THE IMPACT OF PUSH AND PULL MOBILE TECHNOLOGY ON BUSINESS DEVELOPMENT IN AFRICA

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Foreword

The emergence of mobile phones as the leading personal communications device has led to their attractiveness as a potentially lucrative media platform for marketers. One of the many applications on the mobile phones that have gained widespread use is the push and pulls technology. Push technology, or server push, describes a style of Internet-based communication where the request for a given transaction is initiated by the publisher or central server. It is contrasted with pull technology, where the request for the transmission of information is initiated by the receiver or client. Push services include synchronous conferencing, instant messaging, chat messages and Emails. Other uses are push enabled web applications including market data distribution (stock tickers), auctions, online betting and gaming, sport results, monitoring consoles and sensor network monitoring.

Pull technology or client pull is a style of network communication where the initial request for data originates from the client, and then is responded to by the server. The pull technology is effective and economical when advertising to open, unidentified potential customers world wide. It is more effective for the customer when he searches for a specific item. Most web feeds, such as Really Simple Syndication (RSS) are technically pulled by the client. SMS banking services are operated using both push and pull messages. Typically push messages could be either mobile marketing messages or messages alerting an event which happens in the customer's bank account, such as a large withdrawal of funds from the ATM or a large payment using the customer's credit card.

Pull messages are those that are initiated by the customer, using a mobile phone, for obtaining information or performing a transaction in the bank account. Examples of pull messages for

information include an account balance enquiry, or requests for current information like currency exchange rates and deposit interest rates, as published and updated by the bank. This study aims at analyzing the impact of push and pull mobile technology on business development in Africa. The study will explore the extent of usage of push and pull technology in Africa and how push and pull technology has led to expansion of business Africa.

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Key Words: Push and Pull Factors, Mobile Technology, Mobile Telephony and Business

ABSTRACT

The emergence of mobile phones as the leading personal communications device has led to their attractiveness as a potentially lucrative media platform for marketers. One of the many applications on the mobile phones that have gained widespread use is the push and pulls technology. The impacts of push and pull mobile technology has been realized in the business world in various fields. This paper highlights some of the impacts of push and pulls mobile technology in Africa. It is clear that push and pull mobile technology is becoming increasingly important to African countries: as an infrastructure service - improving efficiency of markets, promoting investment, response to emergencies, reducing risk from disasters, and contributing to empowerment; poverty reduction; improving rural livelihoods by expanding and strengthening social networks; increase people's ability to deal with emergencies; cut down travel costs; maximize the outcomes of necessary journeys; increase temporal accessibility; and amplify efficiency of activities. The use of mobile phones also reduces costs of doing business and increases productivity by helping traders and farmers to secure better markets and prices; and promptly communicate business-related information.

1. INTRODUCTION

The physical world gradually becomes more and more integrated due to the vast development of information and communication technologies. Email and messaging have become part and parcel of today's daily life for communication. The ICT departments of different financial institutions are struggling to keep up with the demand for computing, rapid technology changes and the

fundamental transformation of work (Taiton and Sorensen, 2004). As a result, E-Commerce brings the universal access of the Internet to the core business processes of buying and selling goods and other services.

ICTs have penetrated virtually every segment of society and projections suggest increased penetration rates. Though distinctions are often made between new ICTs such as computers and mobile phones, and old ICTs such as radio, television, and landline telephony, the current technological convergences increasingly blur such divisions. Thus, single devices such as mobile phones can now receive, process, store and display text, image and sound together. Judged by the number of users worldwide, the cell phone is by far the most popular personal communications device for consumers and, therefore, is emerging as a coveted media platform for marketers (Yuan and Steinberg 2006). The use of mobile coupons and advertising is rapidly growing (Jakobson 2005) and marketers are developing innovative strategies to exploit this medium (Sultan and Rohm 2005).

1.1 Africa's Experience of Mobile Phones

The demand for mobile phones across African is huge and rapidly expanding. 'An Overview of Evidence' pointed out that less than 3% of the population had access to a telephone in 2001, but the number of mobile subscribers has already grown to over 50 million, representing over 7% of the population1 (McKemey et al., 2003). The number of subscribers is currently expanding at around 35% a year, and is forecast to continue over the next few years. The rapid expansion of markets is clearly linked to liberal regulatory environments, where operators have been given freedom to respond to customer requirements. Globally, the industry recognizes that its next 1billion customers will be won (Scott *et al.,* 2004).

