the use of mobiles in development. Key areas suggested included:

- Mobile money
- Social networking
- Weather reports
- Buying and selling
- Market information
- Job markets
- Mobile learning
- Transport information
- General access to internet
- Entertainment – radio, music, tv, films
- SMS chatting
- RFID – tracking of items
- Security applications
- Sending photos, video, voice recordings

- Diary, alarms – medicine adherence
- GIS location, mapping routes, distances
- Sending data, information, reports
- Whole library of information on phone
- Point of care diagnosis

An evaluation was then undertaken with each team member voting for particular ideas against agreed criteria. The following were the new ideas attracting the highest number of votes from the Evaluation team:

Idea	Description	Team score
Improve whole M&E	Data collection, analysis, reporting. Link with MOH, NAC	12
Client reminders	Medicines adherence, Clinic visit reminders	8
Increasing knowledge levels & communication	Partner to Volunteers Volunteers to Clients Volunteers to communities	7
Village loans, savings, livelihoods	Mobile money, market information, agricultural inputs	2
Hospital – community communication	Website, blog, updates	3

8. Conclusions

The MiHope pilot project was successful in achieving its objectives. It improved communication, provided information and improved data collection processes within an existing project (GOOCH). In addition there is a suggestion that these improvements can lead to improved outcomes – in this case male partner HIV testing within the GOOCH programme.

There were also intangible benefits, which led to a high degree of motivation of the volunteers – driven by the increase in credibility afforded to volunteers from community stakeholders and the data collection benefits.

From a management perspective there is a strong suggestion that when set up and operational there are also significant time and cost savings to be exploited and the possibility of better management of a greater number of volunteers.

There were significant challenges, including deployment, training, language issues, some network issues, phone robustness, high degree of technical support required etc. In addition, costs of development and operational costs (data hosting, airtime, support) need to be carefully considered for any future programme. These costs however should be set against the productivity and outcome benefits suggested from this pilot programme.

In conclusion there was unanimous agreement that the pilot had been successful and a strong recommendation from everyone to Tearfund that further development and scale---up should commence. There was also a desire expressed to expand the system to other areas than only HIV projects.

A key test of value is whether Tearfund within country and partners are willing to cover the operational costs in the future – this was answered positively with a strong willingness expressed to build the costs into future budgets and fundraising proposals. Tearfund UK will cease to fund the airtime after December 2012 and the data collection system is now longer being hosted after the end of the pilot. There is interest from both countries in expanding the existing number of handsets –80 in Malawi and 60 in Zambia.

However, it was agreed that the hardware and software need to be improved for longer---term use. The hardware needs to be more robust for field use – preferably a more rugged phone but at a minimum to provide some protective cover. The software needs to be capable of easier scale---up and updating. An Android system is being considered for the IMPACT project, which has started in Malawi and will also be implemented in Nigeria and DRC.

In terms of future enhancements there was general agreement over the priorities with a complete M&E system and communication system being top of the list.

One of the solutions being considered for IMPACT– POIMapper– offers the opportunity of potentially providing a complete M&E system with multiple forms being developed within country and deployed across different users. This will be tested within the IMPACT pilot.

David Deakin

HIV Programmes Manager, Tearfund

On behalf of the Evaluation Team Sept 2012

Appendix --- Survey

The survey was conducted at baseline and at endline across the users of MiHope. The basic demographics and technology experience of users was as follows:

o 50% were over 50 yrs.

o 74% had never accessed the internet

o 30% not owned a phone before

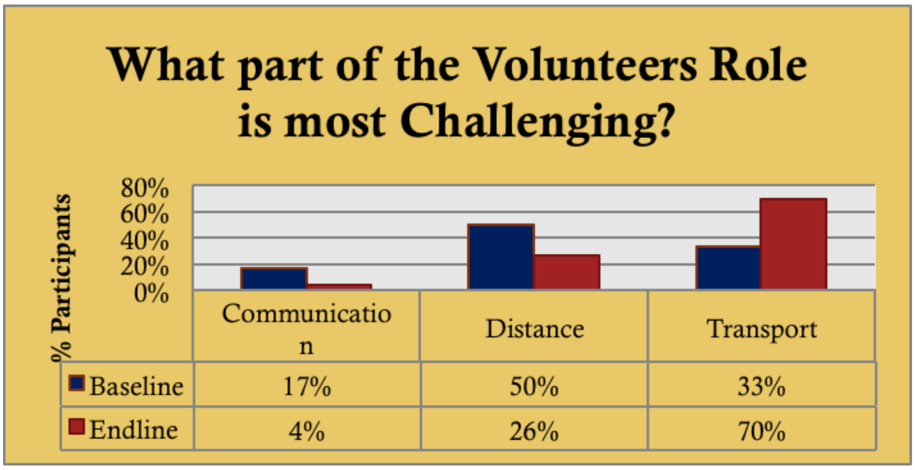
o 82% had never used Instant Messaging

o Therefore capacity to use technology is low

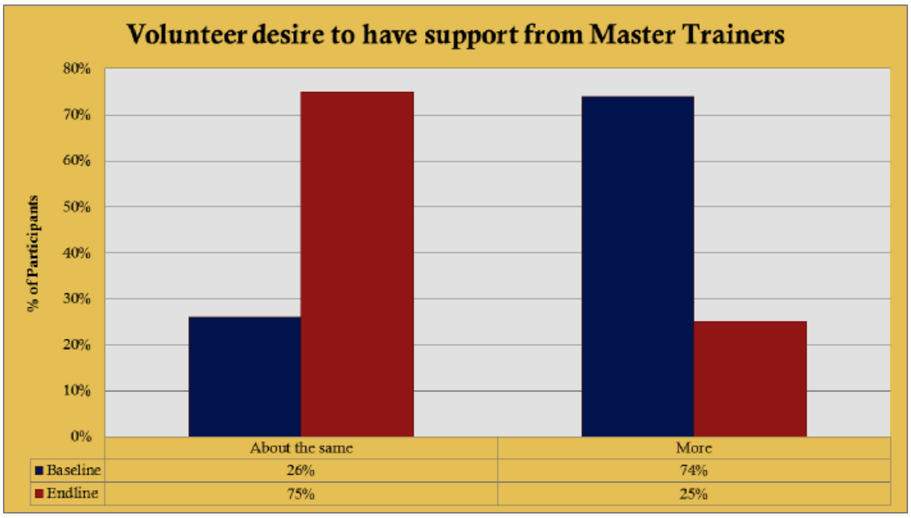
1Below are a number of key findings comparing endline with baseline. Full reports are available.

