Successful ICT Innovations from Emerging Economies

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1. Abstract

Interaction of dynamic ecosystems comprising of government, academia, research institutes and increasingly educated populations are turning developing countries into hot beds for innovations. Firms across the world want to set their foot in developing regions for profits and inclusion of masses through a plethora of innovative services and products that could be developed in today's opportune times by the incorporation of ICTs. Riding on the wave of digital revolution and increasing accessibility, with 6 billion mobile subscriptions worldwide and about 2.3 billion Internet users and growing, firms worldwide are introducing innovative services, products and applications for the mass inclusion of the underserved in various economic sectors.

The report depicts the current ICT Innovation projects, products, services and ecosystem in developing nations and certain projects in developed countries that can have a global impact, discusses current and future trends in developing and developed countries, enabling technologies, opportunities and standardization challenges the ICT innovations face that need to be addressed for the development of a robust, interoperable and secure environment. Success of the ICT Innovations will require extensive collaboration between numerous stakeholders to ensure that consumers see a homogenous solution and are able to access services on various platforms and devices.

Innovative products, services and business models are developed either indigenously in developing nations and developed nations or developed jointly by developers from both developing and developed nations and implemented in developing nations. Although there are successful innovations that provide pioneering services to underserved areas and are emulated in developing economies with slight content and technology alterations, there are innovations that meet failures due to sustainability and interoperability issues or policy bottlenecks related to country specific regulations. There are several reasons for the failure of an ICT facilitated innovation. For instance a number of innovative e-Health initiatives have faded without having any impact. The implementation of e-Health services at a national and global level is a big challenge. The consumers are either not very knowledgeable about the newly incepted remote diagnostic methods and don't want to rely on remote consultation and other e-Health services or few consumers are interested in a digital filing cabinet for their records. What they are interested

in is what that data can do for them. Can it help them better manage their health and/or the health of a family member? Will it help them make appointments and track treatment? Will it save them money on their health insurance bill, their next doctor visit? Can it help them automatically get a prescription refill? These are the basics that the vast majority of consumers want to be addressed first. Regional adoption and scalability of the innovative services and products are issues innovators should think about for the success of deployed projects.

2. Introduction

Innovation is the route to sustainable economic growth of a country. Innovation is indispensable, not only for developing new products, services etc. but also for ensuring survival of any business in the competitive world as it provides ample opportunities for growth and profitability. Driven by the ever-changing needs of a society, innovation is a continuous activity that involves both incremental as well as breakthrough improvements. It is the creative transformation of knowledge and ideas into new products, processes, or services meeting market needs, which culminates in successful innovations.

While innovation brings new products, services etc., its compatibility and coexistence with other product/ technology is ensured only through standardization. Standardization enables innovations to reach global platform by providing a common, robust ground rules for all the participating entities. Standardization and innovation are complementary to each other and together, can provide ample growth opportunities and also ensure the economic development of a country.

After electricity and water, ICT is perceived as the next major utility service. Technology innovations can become an engine for economic growth for developing economies. Innovation creates companies, mobilizes resources, reduces operating costs, provides equity in access to the underserved, helps create inexpensive products and services, creates jobs and fosters socio-economic development of an economy. However, innovation climates in developing countries are, by nature, problematic, characterized by poor business and governance conditions, low educational levels and mediocre infrastructure. This raises particular challenges for the promotion of innovation.

The incorporation of ICTs in various sectors is seen as the cornerstone of the new digital revolution for mass inclusion in the "e-era" and the "m-era". According to the World Development Indicators 2010-11, World Bank data, within the last decade mobile communication has become one of the largest and fastest growing industries worldwide. In 2010 here were an average of 78.2 mobile phone subscribers[1] per 100 people in the world [1] and

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[1] Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network. Post-paid and prepaid subscriptions are included.

about 5.3 billion mobile cellular subscriptions in the world[2]. Today, more than 90% of the world's population lives within range of a cell phone tower and there are approximately 6 billion mobile subscribers globally. By 2020, experts contend that the mobile phone could replace the computer as the primary means of accessing the Internet. In 2010 there was a world average of 31 per 100 people who were Internet users and this number is increasing significantly [2]. In 2012, almost 2.3 billion people use the Internet worldwide [3]. According to the Cisco Visual Networking Index there will be more than 1 billion mobile Internet users worldwide by 2013. The mobile network is the world's largest distribution and communication platform. Globally, mobile data traffic increased 2.3-fold over 2011, growing at a rate of 133%. By 2016, there will be 1.4 mobile devices per capita and over 10 billion mobile-connected devices, including machine-to-machine (M2M) modules. Monthly global mobile data traffic will surpass 10 exabytes[3] in 2016 and mobile handsets will exceed 50 percent of mobile data traffic in 2014 [4].