Mobile phones are, therefore, becoming increasingly important to African countries: as an infrastructure service - improving efficiency of markets, promoting investment, reducing risk from disasters, and contributing to empowerment; as an economic sector – mobile operators can make big profits, and pay taxes; as a development tool – case studies present innovative applications where mobile phones have increased the efficiency of service delivery to the poor (e.g. weather information, market prices), or opened opportunities for new services e.g. tracking

of diseases and as a household expenditure that maintains social capital and contributes to economic management (Scott *et al.,*, 2004).

The poor in Africa tend to use public access facilities and to share phones, so low teledensity figures can mask the extent to which the poor access telecommunications services. Research shows that in 'typical' rural districts of Africa, up to 80% of households make regular use of phones (McKemey et al., 2003). One of the key features driving growth in mobiles is that they are mobile, and inherently suited to remote areas with poor infrastructure. In addition, the prepaid system of low denomination scratch cards is perfectly matched to the economic situation of many Africans, and it is recognized that mobiles offer potentially cheap means of communicating, especially through the use of SMS and 'beeping' (McKemey et al., 2003). It is important to consider constraints facing women in access to and use of mobile phones, but preliminary evidence indicates that the phone appears to be a gender neutral tool.

1.2 Push and Pull Mobile Technology

The emergence of mobile phones as the leading personal communications device has led to their attractiveness as a potentially lucrative media platform for marketers. One of the many applications on the mobile phones that have gained widespread use is the push and pulls technology. The impacts of push and pull mobile technology has been realized in the business world in various fields. The following sections will explore the extent of usage of push and pull technology it has led to expansion of business Africa.

In response to increases in mobile phone coverage and adoption in Africa, mobile phone-based development projects have proliferated in a variety of sectors, including agriculture, health, education, emergency response, and governance. The objective, target group, and use of mobile phones in each project differ significantly, but the underlying belief is that mobile phones can offer a useful platform for providing information and services.

1.2.1 Mobile Technology and Banking

Electronic Banking – the execution of financial services of a Bank via the Internet – is one of most appreciable examples of E-Commerce. Because it has changed the business of retail banks

significantly, at the same time reducing costs and increasing convenience of customer (Pousttchi and Schurig, 2004). Banks and other financial institutions are exploring the use of mobile commerce to allow their customers to not only access account information, but also make transactions, such as purchasing stocks, remitting money via mobile phones and other mobile equipments. This service is often referred to as m-Banking. Since cellular networks has become an essential component of the economic and social infrastructure of the developed and developing countries, a new subset of electronic banking has created, mobile banking (m-Banking). m-Banking refers to that technology which covers account management via mobile devices (Pousttchi and Schurig, 2004). On the other hand, customers get the convenience of accessing the bank directly from their home or workplace. In addition, messaging solution adds real value by its event based alerts. A Customer is informed about all the transactions happening in his/her account. It can include range of services like information about bank accounts, Time deposits, ATM card transactions, Credit card transactions, Fund transfer, Personal loan details, Mutual Funds e.t.c.

1.2.1.1 SMS Technology Adoption Module

Short Messaging Service (SMS) is a communication protocol allowing the interchange of short text messages between mobile telephone devices. Most SMS messages are mobile-to-mobile text messages, though the standard supports other types of broadcast messaging as well. The SMS is a store and forward service. In other words, short messages are not sent directly from sender to recipient, but via an SMS center. Each mobile telephone network that supports SMS has one or more messaging centers to handle and manage the short messages (Mobilecomms, 2009). This module describes the process of communicating with the GSM modem which is the most important provider of our SMS service. This process of communication has been done through a number of attention commands (AT). This AT commands makes our bank server modem to be able to send and receive SMS from customers mobile and vice-versa.

Figure1: SMS based m- Banking system

1.2.1.2 PUSH and PULL m-Banking Services Generation Module

In this proposed service generation module first of all, m-Banking utilities are specified either as PUSH or PULL depending on SMS initiating type between bank and customers. Then PUSH and PULL services are subcategorized as their homogenous utility. In XML, service tables are generated to implement PUSH and PULL category m-Banking services along with five subcategories: Broadcast, Scheduling, Event, Enquiry and M-Commerce. These tables are generated to synchronize which help to maintain newly developed more and more new real time m-Banking v registered. For this, at first the bank server broadcasts SMS giving a notification of their SMS based m- Banking service. When a customer wants to register for this service, he/she has to send SMS with a specified syntax to bank with account number and password.