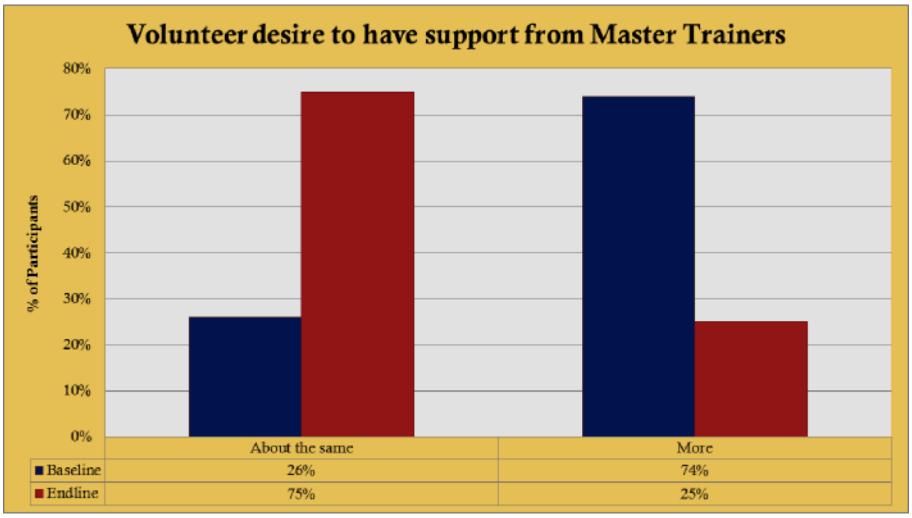
Endline versus Baseline – Key result areas

