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ITU-T Focus Group Bridging the gap: From Innovation to Standards

Successful cases of ICT innovations for developing countries

Focus Group Technical Report

International
Telecommunication
Union

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The procedures for establishment of focus groups are defined in Recommendation ITU-T A.7. The ITU-T Focus Group Bridging the Gap: From Innovation to Standards (FG Innovation) was established further to ITU-T TSAG agreement at its meeting in Geneva, 10-13 January 2012. ITU-T TSAG is the parent group of FG Innovation.

Deliverables of focus groups can take the form of technical reports, specifications, etc. and aim to provide material for consideration by the parent group in its standardization activities. Deliverables of focus groups are not ITU-T Recommendations.

FG Innovation Reports

Deliverable 1: Successful cases of ICT innovations for developing countries

Deliverable 2: New Standardization Activities for ITU-T Study Group and ICT Innovation Panel

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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.

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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 from the World Bank, within the last decade mobile communication has become one of the largest and fastest growing industries worldwide. In 2010 there were an average of 78.2 mobile phone subscribers[1] per 100 people in the world and 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. According to estimates from the ITU, there were approximately 6.8 billion mobile cellular subscriptions globally at the end of 2013 which is almost the same as the world population.

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. Globally, more than 793 million people cannot read and write. About 61 million children do not have access to primary school education. There are around 975 million people (almost 15% of world's population) living with disability. The mobile health financing

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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.

[2] http://www.un.org/millenniumgoals/2011_Gap_Report/1138394%20(E)%20MDG%20Gap%20Report%202011_WEB%20NEW.pdf

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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 identifies a wide range of innovative early-stage including mature ICT projects that are already operational and which have a potential for socioeconomic impact and 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 and
- e-agriculture.

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.

3   Analysis of ICT Innovations

The ICT Innovations in the domain of M-Payments, M-Banking, E-Health and E-Agriculture have been analyzed on various socio-economic factors and subsequently the ICT Innovations causing the maximum impact in each of these domains have been discussed in this report.

The various socio-economic factors, based on which these ICT Innovations have been analyzed are:

Impact of Innovations
1. Social
2. Financial

Economics
1. Economic Viability
2. Economic Sustainability
3. Innovations Viability
4. Technical Feasibility
5. Human Needs
6. Quality of Life

Business Case

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1. Revenue Generation
2. Cost Savings
3. Cost reduction through Standardization

Quality
1. Quality of Innovations

Standardization
1. Feasibility
2. Social Benefits
3. Commercial Benefits

Attached underneath is the excel comprising of the Analysis of the ICT Innovations in the domain of M-Payments, M-Banking, E-Health and E-Agriculture. The first sheet in the attached excel classifies the rating scale from 0-5 explaining the significance of each of these digits. Subsequently, in the following sheets we have the analysis of the ICT Innovations in the domain of M-Payments, M-Banking, E-Health and E-Agriculture. The maximum score that an innovation can achieve as per the designed matrix is 75. The top three innovations from each of these sheets have been included in the last sheet '*Top Innovations*' and have also been discussed in this report.

Analysis of ICT
Innovations

4   Mobile Payments

The main drivers behind the success of mobile payments are the explosive growth in the number of mobile devices and the fall in the cost of computing power, which have lowered the barriers to new entrants in this field. Mobile payment is quite versatile and can support a variety of services, in particular, person to person (P2P) money transfers, which are of significant value for emerging economies.

Broadly speaking, mobile payment refers to financial transactions and services that can be carried out using a mobile device such as a mobile phone or tablet. These financial transactions and services are sometimes referred to as mobile financial services and may or may not be linked directly to a bank account. Innovations in mobile money could lead to a drastic change in the way people pay for goods and services in the near future.

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.

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The recent growth of mobile payment, 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 payment 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 payment 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.

In the mobile payment industry, four main services typically offered by mobile money services are: sending money, paying bills, receiving bulk payments, and purchasing airtime. 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.

4.1   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 at level of households, 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.

Remittances and remote payments are the most common uses of mobile money in developing countries. For example, M-PESA, which markets its service as "Send money home", is used primarily for domestic remittances. In the Philippines, international remittances are more popular, with Smart Communications' Smart Padala enabling overseas workers to send money to their relatives. Consumers are using mobile money where there is a very clear, simple value proposition. Differences in the rate of adoption of mobile money services across markets are therefore dependent on what the user regards as being of value. For instance, in Bangladesh, people may spend three to four hours off work in travelling and queuing at banks to pay utility bills. In this case, mobile utility payments are quite popular. In Russia, on the other hand, this type of payment option for utilities is

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less popular as it usually takes around six to twelve months of non-payment before utility companies disconnect a customer's service.

Mobile money in emerging countries is more than just technology. A well-developed agent network is essential in order to achieve scale. In addition to providing vital cash-in and cash-out services, agents are important for building trust for first-time users of formal financial services. The agents receive a commission for the work they do, i.e converting cash into e-money and vice versa. In addition, since the mobile money services involve both telecommunications and financial services sectors, there is a wide range of stakeholders in both these areas. Moreover, the whole sector requires government regulation to establish a level playing field for operators in both the financial services and the telecommunications sectors and to protect consumers.

In developing countries, the monetary value of most of the financial transactions carried out using mobile payment services is small. The main services offered by mobile money service providers in emerging economies are:

- Money transfers (domestic and international);
- Payment of bills;
- Insurance
- Loans
- Payment of school fees;
- Government to person payments (e.g. social security payments, salaries, pension etc.);
- Banking services; and
- Purchasing airtime.

There is a trend developing for peer 2 peer, government 2 peer and business 2 business, customer to business channels for mobile payments.

4.2 Technology

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

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purchase by swiping the mobile device over a contactless NFC 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

    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)

4.3   Stakeholders involved in Mobile Payments in Developing Countries

A number of stakeholders are involved in the mobile payments in emerging economies. For mobile operators, mobile money means increasing numbers of customers and higher average revenue per customer. Most of the offerings are thus based around increasing customer loyalty to increase revenue from telephone services. Table 1 shows the main expectations of stakeholders in the mobile money ecosystem in emerging economies. Figure 1 shows the win-win situations which mobile money brings to different stakeholders in the ecosystem.

Table 1: Expectations of stakeholders in mobile payment ecosystem in developing countries

Stakeholder	Expectations
Consumer	• Reduced risk of carrying cash • Minimal learning curve • New service is available everywhere • Low or zero additional cost of usage • Security of transactions • Person-to-person transactions • Able to send and receive money (both domestic and international remittances)
Friends/family members	• Able to send and receive money (both domestic and international remittances) • Able to send/receive money in emergency situations
Employers	• Reduce time • Reduce cash risks
Mobile network operator (MNO)	• Potential to add value to existing services • Increase customer loyalty • New revenue channels • Increase average revenue per user • Reduce airtime distribution cost
Banks/microfinance institutions (MFI)	• Branding and customer loyalty • New customers • Ownership or co-ownership of the new payment application • Secure and trusted payment service • Anti-money laundering requirements • Integration/use of existing infrastructure and payment methods
Agents	• Earns commission on transactions • New revenue streams • Increase traffic and sales
Merchants	• Offer convenience to customers
Regulator	• Promote financial inclusion • Promote interoperability among payment services • Reduce risks of money laundering

Source : *Adapted from S. Karnouskos, Mobile payment: a journey through existing procedures and standardization activities, Communications Surveys & Tutorials, IEEE , vol.6, no.4, pp.44,66, Fourth Quarter 2004*

Different business models have emerged, depending on regulatory regime, culture, and population size:

1. Bank centric
2. Mobile operator-led (MNO-centric model)
3. Partnership

The mobile money demand curve from the World Bank[3] (Figure 2), shows where each model is more likely to occur. For instance, the black curve represents mobile money demand for developing countries. In the beginning, in developing countries, mobile money represents an alternative

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[3] World Bank. (2012). *Information and Communications for 2012 : Maximizing Mobile.*

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infrastructure for financial services, and as the infrastructure improves over time, a transition phase is reached as demand migrates from low speed, low cost to high speed, high volume and there is also more competition from banks and financial institutions.

MNO-centric models tend to be more prevalent in developing economies, where financial services infrastructure is not well developed. Bank-centric models are more likely to be prevalent in countries where there is a good level of infrastructure development and regulation for such transactions. In the collaboration phase, mobile money must integrate the financial infrastructure. The partnership business model is likely to be prevalent in such countries, which are mostly developed economies.

In the MNO-centric model, the role of the bank/financial institution is limited in the payment delivery and settlement. In developing countries, MNOs dominate the mobile money transfer market and handle the customer relationship (e.g. M-PESA). MNOs provide an alternative infrastructure for financial services (see Figure 3). MNOs also provide a network of agents for payment and settlement functions. MNO-led models have been successful in developing countries because they have been able to reach large numbers of unbanked people in rural areas where there are no banking facilities. Furthermore, the geographic reach of this model can be extended through multilateral agreements with other telecommunications operators. The MNO-centric models in developing countries are implemented mainly on STK or USSD and handle low-value payments. In some of the payment schemes, the wireless carrier can also charge the payment made via SMS to the consumer's mobile phone bill.

In the bank-centric model, the bank/financial institution is responsible for the customer relationship and provides mobile services primarily as a new channel in addition to existing services. The mobile operator is responsible mainly for provision of the telecommunications facility for domestic and international transfers. This model has seen slow uptake because of low perceived value proposition vis-à-vis traditional payment services and its limited ability to reach the unbanked.

There are different variations as regards arrangements in the bank-centric model as the number of operators entering this field increases and new services are offered. There is no simple binary delineation between bank-centric and MNO-centric models as the level of bank involvement varies in the different models (see Figure 3). The various arrangements between banks and non-banks also vary in the bank-centric and MNO-centric models.