The rapidly evolving communication technologies could become a means to an end for bridging the digital divide by connecting the remote and providing the deprived with a plethora of services and solutions for various sectors. Huge underserved populations subsist globally that could provide immense financial and social rewards, to research firms and businesses as they provide innovative solutions leading to the betterment of mankind. There are about 2.5 billion financially excluded people in the world [5]. Globally, more than 793 million people cannot read and write [6]. About 61 million children do not have access to primary school education [7]. There are around 975 million people (almost 15% of world's population) living with disability [8]. The mobile health financing options, online medical consultation and diagnostics, remote clinical care and imaging services and development of innovative assistive technologies will lead to improving the lives of millions of disabled and diseased people. The simplest low-end mobile phone can do so much to improve health care, provide banking services to the unbanked, market access to farmers, make education accessible through e-learning, m-learning and digitization, efficient governance, etc. in the developing world. The world is fast moving towards "*global e-inclusion*" and access for all.

The report discusses a vast range of innovative early-stage and mature ICT projects that are already operational and identifies the upcoming trends in mobile and web technologies that will change the lives of people in the near future. The Report features some innovations from a repository of *202 ICT innovations* researched in the emerging economies, in the field of mobile payments, mobile banking, e-health, e-agriculture and e-education. In the report innovations in different sectors are described and the socio-economic impact and the technologies used for their implementation are discussed. Furthermore the report identifies the standardization gaps wherever possible.

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[2] http://www.un.org/millenniumgoals/2011_Gap_Report/1138394%20(E)%20MDG%20Gap%20Report%202011_WEB%20NEW.pdf
[3] 1 Exabyte = 10^{18} bytes = 10^8 gigabytes = 10^5 terabytes

3. Successful ICT Innovations

3.1 Mobile Payments

Only 40% of adults in the developing countries have a formal bank account. The most important reason for not having an account is the lack of money to use one. The other reasons are that bank accounts are too expensive; banks are too far away, lack of the necessary documentation and lack of trust in banks etc. A growing number of people in far flung areas are using new alternatives to traditional banking made possible by the rapid spread of mobile phones, as mobile penetration is expected to go up to 100% by 2015 worldwide.

The recent growth of mobile money-sometimes referred to as a form of "branchless banking" has allowed millions of people who are otherwise excluded from the formal financial system to perform financial transactions relatively cheaply, securely, and reliably. Mobile money has achieved the broadest success in Sub-Saharan Africa, where 16 percent of adults report having used a mobile phone in the past 12 months to pay bills or send or receive money. The share using mobile money is less than 5 percent in all other regions.

Mobile-commerce meets the social objectives and is also commercially viable for penetration into remote regions for the financial inclusion of the unbanked. In Africa, the most visible case is Kenya, where active bank accounts have increased from 2.5 million in 2007 to more than 15 million today. Transactions through mobile banking service *M-PESA* exceed US$ 375 million each month and users save up to US$ 3 on each transaction [10].

In the mobile money industry, four main services typically offered by mobile money services are: sending money, paying bills, receiving bulk payments, and purchasing airtime. These payment transactions are executed on a mobile device .The service delivery models are either over the counter or wallet based. The mobile payment service is a small-value electronic payment and store of value system that is accessible from ordinary mobile phones. However in the recent years the mobile money services have extended to offering financial services for formal financial products (savings, credit, insurance), informal service providers (moneylenders), personal networks (on-demand, scheduled payments, sending and receiving money), in-store merchant payments (goods and services) and remote b2c/c2b institutional payments (salaries, pensions, loan disbursements, bill pay, online/e-commerce) etc. Hence when a customer is connected to an e-payment system, her range of financial possibilities expands dramatically.