1.2.1.3 Push and Pull Messages

SMS banking services are operated using both push and pull messages. Push messages are those that the bank chooses to send out to a customer's mobile phone, without the customer initiating a request for the information. Typically push messages could be either Mobile marketing messages or messages alerting an event which happens in the customer's bank account, such as a large withdrawal of funds from the ATM or a large payment using the customer's credit card, etc.

Another type of push message is One-time password (OTPs). OTPs are the latest tool used by financial and banking service providers in the fight against cyber fraud. Instead of relying on

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traditional memorized passwords, OTPs are requested by consumers each time they want to perform transactions using the online or mobile banking interface.

When the request is received the password is sent to the consumer's phone via SMS. The password is expired once it has been used or once its scheduled life-cycle has expired. Pull messages are those that are initiated by the customer, using a mobile phone, for obtaining information or performing a transaction in the bank account. Examples of pull messages for information include an account balance enquiry, or requests for current information like currency exchange rates and deposit interest rates, as published and updated by the bank.

The bank's customer is empowered with the capability to select the list of activities (or alerts) that he/she needs to be informed. This functionality to choose activities can be done either by integrating to the internet banking channel or through the bank's customer service call centre.

1.2.1.4 PUSH Services Generation

PUSH provides a standard means to send data to a mobile subscriber without an explicit request from the subscriber at the time data is delivered. This service generation sub-module composed of three categories of m-Banking services: Broadcast, Scheduling and Event category. The proposed Broadcast category of services allows the bank authority to send PUSH SMS with updated information to all of the account holders who are already registered for SMS banking. Three services are implemented under this category: Change in interest rate, Any Change in Bank Policy and Opening a new branch. If any update in bank current interest rate or policy or opening a new branch of their bank, they broadcast this updating news through SMS.

1.2.1.5 Concerns and skepticism about SMS banking

Many banks would have some concerns when the prospects of introducing SMS banking are discussed. Most of these concerns could revolve around security and operational controls around SMS Banking. However, while SMS banking is not as secure as other conventional banking channels, like the ATM and internet banking, the SMS banking channel is not intended to be used for very high-risk transactions. It is extremely important that SMS gateway providers can provide a decent quality of service for banks and financial institutions in regards to SMS services. Therefore, the provision of Service Level Agreement (SLA) is a requirement for this

industry; it is necessary to give the bank customer delivery guarantees of all messages, as well as measurements on the speed of delivery, throughput, etc. SLAs give the service parameters in which a messaging solution is guaranteed to perform.

1.2.1.6 The Convenience Factor

The convenience of executing simple transactions and sending out information or alerting a customer on the mobile phone is often the overriding factor that dominates over the skeptics who tend to be overly bitten by security concerns. As a personalized end-user communication instrument, today mobile phones are perhaps the easiest channel on which customers can be reached on the spot, as they carry the mobile phone all the time no matter where they are. Besides, the operation of SMS banking functionality over phone key instructions makes its use very simple.

This is quite different from internet banking which can offer broader functionality, but has the limitation of use only when the customer has access to a computer and the Internet. Also, urgent warning messages, such as SMS alerts, are received by the customer instantaneously; unlike other channels such as the post, email, Internet, telephone banking, etc. on which a bank's notifications to the customer involves the risk of delayed delivery and response.

The SMS banking channel also acts as the bank's means of alerting its customers, especially in an emergency situation; e.g. when there is an ATM fraud happening in the region, the bank can push a mass alert (although not subscribed by all customers) or automatically alert on an individual basis when a predefined 'abnormal' transaction happens on a customer's account using the ATM or credit card. This capability mitigates the risk of fraud going unnoticed for a long time and increases customer confidence in the bank's information systems. Empowering Growth through Business Solutions

The lack of encryption on SMS messages is an area of concern that is often discussed. This concern sometimes arises within the group of the bank's technology personnel, due to their familiarity and past experience with encryption on the ATM and other payment channels. The lack of encryption is inherent to the SMS banking channel and several banks that use it have

overcome their fears by introducing compensating controls and limiting the scope of the SMS banking application to where it offers an advantage over other channels.

Suppliers of SMS banking software solutions have found reliable means by which the security concerns can be addressed. Typically the methods employed are by preregistration and using security tokens where the transaction risk is perceived to be high. Sometimes ATM type PIN Nos are also employed, but the usage of PIN Nos in SMS banking makes the customer's task more cumbersome.

Barclays Bank of Kenya (BBK), Kenya's largest bank in terms of assets finally launched a mobile banking service, Hello Money. Hello Money is a USSD-based mobile banking solution that uses a secure gateway and PIN code entry for customers – this is far more secure than the "push and pull" SMS-based mobile banking that is vulnerable to hacking.