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Figure 1 Win-win situations of mobile money for stakeholders
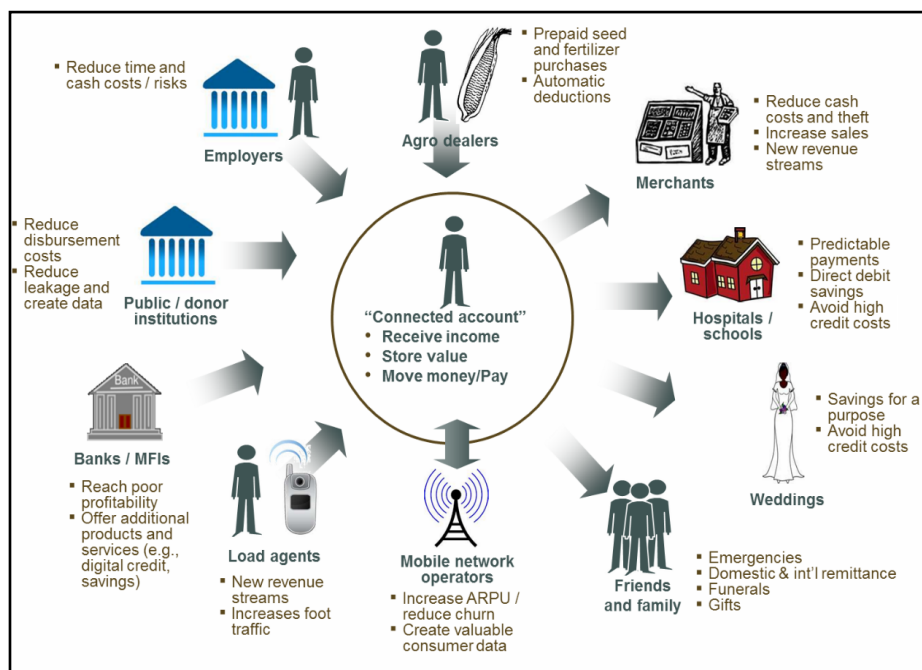
Source: *Melinda and Gates Foundation, Data From Advanced Mobile Money Markets (2012), Jake Kendall* [4],

Figure 2 Mobile Money Demand Curve
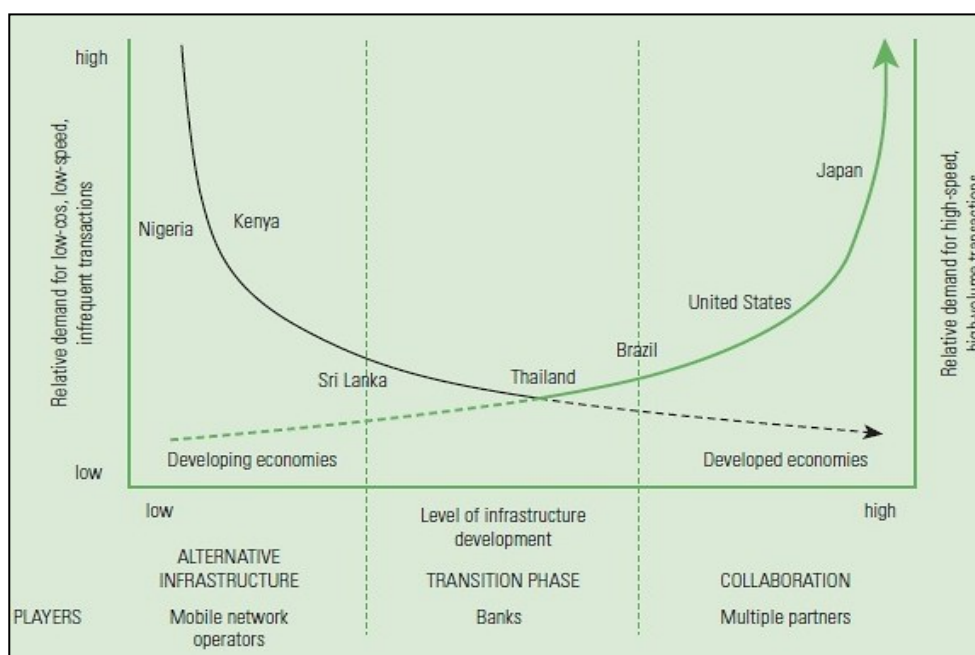
Source: World Bank, Report on Information and Communications for 2012: Maximizing Mobile (2012)

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[4] See http://prezi.com/y9aktlkcg2wi/mmu-data-from-advanced-mobile-money-
markets/?auth_key=1e730106f4c6c94a2b3d105566c85b33b3396cba.

mobile operator is responsible mainly for provision of the telecommunications facility for domestic and international transfers. This model has seen slow uptake because of low perceived value proposition vis-à-vis traditional payment services and its limited ability to reach the unbanked.

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The following arrangements are common:-

- One to one: The bank has an exclusive arrangement with a mobile operator for offering its services.
- One to many: The bank provides mobile money services through multiple MNOs, or an MNO provides mobile money services through multiple operators.
- Many to many: Exclusivity is not allowed and banks and MNOs can provide mobile money services.

Figure 3 Level of banks' involvement in the different business models

Banks have sole control on the accounts offered to individuals which can be managed through other channels such as mobile phones.

Examples : CAIXA (Brazil), Barclays, Xac Bank (Mongolia)

Banks offer accounts to individuals through non-bank (MNO) agents and/or technological platforms online.

Examples : EKO (for State Bank India (SBI)) and SMART (for 21 banks in the Philippines).

Banks issue e-money which is purchased from bank and redistributed by non banks to customers.

Examples : Orange Money in West Africa (e.g. Senegal, Côte D'Ivoire, Mali and Niger).

Non-bank issues e-money and keeps equivalent asset value in pooled accounts in regulated bank.

Examples : Safaricom and M-PESA, GCash.

Bank Centric Model   **MNO Centric Model**

Source : *CGAP, CGAP Focus Note (July 2010), Michael Tarazi and Paul Breloff* [5]

In the partnership model, the financial institutions, MNOs and third party service providers form the ecosystem and collaborate to provide payment services. In such an ecosystem, partners can capitalize on one another's strengths in terms of innovation, compliance with the regulatory regime

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[5] *CGAP Focus note No. 63 : "Nonbank E-Money Issuers: Regulatory Approaches to Protecting Customer Funds".* Retrieved from CGAP: www.cgap.org/gm/document-1.9.45715/FN_63_Rev.pdf

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and consumer experience. New solution providers using this type of model face lower barriers to market entry. Examples include PayPal and Obopay, which have launched P2P payment systems in the United States and in other countries in partnership with financial institutions. Other examples include Visa and Mastercard, which have announced similar services in partnership with Moneygram and Western Union. In the Philippines, Western Union has entered into agreements with Globe Telecom and Smart Communications for international remittances.

4.4   Stakeholders involved in NFC Mobile Payment

A number of stakeholders are involved in the proximity NFC mobile payments business. For example, in a B2C transaction, the following stakeholders would be involved: the customer (payer) and the merchant, the mobile network operators (MNO), financial sector institutions (e.g. banks), payment networks (e.g. Visa, MasterCard), a trusted service manager, the mobile device manufacturer, and software and service providers (e.g. wallet developers). Table 2 shows the expectations of the different stakeholders involved.

Table 2. Stakeholders in the NFC mobile payments ecosystem

Stakeholder	Expectations
Merchant	• Faster transaction time • Low or zero new investment and usage cost • All in one open interoperable devices (e.g. POS) with backward and forward compatibility • Integration/simplification of existing payment approaches • High security and trust in the service • Possibility of customizing the service (e.g. adding loyalty schemes) • Real-time status of mobile money transactions
Consumer	• Minimal learning curve • Better and personalized service • Trusted and secure solutions (at technical and social level) • New service is available everywhere • Low or zero additional cost of usage • Interoperability at the POS and the ability to transfer money across different service providers and banks • Real-time transaction status overview • Being able to pay "anywhere," "anytime" and in any currency • Person-to-person transactions
Mobile Network Operator (MNO)	• Potential to add value to existing services • Increase customer loyalty • New revenue channels • Increase average revenue per user
Mobile Device Manufacturer / Service Developer	• Large market adoption of new embedded hardware/software features of the devices • Open, interoperable, widely-used standards • Low cost of new technologies/features to be integrated • Low time-to-market • Multi-application capability • New relationships with banks/MNOs/payment networks
Bank	• Branding and customer loyalty • New customers • Ownership or co-ownership of the new payment application

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Stakeholder	Expectations
	• Secure and trusted payment service • Integration/use of existing infrastructure and payment methods
Payment Network	• Secure authentication • Integration/use of existing infrastructure • Secure processing of payments
Trusted Service Managers	• Secure payment channel • Provide service to banks and MNO

Source: Adapted from S. Karnouskos, [Mobile payment: a journey through existing procedures and standardization activities](#), Communications Surveys & Tutorials, IEEE , vol.6, no.4, pp.44,66, Fourth Quarter 2004

For MNOs, mobile payment means increasing the number of customers and average revenue per customer. Most of the available deals are thus based around increasing customer loyalty to increase revenue from telephone services. By controlling the authentication of contactless payments on phones, MNOs aim to get a slice of the revenue generated by these payments. MNOs can charge SIM-space rental fees to NFC application providers such as banks, retailers and transport companies.

Trusted service managers (TSMs) are intermediaries between MNOs and service providers and are involved only in NFC mobile payments. For example, Gemalto acts at the TSM for Vodafone NFC mobile payments. The main role envisaged for the TSM is to help service providers securely distribute and manage contactless services for their customers using the networks of mobile operators. One important TSM responsibility is to manage the cryptographic keys and system used to securely communicate the payment information from the financial institution to the consumer's mobile device.

In NFC mobile payments the relationships between stakeholders can differ depending on the route adopted for implementing the secure element (SE). The SE is a smart card chip equipped with cryptographic processor to provide authentication and security for storing payment applications.

Table 3: Differences in implementations

UICC Removable	Embedded	MicroSD Removable
SE on UICC	Embed NFC SE on device	MicroSD has NFC capabilities (including controller, antenna and cryptographic processor)
SIM Cards require upgrades to use UICC that supports NFC	Done during manufacture of phone	Can be used on non-NFC enabled phones.
UICCs created that support NFC controller and antenna	Does not provide portability of the microSD or UICC	

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A mobile device can implement the SE in the following ways (see Table 3):

- Universal Integrated Circuit Card (UICC) Removable
- Embedded
- MicroSD Removable

The entity which controls the distribution of the SE has a direct effect on the possible NFC payment provisioning paths and on stakeholder relationships

All cases of online use (proximity mobile payments, remote mobile payments and mobile money transfer) require secure transactions to protect against eavesdropping or modification of the communication between the device and the server.

4.5   Secure mobile payment transactions

A secure mobile payment transaction has the following characteristics:

- Confidentiality: the confidential information must be secured from unauthorized persons, processes or devices. For SMS payments, the confidential information is stored at the merchant's level. The security of the transaction is as secure as the security of the merchant.
- Authentication: ensures that parties with access to a transaction are trusted.
- Integrity: the information and systems have not been altered or corrupted by intruders
- Authorization: verifies that the user is allowed to make the requested transaction. With post-billing SMS, authorization is an issue but with PIN-based SMS-payment systems, security is better.
- Availability: it must be accessible for authorized users at any time. This is a tricky situation in P2P SMS-based systems, as the receiving party's mobile device must be switched on for the transaction to be completed.
- Non-repudiation: ensures that the user must not deny that he has performed a transaction, or provide proof if such a claim is made. There is no 'proof of delivery' incorporated in the SMS protocol. This can be resolved, but at additional cost.

Mobile payment transactions pose two primary security concerns:

a) How to keep information secure if a mobile phone is lost or stolen, and
b) How to keep information secure when it is transferred from consumer to recipient.

With regard to the first security issue, two-factor authentication is currently used to verify the mobile phone's proper user. Before making any m-payment, the user will typically register the phone, which acts as the "token", with the bank or mobile service provider offering the m-money service (the first factor) and then confirm the payment with a PIN or password (the second factor). Thus, to initiate an m-payment, the user must have both the right phone and know the correct password. In proximity contactless mobile payments, the mobile device is used as the token for the two-factor authentication.