3.2 Trends in Mobile Payments in Developing Countries

With the rise of the Smartphone and mobile applications a new landscape has emerged. However, mobile payments face competition from existing methods. Therefore, they must offer added value to make their use more attractive, compared to other payment methods.

Low penetration of banking infrastructure, low income per capita, low Internet penetration, very high mobile penetration, cash based societies, high rate of emigration and low computer literacy are the reasons why mobile payments are very popular in the emerging market economies.
• Mobile wallets
• Mobile micro insurance
• Mobile microfinance
• NFC technologies is a future trend
• Mobile money transfers
• Mobile commerce – buying top up for mobile phones,
• There is trend developing for peer 2 peer, government 2 peer and business 2 business, customer to business channels for mobile payments.

3.3 Technology Used

The SIM card inside GSM phones can be used to authenticate users, thereby avoiding the costly exercise of distributing separate bank cards to low-profitability poor customers. The mobile phone can also be used as a point of sale (POS) terminal to initiate financial transactions and securely communicate with the appropriate server to request transaction authorization, thus obviating the need to deploy costly dedicated devices in retail environments. The consumer sends a payment request via an SMS to a short code and a premium charge is applied to their phone bill or their online wallet. The merchant involved is informed of the payment success and can then release the paid for goods. An MMS can also deliver barcodes, which can then be scanned for confirmation of payment by a merchant. In direct mobile billing a 2-factor authentication involving a PIN and a password is used, and for transactions a consumer's mobile account is charged after the purchase. Also there could be applications downloaded and installed on the mobile phone to make a payment by using WAP technology. Contactless payment also could be used remotely; for example, to make an online purchase by swiping the mobile device over a contactless NFC (Near Field Communication) reader plugged into a personal computer or using NFC enabled mobile devices with NFC enabled POS devices at merchant locations. Hence phones can emulate an RFID tag. So a user could, for instance, download movie tickets to his cell phone, and then simply wave that phone on a scanner in order to enter the theater.

There are 2 kinds of mobile payment transactions:

• Remote (technologies used are SMS, WAP)
    1. Mobile money transfers for Peer 2 Peer , Government to Customer
    2. Mobile online payments for customer to business (using mobile applications and mobile Internet)
    3. Person to Bank and Bank to Person money transfers
    4. Cross border remittances (employing a network of MNOs, financial institutions and MTOs (money transfer operators)
• Proximity
    1. Customer to business payments using NFC technology (RFID) enabled handsets (using mobile devices as m-wallets), RFID based virtual cards embedded in mobile devices.

2. Mobile POS (point of sale) for customer to business (using NFC component integrated microSD cards in mobile devices), contactless stickers containing the necessary RFID technology could be attached to a mobile device
3. Card equivalent payments (using mobile devices to make real-time credit available at the point of purchase with a virtual card/ 2-D bar code issued over the air directly to a payment enabled mobile device)

3.4 Stakeholders involved in Mobile Payments

The mobile payments involve the following stakeholders:

- Mobile device manufacturers.
- Mobile network operator (MNO) - that provides the mobile infrastructure and customer base that is already using its communication services. An MNO ensures compliance with telecommunication regulations and policy within the country.
- Government and Regulatory institutions across different sectors.
- A bank or other financial institution with banking license and infrastructure that enables the exchange of money between different parties.
- Equipment manufacturers and platform provider include a wide array of stakeholders like mobile phone makers, network equipment vendors as well as mobile application service providers.
- Transaction agent network for cash in and cash out services.
- Businesses that utilize mobile money as a means to deliver their services, such as monetary financial institutions (MFIs) and money transfer operators (MTOs).
- Merchants and retailers, who accept mobile money payments in exchange for different products and services.
- Mobile money users are normally subscribers to an MNO's other services.

The Mobile Payment Application Service Provider provides the necessary technical infrastructure (hardware and software) to facilitate mobile-payments and acts as an intermediary between the financial institutions and mobile network operators. There is the customer and the merchant who would like to use a mobile-payment

Registration: The Mobile Application Service Provider registers users who would like to avail of the m-payment service. The users (customers and merchants) have to be registered with the Mobile Application Service Provider prior to using the service. At the time of registration the Mobile Application Service Provider collects the bank account details (or credit card details) of the customer and merchant as well as their valid digital certificates. The mobile phone numbers of the customer and the merchant are mapped to their respective bank accounts and the Mobile Application Service Provider maintains this mapping. The users are provided with a client m-payment application (mobile wallet) that is either resident on their phones or else in the SIM card. This application may be provided over the air to the users. The mobile wallet will normally interact with the Mobile Application Service Provider server.

