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# **Innovation and Best Practice in Mobile Technologies for Development**

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## Abbreviations

ACF	Action Contre la Faim (Action Against Hunger)
ARV	Antiretroviral Drugs
CBK	Central Bank of Kenya
DFID	Department for International Development
FDI	Foreign Direct Investments
GDP	Gross Domestic Product
ICTs	Information and Communication Technologies
ICRIER	Indian Council for Research on International Economic Relations
INFSS	Integrated Nutrition and Food Security Surveillance
LDCs	Less-Developed Countries
MDGs	Millennium Development Goals
MPA	Mobile Product Authentication
SIM	Subscriber Identity Module
SMS	Short Message Service
UNDP	United Nations Development Programme
UIS	UNESCO Institute of Statistics
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNODC	United Nations Office on Drugs and Crime

# 1 Introduction/Overview

This paper is a review of innovation in the ICT entrepreneurship/mobile internet/mobile related applications space. The paper aims to identify best practice in stimulating innovation in developing countries.

## Definitions of Innovation

We use the standard definitions provided by the UNESCO Institute of Statistics (UIS 2011) of both product innovation and process innovation:

**Product innovation:** “the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses”

**Process innovation:** “the implementation of a new or significantly improved production or delivery method”.

Definitions of innovation in products and processes do not solely refer to the role of technology: all industries can feature innovative dynamics, independently of their degree of technological penetration. Association between innovation and economic prosperity is a mainstream theme in the development field; however, empirical analyses are difficult to perform due to difficulty in measuring a cross-industrial process like innovation.<sup>1</sup>

Our objective is to identify best practice in stimulating innovation in developing countries with a focus on the industry of information and communication technologies. We will examine cases where ICT-based industries have contributed to economic prosperity, as well as other positive life standards ranging from health to education and good governance (UNDP 2001).

This report specifically focuses on the composite sphere constituted by the “ICT entrepreneurship/mobile internet/mobile related applications space”. The focus on innovation in mobile technologies, as developed and adopted in developing nations, is motivated by (1) the massive uptake of mobile telephony in the South, which has increased access dramatically, and (2) the strong association between adoption of mobile phones and increases in national prosperity/economic growth/key dimensions in social development (Vodafone 2005, Qiang and Rossotto 2008, Vodafone and ICRIER 2009). It is mobile telephony which has the capability of determining a sea-change in the lives of people in the global South.

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<sup>1</sup> A report by UIS (2011) performs the specific tasks of “measuring innovation” in a sub-set of low- and middle-income countries, in order to establish the specific contributions of this process to dynamics in development. However, there are two significant limitations here, constituted by (1) limitation of the focus to the sector of low-tech manufacture, and (2) availability of selected indicators for a very restricted number of nations. Therefore, results by UIS (2011) find limited usage here, due to our attention to high-tech sectors and our global perspective on the developing world.

## Types of 'ICT'

This report focuses on mobile technologies. Raw data on technological penetration reveal that computers, despite a fair degree of diffusion in developing nations, are not in the hands of most of the poor.<sup>2</sup> The real ICT revolution is in mobile phones and their degree of global penetration: “no other technology has been in the hands of so many people in so many countries in such a short period of time” (World Bank 2008). Between 2000-2010, the number of mobile subscriptions in low- and middle-income countries increased from 4 to 72 per 100 inhabitants (figure 1); the likelihood of poorer people owning a mobile phone today, and the potential to exploit the developmental impact of this technology, is remarkably higher than before.

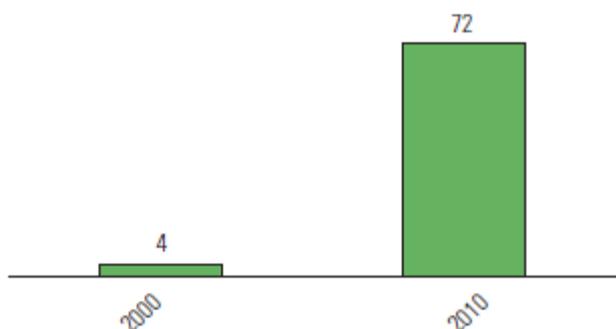


Figure 1: Mobile subscriptions (per 100 people), low- and middle-income economies  
Source: World Bank (2012: p.12)

We provide a focus on Kenya, well-known for its remarkable success in M-PESA, a platform for the mobile transfer of money developed through a local network provider (Safaricom). Little is known about direct support to the development of mobile applications, which could build on the success of M-PESA and expand the role of mobiles in achieving other dimensions of development.