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As regards the second issue, the situation depends on whether the payment is made via proximity or remote mobile payment. Proximity m-money payment uses the same security features as contactless payment cards to secure information passed from customer to merchant. The security of the transaction will depend on the location of the mobile payment application which is used to store the user's data such as payment account information and passwords. The location of the mobile payment application needs to be secure. Cryptograms are used to confirm the validity of the transaction and encrypt the data during transmission.

4.5.1 Securing the mobile payment application

There are two possible options for securing mobile payment applications:

a) The Trusted Execution Environment (TEE); and
b) The Secure Element (SE)

Table 4. Payment Application Location

Type of mobile services	Payment Application Location and storage of encryption keys		Requires Trusted User Interface
	SE	TEE	
NFC Contactless Payments		■	■
Mobile as POS	■		■
Mobile authentication	■	■	■
Remote Payments	■	■	■

■ Recommended

The SE is tamper-resistant and thus provides a high security level for the data. It is used to store sensitive payment and user credentials for offline proximity payment (e.g. Mobile as PoS). Since it is a dedicated hardware component, the SE requires integration with the platform hardware. This type of implementation requires a lot of time to develop and is quite expensive. Many NFC enabled phones come wired with a connection between the NFC chip and the SIM card called Single Wire Protocol (SWP), allowing specially adapted SIM cards to be loaded on the phone which can act as an SE. Because of its reliability in authenticating users immediately and offline, the SE is particularly suited to NFC transactions, which are performed on the spot. Any kind of offline transaction also requires an SE in combination with the Trusted User Interface.

TEE is a hardware-protected environment that runs in the phone's main processor and alongside the main operating system of the smartphone. It is an isolated area in the smartphone which connects to critical device resources without passing through the operating system. It allows critical data and code to be isolated from any malware-type attacks in the smartphone's open environment, without requiring any new hardware component. Sensitive code is executed in this isolated and protected environment, and critical data stored in this area are encrypted. One of the unique capabilities of the TEE is its ability to implement a Trusted User Interface.

The Trusted User Interface enables secure authentication through a secure channel with the Secure Element or a server and non-repudiation for financial transactions performed on smartphones. It controls the screen and keyboard and/or touchpad, isolating them from the operating system, thus providing secure authentication and non-repudiation. TEE includes cryptographic as well as key-storage and management functionalities. It also includes secure mass storage, which can be used to store transaction logs and passwords in a private area.

The TEE efficiently protects sensitive data stored on the device and can therefore enable all online uses such as NFC contactless mobile payments, mobile as POS, and remote mobile payments (see Table 4). With the TEE, all these uses can benefit from hardware-based security, while maintaining flexibility and ease of deployment.

4.5.2   Storing encryption keys and payment information in the cloud

Cloud computing holds the potential to overcome some of the security challenges of mobile payment and has been attracting interest of late. PayPal has invested in the cloud payment model. The advantage of the cloud payment model for NFC contactless payments lies in the key storage, and the fact that personal information related to the credit/debit card is not stored on the phone but in the cloud. The risk is therefore less for a consumer who loses his or her mobile phone. The only problem with cloud computing is the reliability of the network infrastructure. If a problem occurs in the network before the completion of the transaction, the customer could incur additional charges, especially for credit card transactions.

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4.6   Cases of ICT Innovations in Mobile Payments

There are several mobile payment initiatives worldwide that now make it convenient for people in to indulge into mobile payments and a whole range of financial services.

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 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.

Customer registration and deposits are free and does not 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. 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. 60% of adults in Kenya—about the same number as have a bank account—use M-PESA[6]

Source: http://www.policyinnovations.org/ideas/innovations/data/m_pesa

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[6] See: http://www.economist.com/news/special-report/21601624-and-no-end-new-ways-pay-your-bills-end-monopoly?fsrc=rss|spr

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Box 2. Virtual Card Product by Airtel Africa, Standard Chartered and MasterCard, Africa

Airtel Africa, Standard Chartered Bank and MasterCard Worldwide have launched the world's first virtual card that operates off a wallet residing on a mobile phone. This innovative payment method known as Airtel 1 time shopping card will offer communities the opportunity for greater participation in the financial system as they realize the substantial benefits of mobile commerce. This single use shopping card will soon be available in Kenya and rolled out to markets across Africa. The mobile technology platform and Airtel's vast consumer penetration combined with the financial structure and regulatory framework provided by Standard Chartered Bank and the global acceptance of MasterCard will ensure that consumers will be able to transact in a reliable, convenient and secure environment.

The solution will offer consumers a robust e-commerce solution that delivers security, accessibility, acceptance, ability and a global reach. Subsequent phases of the program will allow Airtel subscribers to make payment across the MasterCard network.

Airtel Africa customers in Kenya will soon be able to use their mobile phone to make online purchases from MasterCard merchants around the world. The simplified online transaction will work in the following way; each time an Airtel customer is shopping online he or she will be able to request a single use shopping card number. Airtel money services will generate a special 16 digit number that enables the completion of the transaction. On completion of the transaction, a confirmation message will be sent to the consumer's handset. The single use feature of the Airtel 1time Shopping Card provides the consumer with a convenient and secure online shopping experience.

Source: http://www.airtel.com/wps/wcm/connect/africaairtel/tanzania/home/pq_airtel-africa-standard-chartered-bank-and-mastercard-launch-worlds-first-virtual-card-mobile-phone

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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.

Source: http://www.wizzit.co.za/

4.7   Standardization Challenges

Definition of what is mobile and what constitutes mobile payments has not been standardized yet. The ubiquity, and indeed the popularity, of card payments across the developed world are based on two interconnected principles; security and standardization.

Without the first, the lack of consumer (and merchant) confidence would have stifled adoption, while the absence of the second would have prevented the kind of transaction volumes required for retail card payments to be considered successful. And it will be no different in the mobile world. Trust is a prerequisite in the success or otherwise of mobile transactions. It must be provided by every member of the value chain; from financial institutions, mobile telecom operators and regulators, through to retailers, vendors and of course, end-users. But such commonality does not exist today. Fraud remains a key concern, and while there are undoubted efforts to address these issues, barriers remain. It is perhaps ironic that these barriers are often the product of attempts to encourage that second principle – standardization.

In the developing world mobile payments applications offer more opportunities to people who are at the lower end of the pyramid. The ability of the mobile phone to reach rural populations is a great asset, and provides the catalyst for developing economies through the creation of local banking infrastructures that wouldn't otherwise be possible. Developing countries are using mobile text messaging/SMS for money transfers between users and remittances. This is a huge market in countries with high unbanked populations, like for example India and Kenya. Here, the security concern is of a different nature; with financial and regulatory bodies fearing the development of an uncontrolled, parallel financial system – where, for example, money laundering may occur. This is an area where there is a need for security specific standards.

Common standards and interoperability will be vital for both merchant and consumer adoption of mobile transactions. The new technology resulted from innovation requires standards for market adoption. Heterogeneous and cross-industry players produce complexity in the development of Mobile Payments, because consensus for standards is more difficult to reach among heterogeneous players. Standards creation stipulates consensus among involved parties, which is complicated because each party retains its own interest The regulations for players in the financial industry are different from those governing the telecommunications industry, which means that each industry has its own particular standards body. Financial institutions (including banks) have to deal with being monitored and regulated by national or regional central banks.

Mobile payments lack cohesive technology standards that can provide a universal mode of payment[7]. The financial mobile services sector has distinct developmental challenges. Issues of trust, consumer protection, and network systemic risks that can slow the pace of progress require clear and strong regulations. The need for policy and regulatory development is made more difficult by the speed of technological change. A key precondition is regulation: the Central Bank of Kenya is in the process of finalizing regulations (at the time of writing of the report) that will allow non-bank

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[7] See http://www.kpmg.com/GE/en/Insightmagazine/Documents/Monetizing_mobile_report_ENG.pdf

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outlets and platforms such as M-PESA as a channel for formal deposit-taking. Ensuring security of payments made across the spectrum of devices is difficult, although security can be built into the phone's SIM card. The card holds cryptographic keys to secure transactions, and security vendors secure the generation of those keys and their storage in back-end systems. In general, interoperability[8] and security across phone devices and mobile phone carriers is a big concern; as mobile payments ecosystems develop, it is important for retailers to choose partners that allow them to accept payments from as many end-clients as possible. No single type of provider will be able to overcome the very different product-specific business model challenges.

SMS, while a simple and easy to use technology has a number of limitations that complicate its use in payments. SMS uses store and forward technology, i.e. the message is stored with the operator on its way to the recipient or until the recipient becomes available. Often there is a maximum time limit for which the operator holds the message for delivery in case the recipient's phone is unavailable. Also, SMS does not use any encryption and finally there is no proof of delivery within the SMS protocol. Most SMS-based mobile payment methods do provide a proof of delivery but this requires a second separate message to be sent which increases the costs of a single transaction and is especially not economical if transferred amounts are small. Another concern is Open loop payment processing, the payment must be capable of being processed via the open national or international payment networks, and not restricted to a 'closed loop' environment. Another issue that can impact the scalability of mobile payments globally is the business model company would like to use universally for transaction profit sharing. Another area of concern is whether the mobile payments using NFC technology are as safe as using smartcards. Standardization should also address the issue of portability of m-payment applications (i.e. how payment applications follow consumers when they change mobile network operators).

Standards and mobile payment guidelines such as PCI Data Security Standard (PCI DSS), Payment Application Data Security Standard (PA DSS), PIN Transaction Security Requirements (PTS), Know Your Customer (KYC)[9] guidelines for Anti-Money Laundering (AML) standards and CMP (Contactless Mobile Payment) Product approvals are established for payment interoperability and security. Standardization and industry bodies such as ISO, EMVCo[10], EMV, Global Platform, Mobey Forum, NFC Forum, and GSMA etc. are in the process of establishing industry standards for mobile payments. They are working for developing a solution based on agreed upon standards, rules, and practices that ensure seamless interoperability regardless of the handset, mobile carrier, financial institution, payment network, or merchant location involved in any individual's desired transaction.

Integrity for mobile payments is important and covers the people (employed across the mobile money chain), the systems as well as the data. Technology can play a critical role in ensuring integrity, and this is where regulatory collaboration between central banks and communications regulators becomes paramount. While central banks are conversant with financial regulation,

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[8] See http://www.oecd.org/Internet/consumerpolicy/49441048.pdf

[9] http://rbi.org.in/scripts/NotificationUser.aspx?Id=2039&Mode=0

[10] http://www.emvco.com/approvals.aspx

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communications regulators are more conversant with the underlying technologies and how they can be leveraged to provide safer mobile money services.

G20 leaders have made financial inclusion a global development priority. We need continued product and business model innovation so that we can reach more people with a broader range of products at lower costs. Without the development and adoption of standards for mobile payments the industry risks seeing non-interoperable islands of pilots and solutions worldwide.

Mobile money insurance is another area that could be regulated and standardized. Technically mobile money is referred to as a float (it is not currency or cash) and is not treated as a deposit and can't earn interest, so insurance for such type of e-money needs to be brought into practice.

Interoperability challenges:

- At technical level, where interconnection between the mobile operators is not possible because the platforms are incompatible; or

- At commercial level, where interconnection between mobile operators is not possible because of the absence of a commercial agreement to provide such interconnection, even though it is technically feasible.