***Authentication*:** A mobile phone user communicates with a merchant and makes an economic transaction (e.g., buying a ticket from an airliner over the phone). The merchant obtains the phone number of the customer and initiates the m-payment transaction request stating the amount for which payment is required. The customer confirms the request and authorizes payment by entering the mobile wallet entry PIN to make the payment. The Mobile Application Service Provider receives the authorization and verifies the authenticity of the customer.

***Transaction*:** Upon receipt of the wallet account pin, the user's mobile SIM number or any such uniquely identifiable numbers (and any pre-stored wallet number) along with pin is propagated to mobile wallet service provider through mobile transaction processing service provider. Upon authentication and authorization of the user wallet credentials, the mobile wallet service provider makes the payments to associated merchant account, through standard acquirer, payment gateway service provider networks. The merchant account is deposited with transaction amount based on the earlier agreed settlement periods. The Certifying Authority supplies digital certificates for the users in the system to provide security. Once the electronic funds transfer is successful a confirmation message is sent to the customer and the merchant advising them of the debit and credit respectively.

3.5 Cases of ICT Innovations in Mobile Payments

There are several mobile payment initiatives worldwide that now make it convenient for people in remote areas to indulge into mobile commerce. Here we will be discussing M-Pesa, mChek from India and WIZZIT from South Africa.

Box 1. M-PESA in Kenya

Kenya's M-PESA is an electronic payment and store-of-value system accessible by mobile phone. M-PESA[4] now processes more transactions domestically within Kenya than Western

Union does globally and provides mobile banking facilities to more than 70 percent of the country's adult population. To access the mobile money service such as M-PESA, customers must first register at an authorized M-PESA retail outlet. They are then assigned an individual electronic money account that is linked to their phone number and accessible through a SIM card‑resident application on the mobile phone. Customers can deposit and withdraw cash to/from their accounts by exchanging cash for electronic value at a network of retail stores (often referred to as agents). These stores are paid a fee by Safaricom, the telecom operator in case of M-PESA, each time they exchange these two forms of liquidity on behalf of customers. Once customers have money in their accounts, they can use their phones to transfer funds to other M-PESA users and even to non‑registered users, pay bills, and purchase mobile airtime credit. All transactions are authorized and recorded in real time using secure SMS.

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[4] http://www.imf.org/external/pubs/ft/reo/2011/afr/eng/sreo1011.pdf

Customer registration and deposits are free and doesn't involve any guarantees or elaborate paperwork; this is the key advantage for the financial inclusion of the huge unbanked population. Customers then pay a flat fee for person‑to‑person (P2P) transfers and bill payments. Individual customer accounts are maintained in a server that is owned and managed by Vodafone, but Safaricom deposits the full value of its customers' balances on the system in pooled accounts in two regulated banks. Thus, Safaricom issues and manages the M-PESA accounts, but the value in the accounts is fully backed by highly liquid deposits at commercial banks. M-PESA is useful as a retail payment platform because it has extensive reach into large segments of the population. With the introduction of "Nunua Na M-PESA, Lipa Karo Na M-PESA" the customers will be able to buy goods from supermarkets and pay the school fees of their children using their M-PESA Accounts. With an alliance between Safaricom and Western Union for international money transfers, now from 80,000 Western Union Agent locations in 45 countries, funds can be transferred to an M-PESA mobile phone in Kenya from anywhere in the world . There are 15 million financially included customers today in Kenya due to initiatives such as M-PESA by enabling a network for instant, 'on demand' payments.