This review is structured as follows: first, we provide a global vision of the main facts and figures in terms of mobile innovation for development. Second, we look at mobile innovation that is relevant for Kenya, in three phases: initially, we focus on existing best practice, and in particular on the lessons learnt through M-PESA in mobile banking and finance. Then, we look at innovation that is still to be developed, primarily in the sectors of mobile health and agriculture. Third, we look at relevant policy implications, which may help entrepreneurs and donors concerned with innovation in Kenya, as well as the government in tailoring its policy choices.

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<sup>2</sup> Leaving aside telecentres, a concept taken to loosely define all those public premises on which people can access ICTs, with particular focus on the developing countries (Roman and Colle 2003), which have been hailed as one of the most powerful technologies, in terms of making access to ICTs available to poorer people in remote regions of the world. The fixed structure, and the high cost of investment underlying telecentres are all bypassed by the mobile architecture, whose dynamics and developmental potential are at the centre of the present report.

## 2 Facts and Figures: Mobile Technologies for Development

This overview provides the context of mobile technology over recent years.

1. *Mobile adoption in developing countries has increased dramatically over the last decade.* This is true both in absolute terms and when comparing mobile adoption in less-developed countries (LDCs) with adoption of the same technologies in industrialized nations. The very quick diffusion of mobile technologies over the last 10-15 years is unprecedented (World Bank 2008); UNDP estimates indicate that, out of the 5.4 billion global mobile phone subscriptions, over 483 million come from low-income countries, and 2.6 billion from lower-middle-income nations (UNDP 2012: 11). The rate of growth of mobile subscriptions in LDCs is faster than in the industrialized world: compound annual growth rates in mobile subscriptions for 2000-2010 displayed a rate of 70% in South Asia, and of 42% in Sub-Saharan Africa, whereas that figure is reported as just 14.1% in Europe and Central Asia, and 9% in North America (figure 2).

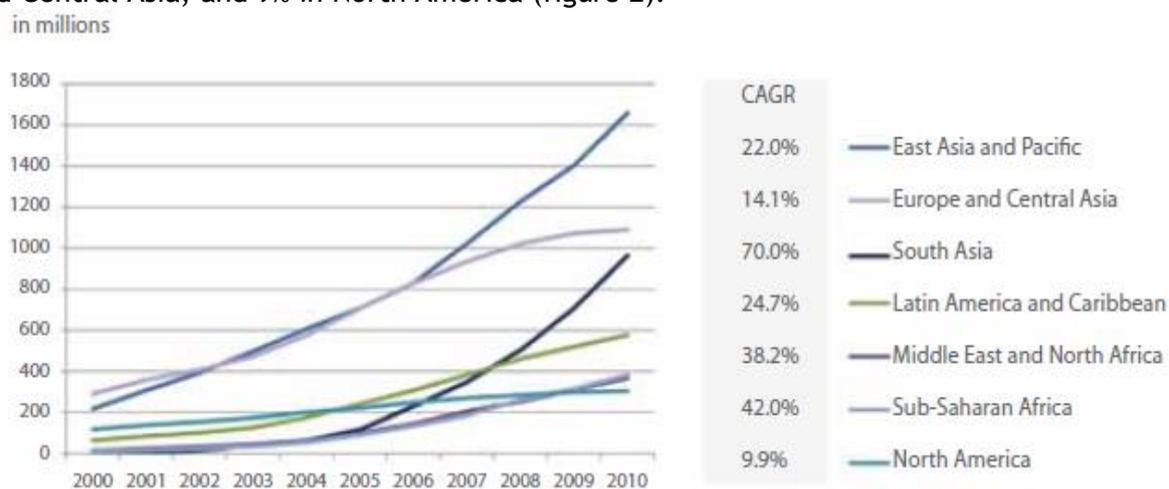


Figure 2: Mobile Subscriptions Trend by Region (2000-2010)  
Source: UNDP (2012: p.14)

There are, as noted by the World Bank (2012: 11), a set of enabling factors, which contributed to achieving this result. Firstly, adoption of mobile phones is concentrated in the youth and the age profile of developing nations is younger than that of developed countries: those under age 15 make up 29% of the population in low and middle-income economies, but just 17% in high-income nations (World Bank 2012: 12). Secondly, incomes in low-and middle-income nations tripled between 2000 and 2010 (figure 3) so more people can afford mobile phones. Thirdly, as noted by a report from Aker and Mbiti (2010), mobile technologies are often viewed as an alternative to landlines, which, in developing contexts, is an expensive and difficult solution: the “linear development” achieved in the Western world, shifting from landlines to mobile phones, has been by and large substituted by a “leapfrogging” dynamic, where the “landline phase” has been skipped. A report from ITU (2009) reveals the presence of 10 times as many mobile phones as landlines in Sub-Saharan Africa - a divide that, as of the trends outlined above, might have deepened over the last years.