In coming up with a standard, one should bear in mind that users in developing countries have low incomes and cannot always afford high end phones (thus although advanced cryptographic solutions do exist, they may not result in affordable solutions) and they should also not be burdened by over protective security policies.

The main issue in developing countries is the security of the transaction. A secure communication channel (through cryptographic mechanisms) is needed between the mobile payment application which is resident on the SIM or microSD card for the payee and also some form of cardholder authentication mechanism should be included for the mobile phone device. There is also a need for the financial institutions in these countries to come up with regulations that are not too rigid and dampen the innovation that can bring financial inclusion to the population.

ISO is working on a future standard for mobile payment called ISO 12812 which will address:

- Security and data protection for mobile financial services

- Financial application management

- Mobile person-to-person payments

- Mobile person-to-business payments

- General requirements for mobile banking applications.

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This is being done in the ISO technical committee TC 68 under WG 10, *Mobile banking / payments*, in SC 7. ISO is also examining successful models in nations where bank accounts, and therefore debit and credit cards, are rare – such as M-PESA in Kenya,– to see if they can be incorporated into the standard.

Table 5: Standards and Certification Organizations[11]

Organization	Standards or Activities Governed within the Mobile Payment Ecosystem			Responsibility
	Mobile Handset Only	Other Ecosystem Functions	Payment Applications	
PCI SSC		✓	✓	Maintains, evolves, and promotes standards for payment account security.
EMVCo			✓	Establishes specifications to ensure interoperability of smart card-based payment systems worldwide. For mobile payments, seeks industry collaboration and coordination in mobile payment standards.
Payment Brands			✓	Requires that a mobile payments application submit to a security and functionality qualification process for the application to be branded for their network (American Express, Discover, MasterCard, and Visa).
Global Platform			✓	Drives adoption of its technical standards, which provide an open and interoperable infrastructure for transactions performed on smart cards, systems, and devices.
ETSI	✓			Produces globally applicable standards for information and communication technologies including fixed, mobile, radio, converged, broadcast, and Internet technologies.
GSMA	✓	✓		Engages in technical, commercial, and public policy initiatives to ensure that mobile services are interoperable worldwide.
OMA	✓	✓		Develops mobile service enabler specifications to promote interoperability.
NFC Forum	✓	✓	✓	Develops specifications for NFC devices that are based on the ISO/IEC 18092 contactless interface, ensuring interoperability among devices and

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[11] http://www.smartcardalliance.org/resources/pdf/Security_of_Proximity_Mobile_Payments.pdf

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				services.
3GPP	✓	✓		Produces globally applicable technical specifications for third generation GSM.
3GPP2	✓	✓		Establishes standards for CDMA 2000.

5 Mobile Banking

Mobile banking refers to the availability of platforms that allow users to access financial services (transfers, payments, receipts or investment) from mobile devices. We can access them through a regular internet browser or a mobile application especially designed for this kind of services. There is another way to manage your banking transactions – sending an SMS.

Convenience, speed and regular monitoring make mobile banking popular and widespread. It's an innovative business model that incorporates ICTs in a unique bouquet of services offered that are making traditional banking more accessible to users. M-Banking is an activity whereby a customer uses their mobile phone to interact with their bank either directly or indirectly via mFSPs (mobile financial service provider). The customer issues instructions, authenticates themselves and or receives information through their mobile phone. GSM mobile handsets are turning into a bank for its users and providing micro-finance, instant cash and the ease of other spot on day to day banking transactions, at the palm of their hands to remote customers thereby providing hassle free accessibility to financial systems and lowering the cost of transactions for the customer. The pursuit of banking institutions to reduce overall operational costs and expand customer base to the remotest regions in the world will lead to the global mobile banking customer base to reach 1.1 billion by 2015. A bank enters into an arrangement with a mobile operator to offer financial services either through text messaging or more elaborate smart phone applications or the customer establishes a direct contractual relationship with a licensed and supervised financial institution, through an agent who may provide customer service, keep records, handle cash and manage liquidity. Customers can carry out a range of financial transactions without having to go to a physical bank facility.

Under the Maya Declaration organized by the Alliance for Financial Inclusion, 25 countries to-date have made specific policy commitments to accelerate financial access for the poor. And in Los Cabos, Mexico, the G20 Leaders endorsed the Basic Set of Financial Inclusion Indicators to help countries spur and measure progress towards financial inclusion.

A mobile banking strategy for financial inclusion aims at providing complete banking facilities to the customers through their mobile devices. The following are the key solutions of this strategy:

- Mobile retail banking – This business strategy aims at bringing the key retail banking services such as statements, balance enquiry, check deposits, money transfers, bill payments, direct debits etc to the customers over the mobile channels.

- Mobile cheque deposits – This business service allows the customers to make cheque deposits remotely.

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- Mobile peer to peer payments – Allows the users to make money transfers or payments directly to one another, using mobile channels, either using their mobile wallet accounts or with their bank accounts including card accounts.

- Mobile money transfers – Mobile enabled local and cross border money transfers can help many customers to make money transfers easily from their mobile devices, either using their card/bank. Transfers involve inter-account transfer, transfer within same bank with same country, transfer within same bank across globe, transfer to other banks within same country, region and globe.

One of the most important use cases of mobile banking is to use the bank or bank card account to charge mobile or fixed phone balance. This kind of service is very common in Tunisia, and it is provided to customers via USSD.

5.1 Trends in Mobile Banking in Developing Countries

As per 'Money on the Move' series from Monitise[12], there has been a rapid growth in the adoption of banking by mobile phone in the last year: 9% of consumers now claim to use some form of mobile banking compared to 4.3% in the autumn of 2008. The growth in smartphone adoption and innovation is one of several strategic factors that will result in the majority of people using mobile money within the next few years. The recession has boosted the use of the mobile phone as a means of banking – the immediacy and control it offers are important benefits at a time when consumers are more aware of their spending. While users of mobile phone banking interact with their bank more frequently than the general population, they are using their mobiles for an increasing proportion of those interactions - mainly at the expense of branch visits and call-centre banking. 70% of consumers who use mobile phone banking are interested in using their handset as a means of paying for goods and services.

Two thirds of the people who use mobile phone banking are interested in using their phone as a means of organizing their finances. Those people who use mobile phone banking like it – 57% report that they have used this channel more often during the last twelve months. More than two thirds have recommended, or will recommend, this type of banking to others. 85% of those using mobile phone banking think that technology (including online and mobile phone banking) helps them manage their money more efficiently. Only 32% of consumers using mobile phone banking state that they find banking 'easier or faster' on a computer.

5.2 Technology

The technology used must be secure and at the same time convenient to deploy and cost effective. The payment processing industry with the growing mobile commerce has floated a number of payment processing models that can be leveraged to relevant mobile communication services such

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[12] www.monitise.com/uploads

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as SMS, USSD, WAP, GPRS, NFC, STK[13], IVR, J2ME[14], etc. The increase in wireless bandwidth and highly available mobile network infrastructure provided by numerous mobile network operators has increased the stability, reliability and quality of service in mobile transactions. Enhanced mobile operating systems (Windows mobile 7.0, Android OS, Symbian, Blackberry OS, Apple IOS4 etc), APIs (J2ME, .NET, Window 7 mobile SDK, Android SDK etc), development tools and technology standards for mobile computing, are making it possible to develop and host a variety of mobile transaction processing solutions for mobile commerce.

Mobile Phone based Banking Application uses secure channel for all traffic between the Mobile Handset and Bank's Servers via the Service Providers. Ensures that customers having mobile phones of any network operator be in a position to avail service. Mobile banking transaction shall be permitted only by validation through a two factor authentication (MSISDN [15] and PIN). Transactions will be end to end encrypted and shall not be in clear text anywhere in the network at all stages of transaction processing to ensure that no information is exposed to unintended eyes. Therefore malicious alteration of information is prevented. One-Time Password (OTP) is also a tool used by financial and banking service providers in the fight against cyber fraud. 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.

5.3   Stakeholders involved in Mobile Banking

A financial institution partners with a mobile applications service provider that uses a mobile platform solution, consisting of a provisioning server, a carrier-independent secure messaging infrastructure, and the transformational financial services extended to excluded people will predominantly be either through the use of standard GSM phones based services or through a mobile application available on the handsets.

An electronic account held on the mobile phone known as a "Mobile wallet" has various functional features converging deposit accounts, credit accounts, loyalty accounts, merchant accounts, gift cards and coupons, line of credit stored on the wallet with remote communication facility at a dynamic time and location. In case of eWallet/stored-value account-based payment via a secure WAP interface. In this case, user card and bank account information are stored securely on the user's mobile device. PIN-based authentication is used in conjunction with transport over interactive voice response (IVR), WAP, SMS and USSD channels. Certain banking services are available by dialing a toll free short code. In this facility there is no need to download software, customers use SMS or GPRS, and the service is accessible on all GSM handsets and is easily accessible to masses through a variety of handsets. Mobile application providers have built SMS and USSD based applications for banks.

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[13] SIM Tool Kit (WIB/SAT/JAVA/Custom)

[14] J2ME – Phone based application language

[15] Mobile Subscriber Integrated Services Digital Network-Number, uniquely identifying a subscription in a GSM or a UMTS mobile network

5.4 Cases of ICT Innovations in Mobile Banking

Various mobile core banking services are currently being offered in developing nations providing financial inclusion to the billions of unbanked adults worldwide.

Box 4. EKO Financial Service in India

There are numerous mobile banking initiatives introduced worldwide for financial inclusion of people residing in remote areas. EKO financial services to non-banking customers, connects a telecom infrastructure to the bank's Core Banking System (CBS). Delivering banking services through the mobile phone makes the cost of banking substantially cheaper and thus affordable for a broader population. It provides a platform for universal financial access and low-cost micro-transactions. Eko hopes to tap a huge potential market in India, where three quarters of the 1.25 billion people live on less than $2 a day. The Reserve Bank of India recently removed restrictions on agent exclusivity, so customers can now transact at customer service points of one bank even if their accounts are held at another bank. Such interoperability should mean greater efficiency and lower costs across the system. TRAI reported an urban tele-density of 66.79% and rural tele-density at 33.21% with a total of 771 million wireless subscribers in India as of Jan 2011. In February 2012, the Government of India released [a task force report](#) on a unified payments infrastructure linked to the [biometric Aadhaar number](#) that proposes electronic payments for government-to-people payments as a means to cut costs for the government and bring added convenience to welfare recipients, about 180 million people have been enrolled to the scheme. The government proposes a provision for a Mobile and Aadhaar linked Account by Banks. The electronic benefit transfers and remittances account for almost 4% of GDP[16] in India. Customers of Banks will access funds in their accounts through existing banking channels that are already in place. In addition, banks will set up the Business Correspondent (BC) banking channel at the last mile. BC sub-agents will be equipped with microATMs that can conduct transactions on the basis of Aadhaar number and biometric authentication, as well as using other authentication methods that are already in use by banks. Just like ATMs, BCs will be able to serve customers of any bank by routing transactions through the NPCI Switch or any other organization's Switch permitted under the Payment and Settlement Systems Act, 2007, connected to the bank that has appointed them. One such system, the Aadhaar-enabled Payments System (AEPS), has been put in place by NPCI (National Payment Corporation of India).