a. Communications and distance

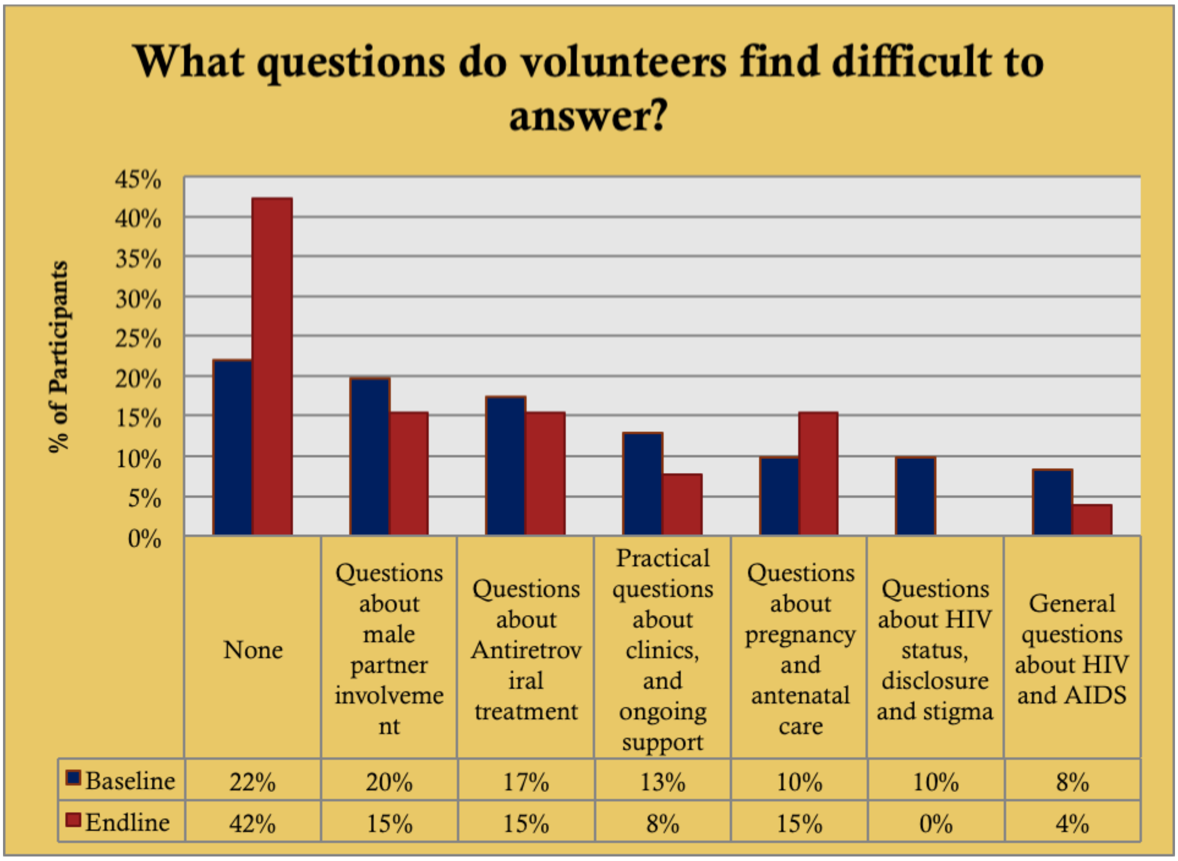


b. Support to Volunteers is increased

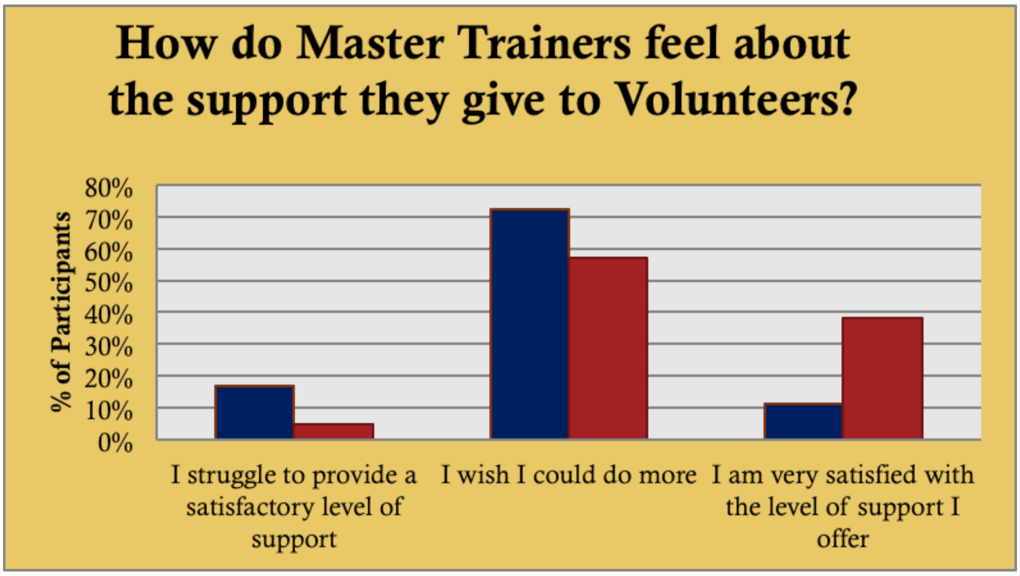




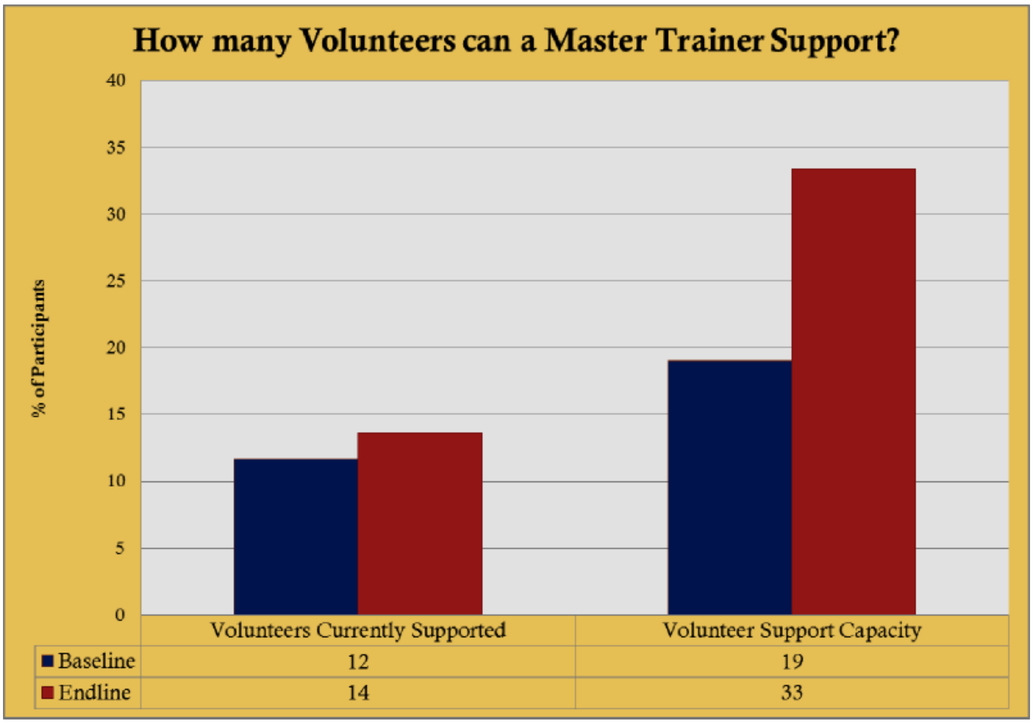
c. Client questions are easier to answer



d. Master Trainers can give better support



e. Potential increased capacity to manage more volunteers


How many Volunteers can a Master Trainer Support?
% of Participants
40
35
30
25
20
15
10
5
0
Volunteers Currently Supported
Volunteer Support Capacity
Baseline
12
19
Endline
14
33

Appendix Eight: Data used for the simulation model

Country	AMI	DigLit	Providers	ElecPwr	Content	Cost	GovReg	Income	Innov	Educ	CrowdAdp	Litry
AGO	-3.363	7.140	40.000	221.256	3.217	0.339	2.693	4328.513	-4.443	1.940	3.920	69.958
ARE	1.897	76.000	100.000	13898.057	5.932	0.094	4.664	57884.226	1.695	4.612	5.865	90.034
ARG	0.429	40.000	94.100	3057.438	4.692	0.711	2.937	9131.328	-1.408	3.366	5.395	97.726
ARM	0.122	21.000	98.900	1874.582	4.434	0.167	3.062	2840.432	-0.890	3.216	4.662	99.531
AUS	3.601	81.100	99.100	11240.600	6.055	0.642	5.483	55671.620	2.014	5.121	6.097	99.000
AUT	3.001	76.186	99.000	7830.923	6.439	0.082	5.334	44988.159	2.122	4.717	6.127	99.000
AZE	-0.691	21.500	100.000	2669.507	4.805	0.145	3.599	6008.248	-0.654	3.040	5.803	99.501
BEL	1.198	76.723	99.900	8412.112	6.339	0.577	4.844	42844.772	2.758	5.479	5.959	99.000
BGR	0.505	35.070	99.990	5873.022	5.233	0.796	3.299	6356.120	-0.413	3.189	5.365	98.319
BHR	1.901	87.000	100.000	11339.286	6.092	0.165	4.530	20474.819	0.423	4.555	6.074	91.359
BOL	-2.236	17.030	45.900	648.752	3.639	0.517	2.989	1900.001	-2.288	3.144	4.197	90.698
BRA	-0.409	34.860	99.890	2419.135	4.932	0.725	3.591	10816.487	-0.678	3.005	5.453	90.037
BWA	-1.057	6.450	99.000	322.792	4.314	0.493	4.331	8116.866	-1.306	3.867	4.534	84.116
CAN	1.621	83.870	99.000	18485.842	6.245	0.327	5.361	46302.668	2.544	5.422	6.277	99.000
CHE	3.192	86.850	100.000	8766.323	6.580	0.513	5.610	67778.528	4.056	5.944	6.196	99.000
CHL	0.234	46.800	100.000	3554.742	5.327	0.286	4.452	11826.565	0.876	3.357	5.832	98.554
CHN	-1.992	35.390	99.460	2602.555	5.630	0.152	4.067	4382.136	0.171	3.970	4.946	93.985
CMR	-3.732	5.360	58.000	295.915	3.347	0.419	2.982	1102.740	-1.828	3.512	3.994	75.900
COL	-0.934	26.100	83.000	1244.818	4.663	0.292	3.508	6359.564	-0.879	3.680	5.146	93.245
CYP	-0.264	60.532	99.980	4714.945	5.436	0.098	4.528	28854.414	0.809	4.591	5.248	97.927
CZE	1.361	64.056	99.800	7825.869	6.059	0.399	3.997	18276.673	0.764	4.091	5.792	99.000
DEU	2.260	85.741	99.000	7168.744	6.071	0.154	5.344	40273.516	3.256	4.931	5.751	99.000
DOM	-0.913	16.420	81.160	1594.835	4.975	0.456	3.187	5226.772	-1.468	2.313	5.306	88.244
ECU	-0.768	27.000	93.300	1323.849	4.123	0.393	2.978	3920.798	-1.522	3.157	4.697	84.207
EGY	-1.709	34.000	99.700	1673.065	4.474	0.087	3.593	2808.037	-1.247	2.318	5.437	74.000
ESP	1.455	68.724	99.800	6387.030	5.618	0.734	4.120	30639.295	0.904	3.213	5.394	97.679
EST	2.500	69.248	99.990	7883.649	6.337	0.359	4.849	14404.735	0.926	4.283	6.118	99.794
ETH	-4.825	1.380	10.000	47.541	3.071	0.172	3.640	350.441	-1.801	3.861	3.195	35.900