The Hello Money service is being offered to BBK customers currently in conjunction with Safaricom, Kenya's leading mobile network – the service will be extended to other mobile networks in due course. There is nothing specifically revolutionary about the BBK mobile banking solution since other Banks in Kenya like the Co-operative Bank, Equity Bank and Standard Chartered Bank already have mobile banking offerings in place and have done so for sometime now.

1.2.2 Mobile Phone Technology in Agriculture

The agriculture sector plays an extremely important role in the world economy but its importance in terms of food security is even more important as it relates to the future survival of people and nations. Strengthening the agriculture sector is, therefore, of universal interest. It is arguably the oldest economic sector in existence. Information and communication technologies by contrast make up the newest economic sector and the technologies are developing at a rate not experienced with any previous form of technology. This ever-changing set of tools, coupled with the decreasing price of ICT, has had an impact on almost every aspect of life for a high percentage of the world's population. Mobile phones in particular are rapidly becoming accepted as essential even for people who live in remote, traditional areas and own very little. Africa is by no means a homogeneous set of countries and even though the agriculture sector as a whole has

general common interests the specific contexts where mobile phone technology is used will have a major effect on how it should be introduced and for what purpose.

Many management decisions in modern farming require up-to-date and local information, for example regarding weather forecasts and regional recordings of crop diseases and pests. PlanteInfo (Jensen et al., 2000). Many farmers, however, are reluctant to use computers and often they need the information when they are in the field – far away from a computer. Modern mobile handsets can solve this problem, since they enable web access, exchange of data and execution of Java programs by wireless connection (Hilden & Hansen, 1999). However, most farmers own an ordinary mobile telephone, which can send and receive SMS (Short Message Service).

1.2.2.1 The Role of Push and Pull Mobile Technology in Agricultural Sector

The mobile phone technology is an important tool to enhance farmers' access to better paying agricultural markets. Mobile technologies are becoming an increasingly important way to connect rural and isolated communities. In fact the mobile phone penetration rates are outstripping those for internet users, fixed phone lines and broadband subscriptions (see Figure 1).

An important trend to observe is the rate of cellular subscription increase in developing countries. Figure 2 indicates that the number of mobile subscriptions have gone from approximately 250 million in 2000 to almost 4 billion in 2010. The rate of penetration is astounding and has brought with it several innovations and opportunities for mobile applications. Users can use mobile phones for various activities such as mobile banking, selling products, and to gain access to market data and commodity prices. Many other services such as health services, extension services and general information sharing are now possible via mobile devices.
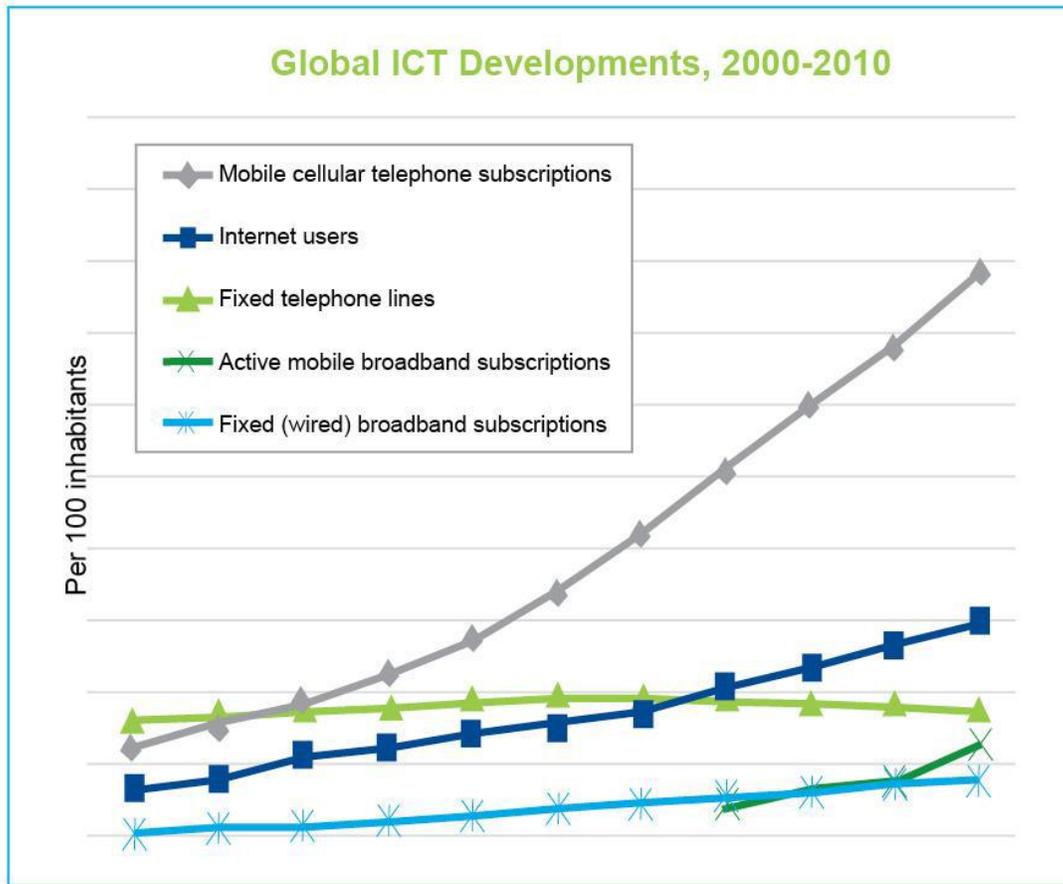
Figure 2: ICT Penetration Rates in Recent Times 2000-2010 adopted from (Deloitte (2011).