Source: http://eko.co.in/

Box 5. Motorola iSIM

Motorola has introduced iSIM which is an ultra-thin (0.4-mm-thick), wafer-like SIM card and the iSIM card is geared towards existing GSM phones that support NFC and non-NFC applications. With Motorola iSIM, financial service providers can issue their security tokens "into" their customers' mobile phones and offer financial services in a trusted environment that is not tied to a particular MNO. The iSIM actually fits between the SIM card and the phone, allowing financial service providers to manage the life cycle of the

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[16] http://finmin.nic.in/reports/Report_Task_Force_Aadhaar_PaymentInfra.pdf

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security tokens, including issuing, cancellation and renewal. While the versions currently being tested in the Chinese market only allow issuers to attach a single account to the iSIM, future versions will allow for multiple accounts and mobile wallet functionality

Source: www.motorolasolutions.com

Box 6. M-KESHO in Kenya– Deposit account to earn interest, on micro-deposits

Equity Bank Kenya's M-KESHO is a collaborative effort between Safaricom's M-PESA and Equity. Registered M-PESA users can sign up for an M-KESHO account which is an Equity bank account that is linked directly to their M-PESA account. A major benefit of M-KESHO is that once registered, the user's M-PESA menu on the STK (SIM application tool kit) is updated with an M-KESHO section. M-KESHO offers Equity Bank customers several advantages over keeping money in their M-PESA account, including: account deposit protection, micro credit, micro insurance and personal accident cover, no limit to the amount that can be saved (M-PESA has a limit), and interest earned above a minimum threshold, customers can earn interest from as little as Ksh1. Money can be conveniently transferred between M-PESA account and M-KESHO account to take advantage of the features.

Source: http://www.equitybank.co.ke/index.php/self-service/mobile-banking/m-kesho

5.5   Standardization Challenges

M-commerce ecosystem is challenged by diversity in terms of mobile device, computing system, application, communication channel, banks and service providers. There are a number of issues encountered by financial institutions and mobile network operators that pose a doubt about the security of financial transactions on mobile devices. Despite all reasonable precautions in the mobile banking scenario, banks may be exposed to enhanced risk of liability to customers on account of breach of secrecy, denial of service etc., mobile malware because of hacking/ other technological failures. Encryption in SMS and USSD communication is not necessarily end-to-end, creating vulnerabilities at various points where data can be intercepted and read by third parties, which may act on it. There are no common technology standards[17] for mobile banking and there are a large number of different mobile phone devices, specific client based and server based technologies used and it is a big challenge for banks to offer mobile banking solution on any type of device. Interoperability is a key issue and becomes tougher with more complex banking transactions. The end-user must be able to transfer money to anyone regardless of the recipient's bank or even if they are unbanked. Inconsistent user experience resulting due to varying connection speeds and different handsets and users needing to have a certain data plan may act as a barrier to adoption among price sensitive demographics. There is no offline (out of coverage) capability offered with mobile banking solutions. Some new mobile financial services place heightened reliance on new networks of agents for handling cash. The management of these networks creates operational risks.

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17 http://www.swift.com/resources/documents/SWIFT_white_paper_Mobile_Payments.pdf

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Other areas of concern would be incorrect transaction due to user error, transaction errors and lack of knowledge or experience of users in remote regions. Programs that allow remittances to be sent via cell phones raise anti-money laundering compliance issues for banks because cell phones, particularly those using prepaid accounts, have few checks on the identity of the user and there could be money movement for terrorism funding. The service offering range makes it difficult for a technology solution provider to deliver on all parameters. Revenue sharing is a key issue as there are many stakeholders like the Bank, the Mobile Technology Vendor and the Mobile Network Operator, wants to garner the maximum share of the customer's wallet and hence the revenue sharing model has to be worked out carefully taking into consideration the technologies used and the various services offered.

Various organizations developing standards such as 3GPP standards, Global Platform Standards, TS 23.048 standard, ISO 8583 and other ISO mobile banking standards, KYC (Know your customer) Standards, international standards set by FATF (Financial Action Task force on Money Laundering), PCI DSS, GSM standards are working towards building a safe ecosystem for mobile banking.

6   E-Health

The WHO estimates that approximately 1.7 billion people lack access to essential medicines. It defines essential medicines as "those that satisfy the priority health care needs of the population. Health systems in low and middle-income countries continue to face considerable challenges in providing high-quality, affordable and universally accessible care. E-health can help address the challenges faced by resource-constrained health markets in terms of the availability, quality and financing of health care. It is nowadays acknowledged that health care is a major issue for a country's welfare status in all levels, either economically and socially, or demographically. We live in an age that the health care sector demands on reducing costs and simultaneously on improving its quality and access to all (OECD, Docteur and Oxley, 2003) [18]. Nowadays, primary care is considered to be in the forefront of importance as the expertise knowledge is moving downwards, closer to the patient in remote units or at home, as also the citizen-centered healthcare envisages. Thus, Government's strategy of decentralizing healthcare delivery is both the realization of equity of access to specialist services outside the hospital environment but also the need to control the increasing cost of health care and the long waiting lists.

E-Health comprises of telemedicine, tele-health and health informatics. Telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve a patient's clinical health status. Telemedicine includes a growing variety of applications and services using two-way video, email, smart phones, wireless tools and other forms of telecommunications technology. Tele-health is the use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health and health administration. Technologies include videoconferencing, the internet, store-and-forward imaging, streaming media, and terrestrial and

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[18] https://www1.oecd.org/els/health-systems/22364122.pdf

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wireless communications. Health informatics is the study of resources and methods for the management of health information.

Online medical consultation and monitoring, remote imaging and diagnostics, prescription tracking and drug authentication, remotely administering medicine and maintenance of extensive patient databases and electronic records for remote tracking are some of the aspects of e-health and m-health. eHealth is the cost-effective and secure use of information and communications technologies in support of health and health-related field, including health care services, health surveillance, health literature, and health education, knowledge and research. Mobile Health, or mHealth, can be defined as medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, tablets, personal digital assistants (PDAs), and other wireless devices. The ubiquity of mobile devices in both developed and developing countries presents an opportunity to improve health outcomes through the innovative delivery of health services and information.The dramatic ageing of the global population leading to more elderly people on the planet than at any time previously in human history (the number of over-sixties increasing by 605 million to 2 billion by 2050, the majority of whom in the low- and mid-income bracket); and the proportion of global citizens affected by some form of disability, reaching an estimated 1 billion. The combined use in the health sector of electronic communication and information technology (digital data transmitted, stored and retrieved electronically) for clinical, educational and administrative purposes, both at the local site and at a distance (WHO HQ 2002; Mitchell 1999)[19].

One of the key problems in healthcare informatics is the lack of interoperability among different healthcare information systems. Interoperability can be investigated in different categories in the e-Health domain, such as the interoperability of the messages exchanged between healthcare applications, interoperability of Electronic Healthcare Records (EHRs), interoperability of patient identifiers, coding terms, clinical guidelines and healthcare business processes.

Acute respiratory infection continues to be a leading cause of death among young children; killing nearly 1.5 million children under age 5 globally each year. The WHO estimates that at least 2.5 physicians, nurses, and midwives per 1,000 people are needed to provide adequate coverage with primary care interventions associated with achieving the Millennium Development Goals (WHO, *World Health Report 2006[20])*. Prompt and effective treatment of malaria is a critical element of malaria control. It is vital that sufferers, especially children under age 5, start treatment early to avoid death. About 3.3 billion people – half of the world's population – are at risk of malaria. In 2010, there were about 216 million malaria cases. Good prenatal and postnatal care improves maternal health and reduces maternal and infant mortality. Two regions, Sub-Saharan Africa and South Asia, accounted for 85 per cent of global maternal deaths. Lifetime risk is the probability that a woman will die from complications of pregnancy and childbirth over her lifetime, women in sub-Saharan Africa face the highest lifetime risk of 1 in 39[21]. Mortality rate under 5 years of age per 1000 births in African nations such as Burkina Faso, Mali and Somalia is almost 180. In BRIC

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[19] https://www.ifw-kiel.de/ifw_portal/konfer/esf-ifw/newtech06/garcia_barbero06.pdf

[20] http://whqlibdoc.who.int/publications/2006/9241563176_eng.pdf

[21] http://www.childinfo.org/maternal_mortality.html

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nations the expenditure on health was 9%, 5.1%, 4.1% and 5.1% of their GDPs respectively in 2010-11. Out of pocket, direct health expenditure as a % of private expenditures on treatments for BRIC nations were 57.8%, 82.8%, 86.4% and 78.9% respectively in 2010-11. The bottom of pyramid spending on health expenditures in developing nations is about $158.4billion.

GSMA predicts the mobile health market in the USA will be about $23 billion in 2017. By incorporation of ICTs with health solutions; e-health and m-health reach out to millions for medical care before and beyond cure. It's immediate, informative, interactive and remotely monitored, hence cost effective, accessible and efficient. Primary purpose for the incorporation of ICTs in healthcare is to extend geographic access, facilitating patient communication for general health education, enabling patient compliance and emergency care, protecting patient privacy, real time assistance for diagnosis and treatment, improving data management and streamlining financial transaction using mobile payments and other services. The domains of e-Health include:

- *eCare*: electronic health assessment and monitoring, remote professional consultation and diagnosis, emergency medicine, remote monitoring of healthcare programs, electronic health care records for follow ups, telecounselling, treatment support and treatment tracking.

- *eLearning*: remote access to health information, remote patient learning for prevention and disease management, awareness about communicable diseases such as HIV etc.

- *eSurveillance*: health services research and electronic health statistics analysis, reporting of outbreak of diseases such as dengue and other epidemics, public health reporting, epidemiological analysis.

- *eGoverment/administration*: reporting of the success of pilots and projects, gathering and the management of health data in order to improve the coordination of health systems clinical outcomes etc., health system financing through eAdministration by improvement of information systems to support more effective resource allocation, electronic pooling and purchasing in areas with low infrastructure.

Following are the comprehensive e-Health and mobile Health services:

(i) Services addressing wellness and disease management:

- Health promotion (prevention)

- Rehabilitation

- Remote Diagnosis

- Long-term care and disease tracking

- Therapy

- Telemedicine (teleconsultation, telecare)

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(ii) Support activities for management, administration, logistics and supply of health-related goods and services:

- Electronic Patient Record (EPR)/Electronic Health Record (EHR)

- Picture archiving and communication systems (PACS)

- e-Prescriptions,

- e-Referrals

- Health cards

- Health portals

- Hospital Information Systems (HIS)

(iii) Provision of health knowledge infrastructure, medical education, medical research and clinical trials, and international and/or collaboration platforms.

(iv) IT infrastructure for the deployment of e-Health, namely the physical networks allowing connectivity, the devices supporting 'interoperability' of systems and technologies, as well as the necessary legal and regulatory framework related to security and confidentiality issues (secure transmission, secure processing, secure storage, authentication and data integrity).