FIN	5.946	81.986	99.500	13398.181	6.193	0.072	5.800	44495.691	4.114	5.852	6.126	99.000
FRA	1.640	76.408	99.000	8600.032	5.546	0.568	5.168	40704.345	2.498	4.463	5.914	99.000
GBR	3.836	82.567	99.800	5970.433	6.435	0.307	5.506	36164.101	2.835	4.832	6.538	99.000
GEO	-0.953	18.200	99.000	1921.021	4.851	0.311	3.306	2629.440	-0.750	3.003	5.472	99.720
GHA	-2.765	9.140	77.000	359.308	3.930	0.123	3.940	1363.854	-1.221	3.642	4.487	66.620
GMB	-2.390	5.720	85.000	134.466	4.639	0.491	4.605	611.770	-1.364	4.528	5.051	46.497
GRC	-0.246	53.387	99.900	4848.412	5.017	0.498	3.489	27310.680	-0.686	2.853	5.050	97.162
GTM	-1.123	15.810	76.000	636.703	5.097	0.175	2.813	2867.227	-0.960	2.602	5.347	74.470
HKG	4.587	77.940	100.000	5485.415	6.229	0.022	5.323	31514.202	1.898	4.819	6.234	99.000
HND	-1.048	12.910	89.930	895.143	4.477	0.324	3.276	1908.279	-1.562	2.577	5.208	83.589
HRV	1.950	60.010	100.000	2764.810	5.389	0.235	3.533	13775.902	-0.363	3.304	5.087	98.762
HUN	1.150	66.440	99.000	3589.993	6.080	0.307	4.097	13023.858	0.190	3.453	5.056	99.366
IDN	-2.149	10.800	90.000	636.034	4.996	0.180	3.484	2974.027	0.312	4.231	5.673	92.192
IND	-3.139	6.120	83.000	697.079	4.756	0.058	3.654	1370.800	-0.352	4.376	4.933	62.754
IRL	2.427	76.464	99.000	6188.549	5.418	0.347	5.164	46298.084	1.289	5.178	5.795	99.000
ISL	2.017	93.000	99.000	53352.475	6.533	0.150	4.982	39025.702	2.421	5.632	6.748	99.000
ISR	4.304	77.000	100.000	7955.079	6.004	0.308	4.794	29264.071	3.576	4.104	5.738	99.000
ITA	1.924	64.846	99.000	4742.098	4.927	0.234	3.505	34058.720	0.394	3.340	5.559	98.872
JAM	-0.848	20.000	95.000	2860.365	5.123	0.288	3.910	4914.829	-1.084	3.179	5.207	86.361
JOR	-0.785	51.410	99.000	2365.894	5.309	0.150	3.871	4326.376	-0.286	3.992	5.594	92.200
JPN	4.219	83.380	99.900	8215.780	6.321	0.808	5.176	42782.523	3.216	4.411	5.231	99.000
KAZ	-0.570	25.100	95.000	5130.899	4.831	0.293	3.418	9008.699	-1.108	3.048	4.427	99.678
KEN	-2.418	4.100	89.000	183.459	4.525	0.293	3.382	807.504	-0.756	4.663	5.223	87.006
KGZ	-1.678	3.980	96.000	2282.237	5.211	0.184	2.727	842.583	-2.926	3.255	4.631	99.241
KHM	-3.430	4.330	99.000	105.696	4.355	0.211	3.636	813.798	-1.381	3.753	4.580	77.587
KOR	5.491	81.800	99.900	9239.736	6.238	0.348	4.143	20756.246	2.484	3.930	5.808	99.000
KWT	1.008	37.530	100.000	20306.857	4.964	0.135	3.809	37009.259	-0.699	3.110	5.376	93.906
LKA	-2.283	12.280	98.000	451.406	4.505	0.045	3.751	2428.093	-0.640	4.322	4.595	90.558
LSO	-3.677	4.980	55.000	92.110	3.238	0.420	3.028	911.075	-2.386	3.290	4.140	89.662
LTU	1.877	59.229	100.000	3966.309	6.169	0.258	3.952	11045.774	0.244	3.799	5.817	99.696
LUX	3.121	90.215	99.900	6293.744	6.085	0.250	5.786	108951.721	2.091	4.461	6.013	99.000
LVA	1.226	62.776	98.800	2322.123	5.402	0.221	3.866	10680.308	0.378	3.694	5.252	99.783
MAR	-0.421	34.230	98.400	664.848	4.609	0.770	3.681	2861.286	-1.114	3.281	5.736	56.084
MDA	-1.040	36.910	97.980	997.508	4.889	0.321	3.082	1630.454	-1.452	3.180	4.776	98.462
MDG	-4.005	1.370	23.000	56.788	3.524	0.426	2.682	414.899	-1.666	2.964	4.858	64.481