The role of mobile communication technology alone has the potential to transform the rural agricultural landscape in manners that will enhance productivity, data sharing and market access. There are a number of benefits that need mentioning and these include: 1) *Access*-Mobile wireless networks are expanding as technical and financial innovations widen coverage to more areas. 2) *Affordability*-Prepaid connectivity and inexpensive devices, often available second hand, make mobile phones far cheaper than alternatives. 3) *Appliances*-Mobile phones are constantly increasing in sophistication and ease of use. Innovations arrive through traditional trickle-down effects from expensive models but have also been directed at the less expensive phones. 4) *Applications*- Applications and services using mobile phones range from simple text

messaging services to increasingly advanced software applications that provide both livelihood improvements and real-time public services.

Through this expansion process, formerly costly technologies quickly become everyday tools for the man in the street. Additional opportunities for more frequent and reliable information sharing will open as technological advances lead to additional convergence between mobile phones and the Internet, GPS, laptops, software, and other ICTs.
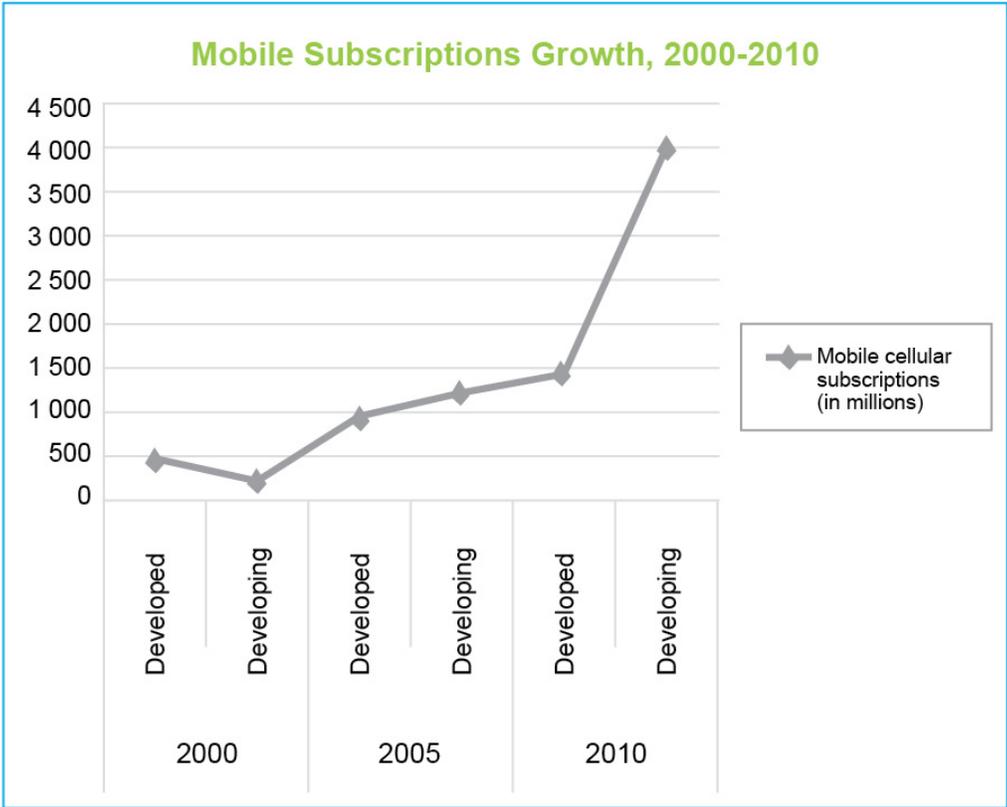

Figure 3: Mobile Subscriptions Growth (2000-2010) adopted from (Deloitte (2011).