6.1   E-Health Trends in Developing Countries

No matter how one defines e-Health, it's clear from the Outsourcing Center-Wipro survey results[22] that e-Health initiatives are still in the early stages at organizations worldwide. While a full third (33.3%) of respondents said their country's e-Health initiatives were just getting started, only 4.4 percent said their e-Health implementation is "Advanced," and only 4.4 percent responded that their country's implementation is "Mature." Just more than one-fourth (28.9%) of survey participants said their country is still in the conceptualization stage, and one in five (20%) said e-Health initiatives are still "immature" in their country. Nearly one in ten (8.9%) said their country currently isn't involved in e-Health at all. Aside from Europe, where many countries have implemented an e-Health model for healthcare, most continents are just becoming familiar with e-Health and are just beginning to understand the full implications of setting up an initiative.

In a day and age where governments are increasingly adopting healthy citizen initiatives, it comes as no surprise that government legislation is the number one trend prompting organizations to look at the e-Health model. More than half (51.7%) of respondents to the Wipro-Outsourcing Center

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[22] http://www.wipro.com/Documents/resource-center/library/trends_in_government_e-Health.pdf

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survey said that government legislations makes e-Health a compelling healthcare model for their organization. In contrast, fewer than one in five (18%) of respondents said that the fact that healthcare is a payer-driven industry makes e-Health a compelling option for their organization. Another 16.9 percent of respondents indicated that increasing patient awareness was a big reason their organization would consider this option.

Additional trends that make e-Health an attractive healthcare model to organizations include efficiency, better outcomes at lower cost and cost reduction. One respondent said that this model was becoming a necessity due to the high cost of healthcare. "Realization on part of government and health industry that e-Health is necessary to transform care delivery if we are to avoid economic problems if health costs are not constrained," said the respondent. Another survey participant said that it was important for his or her organization to have the ability to access and analyze data to support patient needs. "Data collection and analysis are key challenges in African countries at this time," according to the survey participant.

6.2   Stakeholders involved in E-Health

The value chain in providing e-Health services, across remote regions, comprises of many stakeholders involved both on the field and virtually. Regulators (ministry of health, governmental bodies), funders (Banks and NGOs), hardware vendors, application and platform developers, MNOs, health service providers, health workers, database management services, communication servers providing firms, communications and health standards bodies, service chains, cloud based health platform providers, electronic information sharing solution providers etc.

6.3   Technology

The technologies used to provide remote monitoring and access to health practitioners diagnosis are cameras, computing device, GPS, PDAs and other smart phones, radio, remote/portable diagnostic tool, smart cards, SMS and USSD, voice and software applications, unique ID (biometric scanners, RFID) etc. These technologies might seem very simple but in areas that are not resource rich with huge density of poor and illiterate populations, immense timely medical care could be provided to people, using the huge penetration of mobile phones in these under-developed and developing regions. Satellite communication would also be used in covering large areas and increasing the scalability of operations. Mobenzi Researcher[23], Medic Mobile[24], EMIT[25] etc. are cloud based platforms that support medical services worldwide that enable workers with less training to provide high-quality care by using clinical decision-support software to improve the quality and consistency of practice. There are certain other software applications and add-on devices and attachments that could be used with a mobile phone, to make an apparatus for conducting on the spot diagnostic tests in remote areas.

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[23] http://www.mobenzi.com/researcher/Case-Studies/mHealth

[24] http://medic.frontlinesms.com/

[25] http://www.emitmobile.co.za/

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6.4   Cases of ICT Innovations in e-Health

Box 7. Netra tool for refractive assessment, MIT labs in USA

MIT's Media Lab is working on a project that could help people in poor countries get their eyes tested using a cell phone. Media Lab has developed a system for prescribing eyeglasses that only requires a Smartphone and a simple plastic lens attachment that costs around $2. NETRA, or Near-Eye Tool for Refractive Assessment, a patient peers into the lens attachment connected to a Smartphone, loaded with the testing app. Patients will then see parallel red and green lines and use arrow keys on the phone to adjust those lines until they overlap. After about two minutes the app provides an eyeglass prescription. The solution is based on a high-resolution programmable display and combines inexpensive optical elements, interactive GUI, and computational reconstruction. Netra is a $2 clip-on eyepiece that goes on top of a cell phone. The user looks through this eye piece and interactively aligns the displayed patterns by clicking the buttons. The number of clicks required to bring the patterns into alignment indicates the refractive error. This optometry solution combines inexpensive optical elements and interactive software components to create a new portable and inexpensive device that mimics (and replaces) the expensive laser-based Shack-Hartmann wavefront aberrometers that use laser technology to evaluate the eye.

Source: http://web.media.mit.edu/~pamplona/NETRA/

Box 8. SIMpill – Mobile Tracking of Dosage in South Africa

The SIMpill Medication Adherence System is a proven medication management system that monitors the patient's medication intake and will remind the patient in real time if the patient forgets to take the medication as prescribed. As part of DOTS (directly observed treatment, short course) strategy to track diseases and medication management in rural areas, a small pill bottle made by London-based SIMpill that contains a SIM card, when opened, the SIM card delivers a SMS with a unique pill box identification number to a central server. The central server receives the incoming SMS and stores the data, but if no SMS is received at the designated time, the server contacts the patient via phone alerting them to take their medication. If the patient does not respond, the server contacts a caregiver who can follow-up with the patient.

Source: http://www.simpill.com/

Box 9. K-NFB Reading Technology in USA

K-NFB Reading Technology combines technologies into a pocket-sized computer that scans and reads print as it exists in the real world. This portable device is the first technology of its kind that allows blind or visually impaired individuals to read printed text that surrounds them on a daily basis without having to bring it back to their desk-based reading systems.

Users can read material that would not be feasible to bring to a scanner including signs on a wall, text on packages, and electronic displays such as a bank ATM. This dramatically increases their independence, productivity and quality of life.

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The K-NFBR hardware consists of a digital camera and a pocket computer connected and held together by a specially designed case. The software developed by Ray Kurzweil and the team he led at Kurzweil Technologies, Inc. (KTI) contains unique and powerful image enhancement routines that eliminate the effects of uneven illumination, tilt and rotation of the image, curved text lines (from curved books or even from curved objects) and other distortions of real-world print.

The cleaned up images are then processed by optical character recognition software (the first version of which was originally invented by Ray Kurzweil in 1975), and speech synthesis (which Ray Kurzweil also invented in 1975).

The device is remarkably accurate at reading print found in the real world. Ray Kurzweil / KTI and The National Federation of the Blind have worked in collaboration to create the K-NFBR.

Source: http://www.knfbreader.com

6.5 Standardization Challenges

Mobile and E-Health-Care in most countries is characterized by isolated and small-scale applications that cannot promote effectively enough, communication and information-sharing among Health-Care Providers, Medical Institutions and Health Insurance Organizations.

One of the biggest challenges is scalability: while pilot projects have generally been successful, when taken to scale, they resulted in costly and inefficient programs due to the proliferation of discrete and independent systems. Success in the future will depend on achieving much more interoperability and cooperation than is today the case, between all the major stakeholders.

Design flaws can affect the ease of use and reliability of systems and may even be dangerous, creating ill feeling and reducing clinicians' willingness to use emerging systems, software, and hardware in practice. There is little reliable evidence to demonstrate the measurable impact, risks, or cost-effectiveness of e-Health innovations, except in a modest number of application areas and regions. A large pool of skilled healthcare professionals is required for the development and management of the e-health initiatives that cater to the needs of billions of people living in the remote regions with very poor infrastructure.

One set of challenges related to privacy and security. How, for example, can one design the system to safely provide patients access to their private health care information over the Internet, yet still allow needed information to be shared in an emergency situation? Health literacy is another area, which poses an impediment in the rapid adoption of technology.

The most prominent barriers are easy-to-use, intuitive, robust and smooth user interfaces and devices. The services must be offered to all users (in particular also to the elderly and the disabled) through such interfaces, and all of them have to be implemented in a uniform way. Also the lack of availability of data in an electronic format and the lack of modeling for some diseases and extreme weather events might reveal an important barrier for a global prediction and management of emergencies. Responsibility, confidentiality, liability and access only to certified professionals are

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some of the key issues in the health telematics field. There could be some organizational barriers, however, such as healthcare at home requiring smooth collaboration of different organizations.

Financial barriers largely depend on the different countries' policies. In countries with national healthcare systems these services will be a part of the overall healthcare system. In insurance based countries, where services are reimbursed on a fee-for service basis, new codes will have to be established. In countries with market-driven healthcare systems the prices need to be adapted to market prices driven by the healthcare consumers. The challenge is to create comprehensive systems (networks of services offering the basis for patient-individual service chains), which are financially beneficial for all players.

Interoperability is a key challenge. This is the fragmentation problem - many pieces of information, in many formats, on many platforms, in many stakeholder environments, and in many geographic locations. The data sets are thus heterogeneous both physically (stored in different locations) and logically (not organized in the same fashion) accentuating issues of interoperability that are raised by lack of compatibility of systems and equipment. The problem of interoperability is not limited to technical standardization as typically assumed, but encompasses the complex issues of integrating cultural, financial and workflow systems. Ensuring that the 'ways of working' of health systems are interoperable is a major challenge.

A key challenge for the care providers is the reliability and validity of the collected data and protection of health data throughout a person's lifetime. Financial implication of providing health care constantly using computers and maintaining real-time medical patient data. Lack of awareness and education about the public use of e-health service, barriers are created due to high illiteracy levels of a nation, as it is difficult to propagate technology in these circumstances, due to lack of knowledge among masses for the use of e-health related technologies. In some developing nations there is a lack of national policies, comprehensive legal framework backing consumer protection and data privacy and standards in the e-Health domain in various countries. Hence scale, interoperability, fragmented implementation, lack of knowledge and confidentiality are major challenges that SDO's need to address.

Clinical Standards or Codes such as disease, procedure, clinical observation, and drug codes need to be formulated for patient safety. Identification of patients and health plan IDs, content and formats such as patient records and access and controls all need to be standardized for a successful implementation of a national health informatics system.

6.6   Additional E-Health applications in emerging economies

Box 10. JustTested program in South Africa

HIV testing and counseling is an important step for people to protect themselves and to avoid infecting others. Knowledge of one's HIV status is also a decisive factor to seek treatment. The statistics of 2011 in South Africa revealed that only 24.7% of adults, with an age between 15 and 49 years, had tested for HIV, while nearly 5.6 million, or 17.3%, of South Africans, currently live with HIV.

The objective of JustTested program is to supplement HIV counseling and testing (HCT) services by giving support and information to people who would have just tested, regardless of whether they test HIV positive

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or negative. Subscribers can select between the JustTested negative or positive free SMS, both available in many versions (Afrikaans, English and isiXhosa). The service sends 39 messages over the course of three months on the topics of healthy living with attention to HIV and AIDS related issues.

JustTested were launched in May 2012. It is currently active in parts of the Overberg district of the Western Cape and the Nelson Mandela Metro District in the Eastern Cape in South Africa.