MEX	-1.684	29.800	99.900	2256.230	4.792	0.430	3.504	9521.654	-0.832	3.117	5.133		93.442
MKD	0.024	60.330	99.900	3074.751	5.248	0.576	3.505	4482.770	-0.287	3.630	5.682		97.125
MLT	0.867	73.134	100.000	5585.270	6.023	0.570	4.681	19706.544	0.168	4.903	6.105		92.363
MNE	3.135	31.990	100.000	4227.691	5.387	0.516	3.802	6417.190	0.390	4.368	5.756		97.700
MNG	-2.008	22.300	85.000	1553.905	5.228	0.103	3.182	2266.652	-0.708	2.392	4.698		97.489
MOZ	-4.069	7.480	32.230	677.342	3.634	0.508	3.337	439.875	-2.182	3.199	3.804		55.062
MRT	-2.825	2.990	62.000	165.996	3.525	0.496	3.013	1141.369	-3.353	1.991	3.707		57.453
MUS	-1.096	37.710	99.000	1870.937	4.855	0.201	4.359	7589.566	-0.323	4.007	5.168		87.897
MWI	-4.431	4.490	85.000	119.671	4.225	0.672	4.046	343.480	-1.499	4.130	4.520		73.690
MYS	0.813	41.020	95.000	3541.269	5.656	0.187	4.874	8423.176	2.258	5.093	5.927		92.457
NAM	-2.500	15.430	95.000	952.999	4.543	0.284	4.598	5517.733	-1.367	2.784	4.604		88.508
NGA	-2.492	15.370	90.000	140.111	4.265	0.432	3.449	1298.138	-0.904	3.798	5.246		60.815
NIC	-2.847	8.160	100.000	596.390	3.964	0.624	2.664	1126.549	-2.779	2.328	4.449		78.003
NLD	1.791	91.972	98.000	6777.534	6.394	0.358	5.550	46985.758	3.170	5.205	6.197		99.000
NOR	4.594	90.944	97.000	27298.913	6.355	0.099	5.529	84143.691	2.646	4.790	6.237		99.000
NPL	-3.958	4.210	35.130	106.693	3.620	0.066	2.931	557.371	-2.307	3.192	4.050		59.145
NZL	2.145	83.850	97.000	10035.562	5.918	0.554	5.838	32162.574	1.935	5.327	6.151		99.000
OMN	2.648	45.550	97.600	5961.783	5.455	0.239	4.593	19405.399	0.532	4.170	5.207		86.621
PAN	1.558	19.830	90.700	1887.575	5.107	0.234	3.505	7601.202	-0.424	2.421	5.884		93.612
PER	-0.855	22.700	97.100	1139.360	4.636	1.266	3.049	5204.544	-0.692	2.599	5.091		89.591
PHL	-1.719	13.100	99.000	674.491	4.823	0.296	3.147	2123.008	-1.491	3.826	5.748		95.420
POL	2.378	69.021	99.000	3948.393	4.964	0.315	3.748	12322.773	-0.033	3.685	4.390		99.507
PRT	2.069	59.495	99.000	4613.512	6.054	0.270	4.196	21541.641	0.952	3.579	5.801		94.910
PRY	-1.623	19.300	94.000	8902.383	3.942	0.318	2.628	2878.337	-1.739	2.208	4.471		94.558
QAT	2.041	89.600	100.000	15483.575	5.786	0.197	4.824	74901.422	3.567	5.638	6.124		94.724
ROU	0.037	47.893	99.900	3008.679	5.220	0.576	3.370	7542.252	-0.737	3.297	5.145		97.654
RUS	1.178	50.000	95.000	7253.482	5.154	0.216	3.245	10355.668	-0.434	3.433	4.763		99.556
RWA	-3.674	0.480	96.000	15.993	4.377	0.437	5.100	557.964	-0.474	3.979	4.391		70.669
SAU	2.187	57.300	99.100	7803.830	5.436	0.232	4.755	16266.742	2.663	4.707	5.138		86.134
SEN	-2.653	5.690	90.000	203.697	5.017	0.316	3.180	979.955	-0.500	3.828	4.846		49.695
SGP	4.325	84.000	100.000	8741.641	6.353	0.154	5.956	43116.689	3.050	5.928	6.123		94.706
SLV	-0.926	13.260	95.000	972.327	4.886	0.285	2.974	3617.919	-1.349	2.667	5.346		84.103
SRB	0.147	50.850	96.950	3736.577	4.422	0.208	3.054	5138.911	-1.445	3.090	4.315		97.772
SVK	1.174	72.176	99.850	4765.068	5.564	0.821	3.630	16103.985	-0.748	2.976	5.548		99.000
SVN	1.221	70.462	99.700	8125.670	5.767	0.282	3.876	23648.371	1.496	3.815	5.244		99.685

SWE	5.631	89.502	99.000	14341.899	6.578	0.076	5.861	49183.016	4.009	5.342	6.430	99.000
SYR	-2.757	40.370	97.500	2082.993	3.724	1.092	2.880	2823.105	-1.961	3.246	3.675	84.195
THA	-1.468	22.840	37.770	2159.534	4.757	0.087	3.669	4992.432	-0.114	3.570	5.003	93.506
TJK	-2.287	2.870	0.000	2413.092	4.491	0.062	3.972	733.861	-1.693	3.386	3.613	99.673
TUN	-0.872	17.000	100.000	1494.146	4.828	0.312	4.018	4199.346	-0.231	4.317	6.105	77.561
TUR	-0.910	44.227	100.000	2701.047	5.258	0.404	3.800	10309.455	-0.209	3.269	5.183	90.817
TWN	1.504	71.720	100.000	9909.267	6.256	0.501	4.473	18558.091	3.081	4.873	6.011	97.780
TZA	-3.406	2.620	85.000	104.430	3.381	0.704	3.750	545.188	-1.580	3.287	3.834	72.901
UGA	-3.585	2.120	100.000	69.433	3.621	0.484	3.784	500.650	-1.985	3.758	3.935	74.600
UKR	-0.202	30.700	99.900	4184.592	5.141	0.070	2.883	3012.804	-0.634	3.817	4.415	99.689
URY	0.796	52.790	100.000	2620.767	5.831	0.389	4.012	11997.896	0.009	3.412	5.812	98.268
USA	3.073	75.540	99.800	13524.204	6.024	0.250	4.995	46860.242	3.563	4.668	6.170	99.000
VEN	-0.735	17.270	90.000	4251.878	4.368	0.574	2.445	10049.193	-2.753	2.830	5.705	95.155
VNM	0.674	14.210	70.000	849.882	5.345	0.297	3.548	1173.548	-1.093	3.713	4.531	92.778
ZAF	-1.570	18.330	99.790	5180.906	4.772	0.349	4.923	7274.416	0.284	2.330	5.052	89.000
ZWE	-3.002	5.320	80.000	641.688	3.407	0.165	3.062	594.498	-2.593	4.486	4.098	91.859

Appendix Nine: Table of AMI values from T-6 to T+6 Per Country

Please note that ROC is the “Rate-of-Change” of AMI and is an indicator of the rate of adoption of mobile Internet.