1.2.2.2 Success Stories Of Push and Pull Mobile Technology in the Agriculture sector

Mobile phones are facilitating access to agricultural market information, in many cases replacing the message boards and radio programs of traditional market information systems. In the

francophone countries in West Africa, for example, consumer prices for staple grains are broadcast weekly via radio for the largest markets in the country. Yet in many cases, farmers live tens of kilometers from the nearest large market and the data is up to six days old. Farmers in countries as diverse as Niger, Senegal, and Ghana can now type in a code, send a text message, and receive the price of a variety of goods immediately. Mobile phones are also extending the reach of agricultural extension services; in Kenya, Uganda, and India, farmers can call or text hotlines to ask for technical agricultural advice. Table 1 below describes a few success stories categorized according to the type of technology application in them (ITU, 2009). Some of these are covered in greater detail in the following section.

Table 1: Application of Push and Pull Mobile Technology in Africa

Use to which push & pull mobile technology has been put	Objective	Case Studies/ Success Stories
Access To Market Information	To help farmers find out about market prices. This helps them make decisions regarding when to harvest, how to negotiate with intermediaries, and so on. Often combined with other information such as weather forecasts.	• Esoko (various countries in sub-Saharan Africa) • e-Choupal and Reuters Market Light (India) • Manobi (Senegal) • Infotrade (Uganda) • Zambian National Farmers Union MIS (Zambia)
Distribution and Supply Chain Management and	To increase efficiency and predictability, reduce spoilage, and more. To record movements along	• Application across dairy sector (Kenya)

Traceability	the value chain, respond to quality standard requirements, and help large buyers track, manage, pay, and reward small producers.	• Dunavant Cotton (Zambia) • Infosys system for horticulture (India) • EJAB (Bangladesh) • SourceTrace (Costa Rica, Mexico)
Farm Extension Services, Access to Sector Experience, Research, and Other Resource Information	Using Mobile technology to deliver better farm extension services (utilization of best agriculture practices, research, weather, climate and more).	• Grameen AppLab Community Knowledge Workers (Uganda) • Farmer Voice Radio Project (Kenya) • IFFCO/Kassan Sanchar (India) • Radio (Mali and many others in Africa)
Commodity Exchanges/ Warehouse Receipt Systems	To provide transparency in price discovery and to facilitate better prices and efficiencies between buyers and sellers. It avoids moving crops themselves, reducing spoilage, transportation, and transaction costs. Exercises temporal and spatial arbitrage.	• Ethiopia Commodity Exchange (ECX) • Uganda Commodity Exchange (warehouse receipt system) • Zambian Commodity Exchange (ZAMACE) • SAFEX (South Africa)

1.2.3 Mobile Phones and Education

Despite improvements in educational indicators, such as enrolment, significant challenges remain with regard to the delivery of quality education in developing countries, particularly in rural and remote regions. In the attempt to find viable solutions to these challenges, much hope has been placed in new information and communication technologies (ICTs), mobile phones being one example. There has been evidence of the role of mobile phone-facilitated mLearning in contributing to improved educational outcomes in the developing countries by improving access to education, and promoting new learning.

Simple and affordable mobile phones are being used as a means to promote literacy for adults in Africa (Aker, 2009). Despite the fact that text messages are one-seventh the price of voice calls in Niger, the use of text messages has been relatively limited, in part due to high illiteracy rates. In addition to the normal literacy curriculum, adult learners in Niger are taught where to find letters and numbers on a mobile phone and how to send and receive text messages. Within one cycle of classes, students are able to send text messages in local languages to their friends and family, thereby allowing them to practice their newly acquired literacy skills. In a country without local language newspapers and village-level libraries, text messaging makes literacy functional. Preliminary results suggest that the mobile phone-based literacy students have higher test scores than students in normal literacy classes, and these results are maintained six months after the end of classes (Aker, Ksoll, and Lybberty (2010). Similar mobile literacy projects are starting in Senegal, and others in India are using smart phones and mobile games for children.