***Source:** m-HEALTH COMPENDIUM, VOL(2), Technical report, May 2012*

Box 11. Mobile Alliance for Maternal Action (MAMA) in Bangladesh and South Africa

Every day, more than 800 women die of childbirth or pregnancy-related complications and 3.1 million newborn deaths occur every year. However, it is noticed that at least 1 billion women in low- and middle-income countries have currently a mobile phone. To address this stark reality, an innovative public-private partnership between the United States Agency for International Development (USAID), Johnson & Johnson, the mHealth Alliance, the United Nations Foundation and BabyCenter were launched in 2011. It is called "MAMA" (Mobile Alliance for Maternal Action).
MAMA mission was to deliver vital health messages to new and expectant mothers in developing countries via their mobile phones. MAMA started with a three-year, $10 million investment to create and reinforce programs in Bangladesh, South Africa, and India in the objective of achieving Millennium Development Goals (MDGs) 4 and 5. MAMA has developed free, adaptable messages informed by experts in maternal, newborn and child health. These evidence-based, culturally sensitive mobile messages are being downloaded and used by 161 organizations in 54 countries around the world.

In Bangladesh, the service was launched in September 2011, and it was called "Aponjon" (meaning dear one in Bangla). The service sends messages twice a week in either SMS or IVR format to subscribe pregnant women, new mothers and their families with a cost of 0.025 USD per message. Over 52,000 mothers and guardians have subscribed until H1 2012 with prediction to reach 2 million subscribers in 2015.

In South Africa, the service was launched in May 2013, and used three different mobile channels to provide support and information to pregnant women and new mothers: SMS text messaging twice a week (with further information for HIV+ mothers), mobile web-based community portal (askmama.mobi) and USSD interactive quizzes twice a week. Two further channels are planned which consists in an educational portal through the MXit social networking platform and pre-recorded weekly voicemail messages. The service collects aver 377,971 subscribers in November 2013.

Sources:
http://www.mobilemamaalliance.org/who-we-are
m-HEALTH COMPENDIUM, VOL(2), Technical report, May 2012

Box 12. iHRIS Mobile Reference Directrory in Uganda

The iHRIS system consists of three main components: electronic databases for storing information, software for entering and updating data and reporting, and analysis tools. iHRIS databases have been established at various institutions including four health professional councils. The districts can access and use professional council databases to check registration and licenses of applicants, essentially screening applicants and thus identifying falsification cases and health workers who are not in good standing with the professional councils.

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The iHRIS Mobile Reference Directory allows the verification of clinic and/or medical professional registration and practice licensing in an easy and affordable way and that, by sending an SMS message with the doctor's or clinic's name to a widely publicized short code. The directory includes details on 3,877 doctors and dentists in addition to 3,500 facilities.

If the request is about a doctor, the received reply includes the doctor's full name, registration number, qualification and license status. If it is about a clinic, a response with the clinic licensure status with the supervising doctor's name is received. If the "doctor" is determined to be unregistered, the registrar assumes the necessary action to prevent the practice from continuing.

From October 2011 to September 2012, 3,172 requests were made on doctors and 457 on private clinics. The Registrar of the Medical Council researched 58 frequently asked about doctors and 31 private clinics. Two of the doctors were found to be herbalists and the concerned clients were alerted. Two other doctors were arrested and taken to court for illegal practice. Three others are still at large.

Source: *m-HEALTH COMPENDIUM, VOL(2), Technical report, May 2012*

Box 13. TxtAlert in South Africa

TxtAlert was first piloted in 2007 in South Africa, and this, in partnership with Right To Care, one of the largest antiretroviral (ARV) treatment providers. The idea of txtAlert service comes from the fact that a large numbers of patients miss their appointments, drop off treatment, or become lost to follow up. For this purpose, a new mechanism were needed for reminding patients of their visits while also allowing an easy and cost-effective follow up on a patient who has missed an appointment. The main objective was to establish appointment reminders and to create a facility where patients could contact the clinic to reschedule or confirm an appointment, at no cost to the patient. TxtAlert can be integrated with existent hospital and clinic MRS (Medical Record System). If no MRS is already established, Praekelt Foundation can develop a custom interface to input appointment data and manage patient bookings more successfully.

TxtAlert now has four different variants: for simple patient, for HIV patient, for pregnant women and for TB patients.

In the initial trial of txtAlert at the Theba Lethu clinic, important results were achieved in dropping the number of missed appointments. Missed appointments have fallen from 30% to 4% and loss to follow up has decreased from 27% to 4%. There are at present over 18,000 users of the system at three different clinics in Gauteng, South Africa.

Source: *m-HEALTH COMPENDIUM, VOL(2), Technical report, May 2012*

Box 14. MMS Sign

MMS SIGN is a software allowing communication with deaf people through mobile phones. It is based mainly on automatic transformation of a textual message to an MMS containing the translation of the message's content to sign language. This software is used to develop several services for Deaf people, for instance an announcement service that ensures accessibility to public announcements.

Its objective is to contribute in the improvement of e-accessibility of deaf community and to make the mobile phone a way of communication usable by deaf people. In this context, a new system has been

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developed which is able to transform the text to MMS containing the video sequence of the text in sign language in a format which can be sent to deaf via MMS. This transformation is realized in two steps: The first consists to the generation of 3D animation of a 3D avatar, by the use of web-service WebSign. Then, the MMSSign software transforms the 3D animation to an MMS containing a 3GP video sequence.

Source: http://hebergcck224.rnu.tn/websin/mmssign2/home.php

7   E-Agriculture

E-agriculture utilizes information, imaging, and communication technologies coupled with applications of the internet for the purpose of providing enhanced agriculture services and information to the farmer and farming community. E-agriculture is improving agriculture development opportunites, and aiding the practice of agri-business The increased use of e-agriculture, and e-agriculture technologies has empowered farmers and translated into a higher standard of living for farming communities world wide. The Geneva Plan of Action dated December 2003[26] emphasized on building an inclusive information society and to put the potential of ICTs for development. Both the Geneva Plan of Action and Tunis Agenda for the Information Society, November 2005 highlight the role of developments in e-Agriculture and building ICT capacities in order to provide easy access to comprehensive, up-to-date and detailed knowledge and information, particularly in rural areas and also to develop tools by incorporating ICTs for increasing productivity and the quality of the produce. "The Tunis Agenda for the Information Society states that the WSIS implementation mechanism at the international level should be organized taking into account the themes and action lines in the Geneva Plan of Action, and moderated or facilitated by UN agencies such as FAO, CGIAR and IFPRI when appropriate"[27]. UN agencies such as FAO organizes various activities and facilitation meetings related to the action line C7, which highlights the use of ICTs in e-agriculture, of the WSIS.

According to the World Bank Data Report[28] 2010-11, for the 70 percent of the world's poor who live in rural areas, agriculture is the main source of income and employment. The percentage of rural population (% of total population) in BRIC nations is 14%, 27%, 70%, 55% respectively. African nations such as Burundi, Uganda and Guinea have almost 90% rural populations. South and East Asia, followed by Sub-Saharan Africa and the European Union have the most agricultural land as a % of total land area. In countries such as Guatemala, Ethiopia, Sierra Leone agriculture value added accounts for 40 – 45 % of the national GDP.

Agriculture is often the economic driving force in developing countries. World Trade Organization (WTO) statistics show that agriculture accounts for over one-third of export earnings for almost 50

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[26] http://www.itu.int/wsis/docs/geneva/official/poa.html

[27] http://groups.itu.int/stocktaking/About/WSISActionLines.aspx

[28] http://data.worldbank.org/topic/agriculture-and-rural-development/

developing countries, and for about 40 of them this sector accounts for over half of export earnings[29].

Instability in food production can lead to problems in global markets. When agricultural-based countries experience declining per capita production of staple foods, the role of trade becomes pivotal in their food security. The most economically vulnerable group, including least developed countries (LDCs), has been hardest hit; their net food and agriculture import bills have soared over the past 20 years to a level of nearly USD 27 billion by 2010.With the global cost of purchasing food on the international marketplace surpassing USD 1 trillion in 2010 (as it did in 2008), food import bills for LDCs have climbed the most. According to FAO estimates, the number of people who suffered from chronic hunger in 2010 was 925 million. Integrating ICTs in agriculture and development of systems for improving agricultural productivity, improve agriculture, forestry and fisheries practices, food security aimed at smallholder farmers.

Trade, food security, market prices, livestock, aquaculture, crops, water management, agri-processes and techniques are the main areas in which ICT innovations are implemented in the agriculture sector. With a number of mobile, Web and hardware based ICT innovations in the agriculture sector, farmers in rural areas worldwide have been benefitting from their abilities to perform remote monitoring and tracking, trading commodities, access to markets, better agriculture techniques, food security etc., through innovative applications and hardware deployment. Innovative applications of the ICTs can be used for: mapping natural resources, using participatory approaches to empower local communities to manage their own resources; creating business opportunities by providing agricultural market information for farmers and traders; speeding up application procedures in agricultural credit programmes; protecting natural resources, such as fish stocks and forest resources from illegal poachers and loggers; forecasting weather conditions and pest outbreaks; making information more easily available; and enabling communication and knowledge exchange in online communities.

7.1   Trends in E-Agriculture in Developing Countries

- A common platform for agriculture stakeholders: A single, integrated information system for all stakeholders has many advantages. It minimizes the duplication of data and ensures consistency, improves integrity of the data, and addresses a variety of requirements.

- Multi-stakeholder eAgriculture knowledge sharing: ICT infrastructure to connect the knowledge quadrangle of farmers, extension professionals, educators and scientists. Multi-channel information delivery, ICTs for better risk management, ICTs and financial services for the farmer, ICTs and information gaps, eEducation, Virtual aggregation of small stakeholders.

- Role of mobile technology in eAgriculture: Mobile phones, GPS systems, barcode scanners,

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[29] See
http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTARD/0,,contentMDK:20451181~menuPK:336688~pagePK:148956~piPK:21661 8~theSitePK:336682,00.html

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RFID readers and smart card reader technology can be used to read and capture data and to store data. However, further components, such as the Internet, communication networks and regulatory systems (to provide data security and standard systems for codes), are essential to complement the input and output devices.

- Precision agriculture

- Traceability and remote tracking: traceability is the tracking of animals and food by electronic means. There is an increased emphasis on the traceability of agricultural production particularly in the markets of the developed world, due to an increasing consumer demand for quality and food safety.

- Agriculture insurance: Agricultural insurance is not limited to crop insurance, it also applies to livestock, bloodstock, forestry, aquaculture, and greenhouses. Crop insurance has long been used in developed countries to deal with weather uncertainties, but its availability in developing countries, particularly to smallholder farmers, has been extremely limited.

- Food security is one of the main concerns related to the future survival of individuals and families and ultimately it impacts nations.