Country	T-6	T-5	T-4	T-3	T-2	T-1	T0	T+1	T+2	T+3	T+4	T+5	T+6	ROC
AGO	-6.67	-4.80	-3.29	-2.09	-1.14	-0.39	0.14	0.66	1.02	1.46	1.96	2.50	3.10	0.75
ARE	-1.02	-0.82	-0.58	-0.32	-0.04	0.26	0.62	0.99	1.41	1.87	2.41	3.06	3.85	0.37
ARG	-0.87	-0.56	-0.28	-0.02	0.20	0.38	0.49	0.60	0.75	0.97	1.25	1.62	2.07	0.23
ARM	-1.87	-1.39	-0.93	-0.50	-0.12	0.22	0.46	0.70	0.85	1.03	1.29	1.65	2.10	0.31
AUS	-1.02	-0.78	-0.50	-0.21	0.05	0.35	0.78	1.21	1.78	2.46	3.29	4.32	5.59	0.51
AUT	-1.18	-0.88	-0.57	-0.28	0.00	0.31	0.73	1.14	1.69	2.32	3.08	3.99	5.11	0.48
AZE	-1.62	-1.20	-0.81	-0.45	-0.11	0.18	0.38	0.59	0.70	0.85	1.10	1.44	1.91	0.27
BEL	-1.64	-1.24	-0.92	-0.57	-0.23	0.11	0.56	1.01	1.58	2.29	3.17	4.27	5.65	0.56
BGR	-0.72	-0.46	-0.22	0.00	0.21	0.38	0.49	0.61	0.73	0.91	1.16	1.50	1.94	0.20
BHR	-1.37	-1.13	-0.84	-0.51	-0.16	0.20	0.62	1.05	1.53	2.05	2.62	3.25	3.97	0.41
BOL	-2.87	-2.15	-1.55	-1.03	-0.55	-0.11	0.24	0.59	0.87	1.15	1.41	1.73	2.12	0.38
BRA	-0.87	-0.52	-0.24	-0.03	0.14	0.29	0.41	0.53	0.64	0.73	0.87	1.07	1.33	0.17
BWA	-2.27	-1.71	-1.20	-0.74	-0.33	0.05	0.35	0.65	0.87	1.07	1.26	1.44	1.62	0.30
CAN	-1.49	-1.16	-0.87	-0.56	-0.25	0.11	0.60	1.09	1.73	2.49	3.42	4.57	5.99	0.58
CHE	-2.07	-1.54	-1.13	-0.68	-0.23	0.20	0.74	1.29	2.01	2.88	3.98	5.36	7.12	0.71
CHL	-0.67	-0.40	-0.15	0.07	0.24	0.37	0.47	0.57	0.74	0.98	1.29	1.68	2.16	0.22
CHN	-0.89	-0.64	-0.42	-0.21	-0.03	0.14	0.26	0.39	0.50	0.63	0.80	1.00	1.25	0.16
CMR	-4.45	-3.37	-2.43	-1.62	-0.93	-0.33	0.10	0.54	0.81	1.09	1.44	1.85	2.35	0.52
COL	-1.00	-0.71	-0.44	-0.19	0.02	0.21	0.36	0.51	0.63	0.72	0.80	0.89	1.02	0.16
CYP	-0.47	-0.33	-0.20	-0.07	0.06	0.22	0.42	0.63	0.88	1.21	1.63	2.16	2.82	0.25

Country	T-6	T-5	T-4	T-3	T-2	T-1	T0	T+1	T+2	T+3	T+4	T+5	T+6	ROC
CZE	-0.70	-0.44	-0.21	-0.02	0.13	0.31	0.57	0.84	1.20	1.62	2.11	2.69	3.36	0.31
DEU	-1.56	-1.20	-0.83	-0.46	-0.12	0.23	0.66	1.08	1.62	2.27	3.07	4.05	5.28	0.53
DOM	-2.15	-1.42	-0.87	-0.46	-0.14	0.13	0.36	0.60	0.81	1.02	1.19	1.39	1.71	0.30
ECU	-2.26	-1.57	-1.01	-0.55	-0.18	0.14	0.38	0.62	0.78	0.95	1.12	1.32	1.55	0.29
EGY	-3.36	-2.26	-1.41	-0.76	-0.28	0.06	0.29	0.52	0.75	1.03	1.33	1.66	2.02	0.41
ESP	-0.61	-0.43	-0.25	-0.08	0.11	0.32	0.58	0.85	1.18	1.56	2.02	2.56	3.19	0.29
EST	-0.83	-0.55	-0.29	-0.07	0.13	0.35	0.68	1.01	1.46	1.99	2.60	3.31	4.14	0.38
ETH	-4.92	-3.71	-2.67	-1.77	-1.03	-0.43	0.01	0.45	0.76	1.11	1.60	2.24	3.03	0.61
FIN	-1.51	-1.00	-0.63	-0.24	0.15	0.50	1.00	1.50	2.14	2.92	3.90	5.14	6.73	0.63
FRA	-0.54	-0.39	-0.23	-0.07	0.11	0.30	0.60	0.90	1.32	1.84	2.48	3.27	4.25	0.37
GBR	-1.23	-0.91	-0.58	-0.26	0.05	0.37	0.80	1.24	1.83	2.53	3.37	4.39	5.63	0.53
GEO	-1.62	-1.20	-0.82	-0.46	-0.13	0.15	0.36	0.57	0.70	0.81	1.01	1.31	1.74	0.26
GHA	-4.35	-3.19	-2.21	-1.38	-0.70	-0.17	0.19	0.55	0.73	1.03	1.45	1.98	2.64	0.54
GMB	-5.58	-3.94	-2.59	-1.52	-0.69	-0.11	0.23	0.56	0.77	1.19	1.80	2.61	3.59	0.71
GRC	-0.30	-0.12	0.01	0.11	0.20	0.29	0.43	0.56	0.75	1.01	1.36	1.81	2.37	0.21
GTM	-3.07	-2.07	-1.28	-0.67	-0.22	0.11	0.34	0.57	0.70	0.79	0.91	1.04	1.19	0.33
HKG	-0.97	-0.69	-0.40	-0.11	0.17	0.47	0.87	1.28	1.81	2.43	3.17	4.06	5.13	0.47
HND	-2.86	-1.98	-1.29	-0.74	-0.30	0.05	0.35	0.65	0.90	1.15	1.40	1.62	1.84	0.36
HRV	-0.18	-0.03	0.12	0.24	0.33	0.45	0.63	0.81	1.04	1.33	1.69	2.13	2.66	0.22
HUN	-0.73	-0.50	-0.29	-0.12	0.06	0.28	0.55	0.83	1.17	1.57	2.03	2.57	3.19	0.30
IDN	-1.29	-1.01	-0.74	-0.47	-0.22	0.04	0.25	0.46	0.64	0.79	0.91	0.98	1.09	0.18
IND	-4.10	-2.97	-2.01	-1.23	-0.61	-0.15	0.16	0.46	0.60	0.83	1.17	1.60	2.12	0.48
IRL	-0.60	-0.43	-0.24	-0.03	0.16	0.37	0.67	0.97	1.38	1.90	2.55	3.39	4.45	0.39
ISL	-2.45	-2.02	-1.62	-1.14	-0.62	-0.08	0.64	1.35	2.23	3.22	4.39	5.77	7.44	0.76
ISR	-0.81	-0.45	-0.18	0.04	0.27	0.52	0.85	1.17	1.61	2.14	2.79	3.57	4.53	0.41
ITA	-0.08	0.04	0.15	0.25	0.33	0.45	0.63	0.80	1.05	1.35	1.71	2.15	2.67	0.21