1.2.3.1 Mobile learning

mLearning increases access for those who are mobile or cannot physically attend learning institutions – those who would not otherwise be able to follow courses in a traditional educational setting due to the constraints of work, household activities, or other competing demands on their time. MLearning makes education more accessible in that it enables learners to pursue their studies according to their own schedule. The portability of mobile technology means

that mLearning is not bound by fixed class times; mLearning enables learning at all times and in all places, during breaks, before or after shifts, at home, or on the go. Interestingly, however, while mLearning is portable, it is not necessarily associated with physical movement. According to a study conducted by Vavoula, few people actually utilize the time spent in transit to learn (Sharples, Taylor, & Vavoula, 2005, p. 3).

MLearning, as Visser and West (2005) suggest, can also increase access in those situations where cost represents a significant barrier to learning (p. 132). For those in rural or remote areas where environmental and infrastructure challenges hinder other learning modalities, particularly eLearning, mLearning presents great opportunities. For the individual learner, mobile technology is much less cost-prohibitive than other technologies like personal computers and broadband connections that are necessary for eLearning. The ubiquity of mobile phones, moreover, means that educational services can be delivered with learners' existing resources. In as much as mobile technology presents a less cost-prohibitive medium for learning, it represents an important avenue by which to reduce the gap between the haves and the have-nots in contemporary society where access to knowledge and information is increasingly important (VanWeert, 2005).

In regards to cost, the benefit of increased access afforded by mLearning is particularly relevant in the developing country context. Many developing countries are completely bypassing investments in costly, fixed telephone infrastructure for the installation of mobile phone networks (Motlik, 2008; Sharples, Taylor, & Vavoula, 2007, p.224; Traxler & Dearden, 2005). Thus, mLearning provides a potential way forward for the expansion of education programs to larger segments of the population rather than via the eLearning model that has been adopted in much of the developed world. MLearning allows a method of educational delivery that could be more cost-effective than eLearning methods, not to mention that the ubiquity of mobile phones means that many people are already familiar with mobile phone applications (Motlik, 2008).

1.2.3.2 Education through Technology in Tanzania

Nokia, in collaboration with other partners, agencies and organisations launched Bridge*it* Tanzania, an Africa pilot of the Bridge*it* programme. Bridge*it* Tanzania, locally known as *Elimu kwa Teknolojia (Education through technology)*, seeks to facilitate creative and quality

classroom instruction through the innovative use of cell phone and digital technology with the desired outcome of increasing achievement of primary school children in the areas of Math, Science and life skills. Supported through a grant from the United States Agency for International Development (USAID), Bridge*it* Tanzania is implemented by a dynamic alliance comprised of the International Youth Foundation (IYF), the Tanzania Ministry of Education and Vocational Training (MoEVT), Nokia, Nokia Siemens Networks, the Nokia Institute for Technology (INdT), Pearson Foundation, the Forum for African Women Educationalists (FAWE), and Vodacom Foundation. The project, launched in 150 schools in April 2010, had already reached more than 15,000 students and 300 teachers by the end of that year (Ochieng, 2010).

1.2.4 Impacts of Mobile Technology in Emergency Response

The impetus for the mobile communication infrastructure investment requires mobile operators to provide location information for mobile devices in order to facilitate emergency services (Angelides 2005; Jagoe 2003). In the coming years, location tracking technologies are expected to facilitate a wide-range of mobile services. In this context application of push and pull mobile technology is based on Location-based services (LBS). It is defined as a subset of location-based marketing (LBM). LBM activities would include all aspects of the marketing mix in the mobile location-based setting, whereas LBA is a narrower concept focused on the advertising strategy and communications elements of LBM. In turn, these concepts fall under the umbrella domain of mobile marketing and its derivative mobile advertising (Tahtinen 2005). These involve services enhanced by and depend on information about a mobile device's position (Jagoe 2003; Unni and Harmon 2003). These services include emergency and safety-related services, entertainment, navigation, directory and city guides, traffic updates, location-specific advertising and promotion, and site-based purchasing with e-wallet enabled mobile devices. They have the potential to add significant value by placing information, transactions, and entertainment in a location-specific context (Jagoe, 2003).

Moreover, Sub-Saharan Africa is an inherently risky environment. Covariate shocks, such as natural disasters, conflicts, and epidemics, routinely affect households. Kinship ties play both important social and economic functions in African society, specifically in creating informal

insurance networks, increasing access to credit and savings, and reducing risk (Grimard, 1997; De Weerdt and Dercon, 2006). Mobile phones also allow households to obtain information about potential shocks, allowing them to use such information to make decisions, which can have important effects on economic activities (Rosenzweig and Binswanger, 1993).