Box 2. SQUARE

Twitter founder Jack Dorsey has introduced *Square*[5], which is a mobile payment service that will have a global impact in the future and is being viewed as a disruptive innovation, which will help to create a new market and value network. It has revolutionary features such as no elaborate hardware installations (Square Card reader is only 1 inch tall and can be carried in the pocket. It can simply be plugged into a mobile device's standard 3.5mm headphone mini-jack and can be used for swiping credit cards) and no merchant account is required, also there is no monthly fees or set-up costs, a free app, free Square Card Reader and free shipping are offered to clients. The *Square* has two main applications Pay with Square and Square Register, which currently work on smart phones that must be running on **iOS 4.1** or **Android 2.2** or above operating systems, to be able to use these Square applications. Pay with Square allows customers to view merchant menus, do mobile payments, receive virtual receipts, and discover other Square-enabled merchants. Square Register is point of sale software aimed at replacing traditional credit card terminals and cash registers. The Pay with Square application allows customers to buy items directly from their mobile device without having to reach for a credit card. Customers just need to provide their name at the check-out, the merchant will know the customer's name as they'll see the name and a picture of the customer on their register, and can accept payments with a simple tap of a button. Square's Technology is PCI compliant and VeriSign certified and it uses strong encryption on its devices, these include SSL and PGP. Card numbers, magnetic stripe data, or security codes are not stored on Square client devices. Square's web development follows industry-standard secure coding guidelines, such as those recommended by OWASP (Open Web Application Security Project). Square's website and API (Application Programming Interface) are accessible via 128-bit, extended-validation SSL[6] certificates issued by VeriSign. Hence Square adheres strictly to industry standards to manage its

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[5] https://squareup.com/
[6] Secure Sockets Layer (SSL), are cryptographic protocols that provide communication security over the Internet

network, secure its Web and client applications, and uses live monitoring programs that analyze transactions as they're happening.

Box 3: WIZZIT in South Africa

WIZZIT Payments (Pty) Ltd is a provider of basic banking services for the unbanked and under banked (people or enterprises that have no or only limited access to banking services) in South Africa. Its services are based on the use of mobile phones for accessing bank accounts and conducting transactions, in addition to a Maestro debit card that is issued to all customers upon registration. Wizzit is a branchless banking business, meaning that its services are designed so that customers can generally conduct transactions without the need to visit bank branches.

While Wizzit does not operate any branches on its own, it has partnered with the Absa Group and the South African Post Office that act as banking agents and allow Wizzit's customers to deposit funds at any Absa or Post Office branch. Similarly, Wizzit does not have an automated teller machine (ATM) network but its customers can pay for purchases and withdraw funds using their debit card at any point of sale (POS) or ATM accepting Maestro cards. Wizzit has also partnered with Dunns, a fashion retailer focusing on lower to middle-income customer segments that acts as an agent for opening accounts

The company maintains a policy of only recruiting unemployed people, which it has integrated into its promotion strategy: Because marketing costs represent one of the biggest financial challenges to its business, Wizzit does not use mass media advertisements but relies instead on so-called WIZZkids— previously unemployed individuals that the company certifies to become sales agents. Besides the commission on sales, WIZZkids receive annuity income based on the transaction level of account holders, which motivates them to train customers to use their accounts. The WIZZkids are typically young, low-income individuals living in the communities from which they recruit their customers.

Launched in 2004, Wizzit is formally a division of the South African Bank of Athens but its brand is owned and its operations are run by a group of independent entrepreneurs. Wizzit had an estimated 250,000 customers in South Africa at the end of 2008 and has launched pilot projects in Zambia and Romania, where it intends to expand. It had earlier reported that it expected to expand into other African countries as well and that it had been approached by potential partners from Kenya, Botswana, Namibia, Zambia, and Malawi.

Wizzit aims at partnering with either existing banks or microfinance institutions (MFIs) in the countries it intends to expand to. Wizzit has also been planning to acquire merchants as agents in South Africa's rural areas, where the majority of its potential customers reside. If successful, merchants will offer customers the ability to deposit money to and withdraw money from their Wizzit bank accounts, as well as to pay for purchases by using their mobile phones.

Future scope of work: The future scope of work is to include in this report the other identified successful innovations in the domain of E-Health, E-Agriculture, M-Banking, E-Commerce & Trade, E-Environment & Energy and E-Governance.

Successful innovations are yet to be investigated in the domain of E-Education, E-Transport, E-Journalism and Telecommunication. Once identified, they will be included in the report subsequently.