Country	T-6	T-5	T-4	T-3	T-2	T-1	T0	T+1	T+2	T+3	T+4	T+5	T+6	ROC
JAM	-1.38	-0.89	-0.51	-0.21	0.02	0.21	0.37	0.53	0.65	0.79	0.92	1.04	1.14	0.19
JOR	-0.10	-0.01	0.07	0.13	0.19	0.27	0.38	0.48	0.63	0.79	0.97	1.19	1.44	0.12
JPN	-1.39	-1.04	-0.69	-0.34	0.03	0.40	0.84	1.28	1.80	2.43	3.19	4.11	5.23	0.51
KAZ	-1.52	-1.10	-0.72	-0.36	-0.04	0.23	0.40	0.56	0.67	0.87	1.15	1.54	2.05	0.27
KEN	-2.32	-1.75	-1.25	-0.82	-0.44	-0.10	0.22	0.54	0.84	1.14	1.41	1.65	1.84	0.32
KGZ	-2.51	-1.86	-1.29	-0.78	-0.34	0.03	0.29	0.55	0.73	0.86	1.01	1.24	1.61	0.32
KHM	-3.22	-2.42	-1.72	-1.12	-0.61	-0.18	0.13	0.44	0.64	0.77	0.93	1.17	1.47	0.36
KOR	-0.75	-0.42	-0.16	0.07	0.31	0.59	0.96	1.33	1.80	2.36	3.00	3.75	4.62	0.41
KWT	-0.59	-0.34	-0.13	0.05	0.23	0.40	0.54	0.68	0.82	0.99	1.21	1.48	1.82	0.19
LKA	-1.83	-1.42	-1.04	-0.69	-0.36	-0.04	0.24	0.51	0.74	0.96	1.14	1.29	1.47	0.25
LSO	-3.62	-2.80	-2.08	-1.45	-0.88	-0.34	0.11	0.56	0.93	1.31	1.69	2.05	2.40	0.46
LTU	-0.93	-0.55	-0.23	0.03	0.23	0.39	0.62	0.86	1.18	1.55	1.99	2.47	3.02	0.30
LUX	-1.17	-0.88	-0.58	-0.29	0.00	0.32	0.74	1.15	1.70	2.37	3.19	4.19	5.43	0.51
LVA	-0.37	-0.14	0.05	0.18	0.26	0.39	0.56	0.74	0.96	1.24	1.58	1.97	2.43	0.22
MAR	-3.95	-2.66	-1.62	-0.80	-0.19	0.22	0.41	0.60	0.91	1.39	2.02	2.80	3.72	0.59
MDA	-1.14	-0.78	-0.46	-0.18	0.06	0.25	0.35	0.45	0.57	0.76	1.03	1.40	1.86	0.23
MDG	-5.59	-4.11	-2.87	-1.86	-1.05	-0.40	0.08	0.55	0.86	1.18	1.62	2.14	2.73	0.64
MEX	-1.01	-0.69	-0.44	-0.23	-0.03	0.14	0.29	0.44	0.55	0.65	0.80	1.02	1.32	0.18
MKD	-0.24	-0.09	0.04	0.15	0.21	0.30	0.45	0.60	0.81	1.07	1.36	1.71	2.11	0.18
MLT	-1.08	-0.81	-0.61	-0.37	-0.09	0.18	0.53	0.87	1.29	1.76	2.29	2.91	3.65	0.36
MNE	-0.58	-0.33	-0.07	0.17	0.40	0.61	0.74	0.87	0.99	1.16	1.42	1.75	2.19	0.21
MNG	-1.90	-1.37	-0.93	-0.58	-0.25	0.04	0.26	0.48	0.62	0.79	1.06	1.47	2.04	0.30
MOZ	-6.33	-4.60	-3.17	-2.01	-1.08	-0.36	0.07	0.50	0.84	1.36	2.06	2.90	3.90	0.79
MRT	-7.41	-5.29	-3.58	-2.23	-1.16	-0.34	0.19	0.72	1.10	1.64	2.28	3.00	3.75	0.86
MUS	-0.37	-0.20	-0.05	0.07	0.18	0.27	0.35	0.42	0.49	0.54	0.60	0.65	0.73	0.08
MWI	-3.77	-2.85	-2.06	-1.39	-0.81	-0.32	0.04	0.39	0.62	0.80	1.06	1.39	1.80	0.43