7.2   Technology

ICT in agriculture is applied in the following areas:

a. Automation and computer controlled devices
b. Knowledge and information management systems (mobile phones and web portals)
c. E-commerce
d. Managing Agricultural Resources and Services
e. Wireless Technologies and RFIDs
f. Location based services (e.g using GPS)
g. Geographical Information Systems (GIS)
h. Digital repositories and agriculture metadata

ICT innovations in e-Agriculture are predominantly hardware, mobile and web based. Mobile technology is the dominant tool in agricultural information services, with the use of SMS services information can be made available to farmers about agriculture techniques and practices and markets. Also through the use of web portals and community servers information can be exchanged amongst farmers and various buyers and sellers.

7.3   Stakeholders involved in e-Agriculture

International organizations such as FAO (Food and Agriculture Organization of the United Nations), Non Governmental Organizations (NGO's), Community Based Organizations (CBO's), Farm workers organizations, Corporate Agri-business industry, Traditional village government leaders,

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Women In Agriculture, Youth In Agriculture, researchers , local cooperatives , businesses: businesses, associations, other organizations, farmers: individuals; organized and informal associations, businesses selling products into the sector, such as seeds and fertilizers and businesses enabling the sale of agricultural produce to consumers mobile network operators, crowd sourcing and other community digital platform and web portal developers, mobile application developers, hardware providers, governments etc.

7.4   Cases of ICT Innovations in e-Agriculture

Several ICT applications are employed in various e-agriculture initiatives related to providing information and bringing markets to buyers, food processing, cultivation, irrigation, harvesting, tracking, automation etc. e-Agriculture includes the involvement of innovation cloud (research, academia, development), farmers (and their communities), market prices, information and logistics in trade cycle, food security in the entire value-chain.

Box 15. ITC e-Choupal in India

Member farmers receive information, order products and services needed to enhance their farming productivity, and sell their harvests at fair market prices. Today, 4 million farmers in 40,000 villages use 6,500 e-Choupals to their advantage, bargaining as virtual buyers' cooperatives. The e-Choupal model has been specifically designed to tackle the challenges posed by the unique features of Indian agriculture, characterized by fragmented farms, weak infrastructure and the involvement of numerous intermediaries, among others.

Real-time information and customized knowledge provided by 'e-Choupal' enhance the ability of farmers to take decisions and align their farm output with market demand and secure quality & productivity. The aggregation of the demand for farm inputs from individual farmers gives them access to high quality inputs from established and reputed manufacturers at fair prices. As a direct marketing channel, virtually linked to the 'mandi' system for price discovery, 'e-Choupal' eliminates wasteful intermediation and multiple handling. Thereby it significantly reduces transaction costs.

Agricultural community can access ready information in their local language on the weather & market prices, disseminate knowledge on scientific farm practices & risk management, facilitate the sale of farm inputs (now with embedded knowledge) and purchase farm produce from the farmers' doorsteps (decision making is now information-based).

Source: https://www.echoupal.com/

Box 16. DrumNet in Africa

DrumNet, a project of Pride Africa, offers support services to smallholder farmers in Kenya by providing access to information, financial services and markets. It addresses the need for access to markets using information technology, efficient business processes, and economies of scale. It combines information, commodity transaction services, and financial linkages into a single business service model that provides access to markets, market information, and credit for the rural poor to support sustainable agriculture and rural development.

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DrumNet tries to overcome the lack of information flows by directly linking commercial banks, smallholder farmers, and retail providers of farm inputs through a cashless microcredit program. DrumNet encourages production of export oriented crops even as it ensures that farmers meet the quality standards. DrumNet members, organized into co-guaranteed solidarity groups, are able to access required farm inputs (seeds, fertilizers, pesticides, etc) at local participating stockiest (input suppliers) through an established line of credit using their DrumNet transaction card.

The stockiest, trained in basic DrumNet record keeping, submit receipts to DrumNet and are paid in two-week cycles from a credit account maintained by DrumNet. DrumNet clients are required to sell their produce to DrumNet at harvest time. DrumNet organizes the pick-up of the produce and deducts principal and interest payments from farmer net returns, as well as a 15% commission. Immediately following a successful transaction, data is entered into DrumNet systems, and a set of bank account transfers are triggered to pay the participating farmers, agents, and (if necessary) transporters. In case the value of the produce does not cover the loan repayment, DrumNet enforces a group guarantee by subtracting the required amount from a group of peers. Later, generally at monthly intervals, funds from the buyer are transferred into DrumNet accounts to complete the transaction. The DrumNet platform also links large-scale buyers, farmers, transporters, and field agents through an integrated marketing and payment system. Before farmers plant crops, DrumNet negotiates contractual arrangements between buyers and farmers, and at harvest time coordinates produce aggregation, grading, and transportation through agreements with local field agents and transporters. Market data and transaction details are made available to participating farmers.

Source: http://siteresources.worldbank.org/DEC/Resources/DrumnetCaseStudy.pdf

Box 17. Esoko in Ghana

Esoko links mobile phones to web-based management systems. It enables agri-business, agri-associations and other agri-projects to systematically build polls, and automatically scouts participants for critical field information. The scout technology can be programmed to send or receive text messages from participants in the field in order to track activities and inventories or evaluate crop behavior, dramatically reducing the cost of real-time distribution and recovery of responses from thousands of participants.

The Esoko Ghana Commodity Index (EGCI) is a rural communication platform that publishes a cash market price index composed of data on physical commodities. The index is published weekly and tracks prices at wholesale and retail levels. Esoko seeks to improve incomes by building healthy markets. Any individual, business or producer group can set up Esoko, to better manage marketing, distribution and procurement networks. Currently Esoko is active in ten countries throughout Africa with different partnership agreements which include public sector agricultural projects, Esoko country franchises and licensed partners. Esoko provides a complementary partner support programme, which focuses on capacity building and financial sustainability, with an emphasis on market data enumeration and business development services.

There are four key services provided by the platform as follows:

- Live market feeds: real-time SMS alerts on market prices and offers that are automatically delivered to subscribers. Users can submit offers into the system directly using SMS.

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> *- Direct SMS marketing: businesses can target specific groups of users and target procurement or extension messages to reduce their travel and communication costs.*
>
> *- Scout polling: enterprises can set up automatic SMS polling for field activities to track inventories, crop activities, etc. to monitor and report on crop cycles and yields.*
>
> *- Online profiling and marketing: any user or business gets a customizable web space that can advertise their goods and services. This space can be updated using Esoko's mobile-to-web content management service.*
>
> *Source:* https://esoko.com/

7.5 Standardization Challenges

E-agriculture needs to provide the whole breadth of agricultural value-chain with the interaction of various stakeholders. E-agriculture has to provide solutions for when to plant and what seeds to use, weather information, soil information, fertilizer information, commodity prices, transportation information, crop and pest control, market information, storage information, food processing guidelines etc. Marketing of agricultural produces and little access of farmers to modern technology are serious impediments to the development of small nations with largely agrarian societies.

With regard to patterns in access to e-agriculture, farmers are affected by restricted access to digital media/technologies, high cost of access, insufficient content in the correct language, lack of equipment, and lack of power and sustained technology support.

As different regions with agrarian populations have varied physical and technology infrastructure and literacy levels, various challenges in implementing e – agriculture are in the following areas:

- Developing virtual communities/networks for information and knowledge exchange between rural stakeholders, as well as for their empowerment through participation;

- Capacity building of rural stakeholders in use and application of ICT;

- Enhancing farmers and producers access to markets and information on farming techniques and practices;

- Improving dissemination of and access to scientific and technical information; and

- Enhancing access to statistics and other types of information for policy and decision-making.

A big challenge for the deployment of e-agriculture services is to make sure that relevant and localized content is made available. The content should be demand-driven and it would be more beneficial if developed jointly with the farmers. Another challenge is developing and sourcing content in local languages. For e-agriculture apps and platforms to be successful and reach a wide range of audience, they need to also have graphic support and should be able to cater to illiterate masses. Agri-insurance, micro insurance and mobile money transfers also need to be interoperable

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amongst large number of mobile financial service and mobile network operators, so that the mobile payment, mobile banking, mobile commerce and other services could be provided through safe and secure transactions in rural areas.

National governments, research institutions, academia and other e-agriculture community efforts should work towards establishing certain preconditions for ICT use in agriculture, e-agriculture development, e-service delivery model, e-agriculture information flow and e-content development landscape, delineation of e-services, development of affordable technological platforms or diffusion pathways and identification of tangible benefits are necessary but not sufficient conditions for successful e-agriculture development. Promoting e-value creation in e-agriculture service delivery across the agricultural value chain is a great challenge.

Other common challenges in implementing e-agriculture services are poor diffusion and awareness raising, ICT skills shortage in agriculture, wide diversity of ICT to learn, diverse languages and cultures, lack of robust e-agriculture curriculum on the continent, digital divide and rural infrastructural gaps, riskiness of agriculture, poverty dilemma, and lack of enabling policy environment.

e-Agriculture also involves providing crucial information to farmers and for agriculture information monitoring, water, soil conditions, crops, fruits conditions, as well as conditions of livestock are required to be monitored in real-time by many spatially distributed wireless sensors. This creates an infrastructural and technology challenge for remote areas where continuous monitoring could be interrupted due to technical snag. Farmlands are often in the scale of hundreds of hectares. The complexity of network organization and routing will be a challenge when the network scale becomes very large. Agriculture applications and remote sensors need the network to be functional for years, but the scarce energy on the sensor node can hardly afford this, especially when the network is large and the sensor has many data to forward. Network management, sensor devices, gateway devices and web portals and platforms for sharing of information and data could be difficult to manage in a sustained manner for a long period of time in areas of poor infrastructure and there could be issues related to the interoperability of platforms, services and products. The adverse weather will challenge the durability of the hardware. The growth of crops will block or affect the wireless links, causing the network working in a highly dynamic radio environment.

The development of ICT infrastructure, literacy rate, lack of commitment from leaders, human resources, development issues, political instabilities, legal and standardization issues, etc. are mentioned as the major challenges in the implementation of e-agriculture services. There could be standardization challenges: local language issue, the process itself of standardization, lack of trained manpower in the area, enforcement of the standards, coordination of major stakeholders, etc. The stakeholders that are involved in the process of standardization and preparation of legal framework don't have equal sense about the importance and urgency of the standards and legal frameworks and their approval and enforcement. Other challenges could be building a cost effective agriculture information dissemination system to disseminate expert agriculture knowledge to farming community, governments at times map restriction policies for remote sensing and geographical information systems and this can impose as an impediment for implementation of e-services.

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Capacity building at a local level, need service gaps, building learning culture amongst communities, rural literacy level and ability to use right and interoperable technology platforms and sharing information through web portals and servers, region specific and community specific needs, what farmers need ICT solutions for?, are areas for e-agriculture development agencies to ponder about. Interoperability of services and products is imperative as billions of people in the world belong to agrarian societies with similar need for technology for efficient food production and safety.

8   New Standardization Activity for the ITU-T

For more details, please refer to the Deliverable D2 on '**New Standardization Activity for the ITU-T and ICT Innovation Panel**[30].'

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[30] New Standardization Activity for the ITU-T and ICT Innovation Panel; Deliverable D2 of FG Innovation, Dr. Ramy Ahmed Fathy, NTRA Egypt, FG-Innovation Vice Chairman.