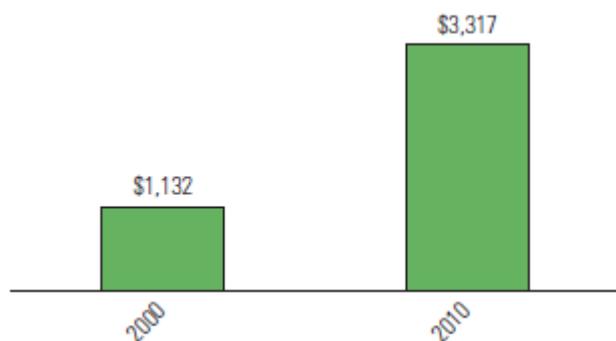


Figure 3: GNI per capita (current US\$, low-and middle-income economies)  
Source: World Bank 2012 (p.11)

The dramatic increase in the adoption of mobile phones takes different forms in different contexts. For example Zuckerman (2009) notes that the number of mobile subscriptions does not necessarily coincide with the number of people actually owning a mobile phone; one person may be the owner of several SIM cards, and conversely, several people may share ownership of one handset (a common practice in many villages of Sub-Saharan Africa). Estimates indicate that over 10% of the global population, and 40% of people in the LDCs, are not covered by mobile networks (Blackman and Srivastava 2011). Still, the dramatic increase in the adoption of mobiles in developing contexts remains significant.

2. *The rise in mobile penetration is strongly associated with economic growth.*<sup>3</sup> A Vodafone report indicated that, between 1996 and 2003, developing countries with an average of ten or more mobile phones per 100 people enjoyed a 0.59% higher per capita GDP growth than similar countries with less mobile penetration (Vodafone 2005). An even higher impact is reported by Qiang and Rossotto (2009), who find an association between a 10% increase in mobile penetration, and a 0.8% increase in economic growth. Similar results are obtained when we look at the impact of mobile penetration on specific local zones: an analysis of the Indian market, jointly performed by Vodafone and ICRIER (2009), reports correspondence between mobile adoption in diverse Indian states, and the rates of economic growth in the same states.

Industry reports point out diverse channels of connection between these phenomena: the first is tax revenues derived from the telecommunication industry. A multi-country analysis conducted by Deloitte (2008) on six emerging markets shows that mobile operators accounted for about 26% of total tax revenues.

Secondly, a well-functioning mobile industry is able to foster competitiveness, primarily through the attraction of foreign direct investments (FDI). Positive association between mobile adoption and FDI is found by several studies, cited by the World Bank in its 2012 report (Lane et al. 2006, Williams 2005). Thirdly, these dynamics act positively upon job creation: not only in the mobile industry, but also in other formal sectors, fostered by the spillovers that a thriving telecommunications industry generates. The micro-dynamics of market efficiency (below) give a specific economic rationale for these dynamics.

3. *The rise in mobile penetration is significantly correlated with higher market efficiency.* According to the report by Aker and Mbiti (2010), there are several mechanisms behind improvements due to mobile adoption: mobile coverage reduces price disparities

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<sup>3</sup> We refer to “association”, and not to “causation”, due to the problems of causal attribution that may be encountered here.

across markets, improves both consumers' and producers' welfare, improves entrepreneurs' behaviour, and promotes employment:

- Jensen (2007), in his well-known study on the effects of mobile phones on the fisheries sector in Kerala, southern India, finds that the expansion of mobile services significantly reduces disparities in fish prices across markets. This is because mobile phones are capable of reducing informational asymmetries, making fishermen aware of real prices on markets, enabling them to negotiate better selling conditions. He also finds welfare improvements for both consumers and producers: fishermen's profits increased by 8%, consumer prices decreased by 4%, and overall consumer surplus augmented by 6%.
- Aker (2008), in a study that examines the impact of mobile phones on grain markets in Niger, finds that the introduction of these technologies reduces the dispersion of grain prices by almost 10%.<sup>4</sup> She argues that adoption of mobile phones tends to change the behaviour of middlemen because mobile phones allow farmers to search over a greater number of markets and make marketing choices that are not possible without mobiles. Mobile technologies seem to improve farmers' behaviour too, yielding a positive impact on the market as a whole.
- Klonner and Nolen (2008) examine the effect of mobile phone coverage on rural labour markets in South Africa. The authors report positive association between mobile phone coverage and employment while studying markets where mobile phone towers are placed nearby, and find that most of this effect is due to increased employment by women. They also find a significant shift in occupational patterns as with the availability of mobile phone coverage employment moves away from agricultural jobs.

Most studies report that mobile phone coverage is positively associated with economic growth, but also with increases in the health of the economy, epitomized by market efficiency and its micro-level mechanisms. These data need to be read in the light of the caveat that association does not imply causation.