Country	T-6	T-5	T-4	T-3	T-2	T-1	T0	T+1	T+2	T+3	T+4	T+5	T+6	ROC
MYS	-1.29	-0.81	-0.42	-0.11	0.14	0.37	0.52	0.68	0.90	1.18	1.57	2.08	2.76	0.31
NAM	-2.43	-1.75	-1.20	-0.75	-0.38	-0.05	0.22	0.48	0.69	0.90	1.08	1.25	1.51	0.30
NGA	-3.91	-2.79	-1.86	-1.09	-0.50	-0.06	0.22	0.49	0.66	0.97	1.43	2.05	2.82	0.52
NIC	-4.64	-3.34	-2.30	-1.47	-0.79	-0.24	0.18	0.60	0.90	1.19	1.50	1.80	2.17	0.52
NLD	-1.88	-1.50	-1.09	-0.67	-0.28	0.12	0.61	1.11	1.76	2.53	3.47	4.62	6.05	0.61
NOR	-1.37	-1.05	-0.75	-0.44	-0.09	0.32	0.87	1.43	2.12	2.92	3.88	5.04	6.45	0.60
NPL	-6.16	-4.51	-3.13	-1.99	-1.08	-0.37	0.08	0.54	0.82	1.27	1.87	2.59	3.42	0.74
NZL	-1.20	-0.94	-0.67	-0.38	-0.08	0.22	0.65	1.08	1.64	2.31	3.13	4.15	5.40	0.51
OMN	-0.10	0.12	0.29	0.42	0.52	0.60	0.69	0.79	0.91	1.03	1.17	1.32	1.50	0.12
PAN	-1.44	-0.91	-0.50	-0.16	0.12	0.39	0.59	0.80	0.94	1.03	1.21	1.50	1.93	0.26
PER	-2.03	-1.42	-0.94	-0.54	-0.21	0.09	0.37	0.65	0.91	1.15	1.35	1.61	1.97	0.31
PHL	-1.79	-1.31	-0.88	-0.50	-0.18	0.09	0.29	0.49	0.61	0.71	0.80	0.90	1.07	0.22
POL	-0.06	0.13	0.27	0.37	0.42	0.49	0.67	0.84	1.12	1.45	1.83	2.27	2.77	0.22
PRT	-0.52	-0.30	-0.10	0.08	0.24	0.41	0.64	0.87	1.16	1.49	1.86	2.28	2.76	0.25
PRY	-2.85	-2.06	-1.42	-0.90	-0.46	-0.05	0.30	0.65	0.94	1.24	1.64	2.19	2.90	0.44
QAT	-1.57	-1.20	-0.89	-0.54	-0.19	0.17	0.64	1.11	1.70	2.41	3.31	4.46	5.92	0.58
ROU	-0.38	-0.19	-0.02	0.13	0.26	0.35	0.45	0.55	0.70	0.90	1.18	1.53	1.97	0.18
RUS	-0.36	-0.13	0.08	0.25	0.37	0.46	0.56	0.65	0.83	1.08	1.39	1.78	2.26	0.20
RWA	-3.74	-2.81	-2.00	-1.30	-0.72	-0.23	0.11	0.45	0.64	0.81	1.07	1.41	1.82	0.43
SAU	-0.71	-0.33	-0.05	0.14	0.29	0.46	0.65	0.84	1.07	1.33	1.63	2.03	2.54	0.25
SEN	-4.67	-3.29	-2.15	-1.23	-0.53	-0.04	0.20	0.45	0.56	0.89	1.41	2.14	3.06	0.59
SGP	-1.90	-1.32	-0.91	-0.51	-0.07	0.35	0.85	1.35	1.97	2.70	3.60	4.73	6.17	0.62
SLV	-2.42	-1.65	-1.04	-0.56	-0.18	0.12	0.36	0.61	0.80	1.00	1.19	1.35	1.49	0.30
SRB	-1.12	-0.75	-0.44	-0.16	0.08	0.28	0.46	0.65	0.93	1.29	1.72	2.25	2.88	0.31
SVK	-0.73	-0.54	-0.34	-0.16	0.04	0.27	0.56	0.85	1.22	1.66	2.19	2.83	3.60	0.33
SVN	-0.67	-0.38	-0.17	-0.03	0.12	0.31	0.56	0.81	1.13	1.52	1.98	2.52	3.16	0.29

Country	T-6	T-5	T-4	T-3	T-2	T-1	T0	T+1	T+2	T+3	T+4	T+5	T+6	ROC
SWE	-1.64	-1.24	-0.82	-0.39	0.02	0.41	0.97	1.53	2.24	3.09	4.10	5.36	6.92	0.66
SYR	-2.79	-2.05	-1.43	-0.91	-0.45	-0.06	0.19	0.45	0.80	1.19	1.59	2.01	2.46	0.40
THA	-1.07	-0.80	-0.55	-0.30	-0.07	0.14	0.31	0.48	0.62	0.72	0.80	0.89	1.02	0.16
TJK	-3.09	-2.39	-1.73	-1.12	-0.57	-0.08	0.24	0.56	0.72	0.88	1.11	1.42	1.82	0.38
TUN	-2.27	-1.60	-1.03	-0.55	-0.16	0.16	0.37	0.57	0.66	0.78	0.94	1.13	1.32	0.28
TUR	-0.22	-0.05	0.07	0.16	0.22	0.29	0.36	0.44	0.52	0.62	0.75	0.92	1.14	0.10
TWN	-1.19	-0.90	-0.62	-0.34	-0.07	0.21	0.59	0.97	1.47	2.07	2.80	3.71	4.81	0.46
TZA	-4.95	-3.74	-2.69	-1.78	-1.01	-0.35	0.13	0.61	0.90	1.22	1.62	2.08	2.60	0.58
UGA	-4.31	-3.26	-2.35	-1.56	-0.88	-0.30	0.12	0.53	0.77	1.02	1.37	1.81	2.36	0.51
UKR	-1.28	-0.83	-0.44	-0.12	0.14	0.34	0.43	0.52	0.60	0.75	0.95	1.22	1.56	0.22
URY	-0.68	-0.44	-0.21	0.00	0.19	0.34	0.52	0.71	0.97	1.29	1.67	2.12	2.65	0.26
USA	-0.84	-0.58	-0.33	-0.10	0.13	0.36	0.73	1.11	1.62	2.24	3.01	3.97	5.16	0.46
VEN	-2.21	-1.58	-1.07	-0.64	-0.25	0.10	0.38	0.66	0.90	1.12	1.40	1.78	2.28	0.35
VNM	-1.29	-0.91	-0.56	-0.23	0.06	0.32	0.51	0.70	0.82	0.92	1.00	1.08	1.16	0.19
ZAF	-1.97	-1.34	-0.85	-0.48	-0.18	0.07	0.30	0.53	0.76	0.96	1.12	1.33	1.67	0.28
ZWE	-3.31	-2.60	-1.96	-1.37	-0.81	-0.27	0.17	0.61	0.97	1.33	1.68	2.04	2.52	0.45

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