Health practitioners have often been at the forefront of using mobile phones as a development tool in Africa, with a variety of mobile health (m-health) projects on the continent. These projects range in variety and scope, from monitoring measles outbreaks in the Zambia, to supporting diagnosis and treatment by health workers in Mozambique, to sending health education messages in Benin, Malawi, and Uganda. In Kenya, Malawi, and South Africa, mobile phones are being used to send several reminders a day to HIV-positive patients about their anti-retroviral therapy schedule, as well as allow community health workers to send information about HIV patients' status. Mobile phones are also extending the reach of medical workers and medical services. In the Democratic Republic of Congo, mothers can (ICT4D) call a hotline to ask questions about their child's health status. Mobile phones have been used in the collection, measurement, and monitoring of health data, such as monitoring and tracking epidemics. For example, low-cost medical imaging systems have used mobile phone technology to transmit data and images to a central processor (Granot, Ivorra, and Rubinsky, 2008).

1.2.5 Mobile Technology in Rural Networking

Notwithstanding the digital divide that differentiates those who have access to ICTs and those who do not, phenomenal growth rates in the mobile telephony sector, have made hitherto isolated communities to have unprecedented access to communication flows. In the developing world, there is evidence that many emerging mobile users are found in rural areas (Sood, 2006), and Africa has the world's fastest growing mobile phone subscriptions (ITU, 2006).

According to industry estimates, there are more than 500 million mobile phone subscribers in Africa now, up from 246 million in 2008. In 2000, the number of mobile phones first exceeded that of fixed telephones. The four biggest mobile phone markets in Africa are Nigeria, South Africa, Kenya, and Ghana. Strategic investors in Africa's mobile industry include South Africa's MTN, India's Bharti Airtel, France Telecom (via its Orange brand), Britian's Vodafone and Luxembourg's Millicom.

At a basic level, mobile phones improve communications among members of a social network both within a country and across international boundaries. The reduction in communication costs can increase the speed of information flows within the network, thereby allowing them to respond better to shocks.

Mobile phone usage can either improve or greatly improve coordination of social activities such as marriage ceremonies, burials, meetings, and religious activities in rural areas. Coordination of social events is mostly achieved through for example, sending short messages to multiple recipients. Leaders in various organizations or groups can use messages to notify group members or committee members to attend meetings, and to arrange collective community activities with other villages. Hence the use of mobile phones reduces financial and time costs associated with coordination of social activities. Considering the communal, cooperative and collective culture available in most African societies, mobile communication can be used to enhance the social capital, upon which people draw in pursuit of their livelihood activities.

Conclusion and Areas for Further Research

The evidence on the effect of mobile phone coverage and services suggests that the mobile phone technology can potentially serve as a tool for economic development in Africa. But this evidence, while certainly encouraging, remains limited. First, while economic studies have focused on the effects of mobile phones for particular countries and markets, there is little evidence showing that this has translated into macroeconomic gains. Second, while the proliferation of mobile based services and projects has the potential to promote economic development, there is a tendency for development agencies and donors to "jump on the information technology bandwagon" without properly assessing its effects. Finally, communications technology cannot replace investments in public goods such as education, power, roads, and water—especially when access to mobile phones and services still remains out-of-reach for the poor.

Existing micro- and macro-level evidence suggests that mobile phones can improve consumer and producer welfare in developing countries (Jensen 2007, Aker 2008, Klonner and Nolen, 2008). Yet can mobile phones serve as an engine for economic growth? The effect of mobile

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phones on changes in GDP and growth, especially in sub-Saharan Africa, is still relatively unexamined. If we want to identify the magnitude of the impact of mobile phones on GDP growth in Africa, more research addressing these endogeneity concerns is required. In addition, to the extent that mobile phone adoption is associated with increases in consumer surplus—as the current micro-level evidence seems to suggest—changes in measured GDP will not capture the true welfare gains of this technology.

It is also clear that mobile phones provide households with fast and easy modes of communication, thereby increasing their ability to access livelihood assets, undertake diverse livelihoods strategies, and overcome their vulnerabilities. The phones contribute to reduce poverty and improve rural livelihoods through a number of ways. First, by expanding and strengthening social networks; increase people's ability to deal with emergencies and to work together thereby reducing costs and increasing productivity. Secondly, mobile phones enable people to cut down travel costs; minimize physical risks; maximize the outcomes of necessary journeys; increase temporal accessibility; amplify efficiency of activities; and send and receive money. Thirdly, mobile phones help rural traders and farmers to secure better markets and prices; save time and money; and promptly communicate business-related information.

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