*4. When adopted, mobile finance has caused major changes in local banking systems.* There are a plethora of sectors that have been profoundly changed by the advent of mobile technologies: mobile phones have been reported to enable telemedicine and m-health applications, allow close monitoring of governance dynamics, and improve connections between agents across all sides of national economies. Mobile banking is the one sector that has influenced financial transactions profoundly, fundamentally reshaping the industry. Mobile financial applications took shape around a decade ago, and allow several tasks such as utilizing mobile accounts to send and withdraw money, pay bills, transfer money between individuals, and purchasing airtime (Morawczynski and Pickens 2009).

M-PESA was started in Kenya in 2007 and, due to its perceived ease of use (and other factors which will be reviewed later), was adopted at rapid rates across the entire nation. The Kenyan financial system has been revolutionized by M-PESA, which has filled the gap created by the absence of a banking system for the poor (Mas and Radcliffe 2010); where there was no banking system in place, mobile services have created one specifically suited to the patterns of domestic migration and internal remittances in Kenya.

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<sup>4</sup> As noted in the report by Aker and Mbiti (2010: 13), the magnitude of the dispersion effect is higher in Jensen's study on the fisheries industry, than in Aker's on the grains sector. However, the effect found in the latter paper is perhaps more surprising than that found in the former, due to the less perishable nature of grains as compared to fish.

5. The mobile industry, and its market dynamics, has been significantly changed by the advent of smartphones. As reported in the raw data by Gartner (2012), worldwide smartphone sales witnessed a dramatic increase in 2012. Worldwide sales of smartphones to end users have increased by 149 million units in the fourth quarter of 2011, with respect to the same quarter in 2010. What is relevant here is not only the major rise in sales in absolute terms, but the very high increase in the number of smartphones sold, as a share of mobile handsets (31%). This means that smartphones, with new, Internet-based features, are increasingly dominating the global market for mobile phones.

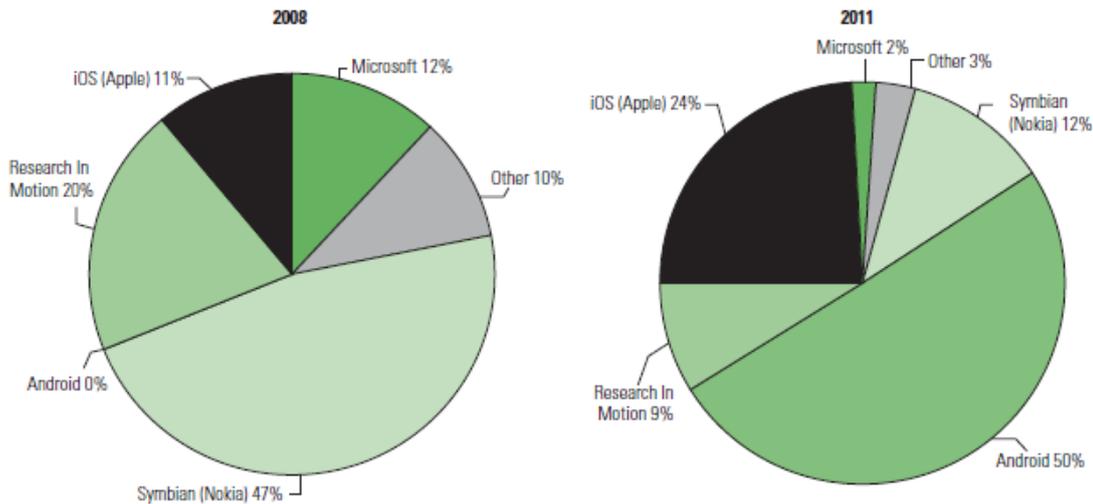


Figure 4: Changing Market Shares of Mobile Handset Sales by Operating System  
 Source: World Bank (2012, p.21, adapted from Gartner 2012)

The result, as reported in figure 4, is a massive change in mobile handset sales in terms of underlying operating systems: Symbian, underpinning Nokia devices, held 48% global market share in 2008, which was reduced to a meagre 12% three years later, when Android achieved market domination with 50% market share. With increasing market share held by smartphones has come a rapid increase in applications and the potential to extend mobile telephony into new areas.

### 3 Best Practice in Mobile Innovation for Development: Mobile Banking in Kenya

Having reviewed the main facts and figures for this industry, we now identify examples of best practice in the field of innovation for development, with specific attention to mobile technologies. In the first example Kenya already displays a highly recognized example of best practice: Kenya has seen the development and massive adoption of M-PESA, a system aimed at sending and withdrawing money from mobile-based accounts (M stands for “mobile”, and “pesa” means “money” in Swahili).

Figure 5 shows the data collected through FinAccess surveys conducted in Kenya in 2006 before M-PESA was started, and in 2009, two years after its launch. These surveys capture the raw data related to the mobile industry as a whole and indicate that mobile access and usage in Kenya in 2006 was already relatively high for a developing nation: this factor was perhaps why mobile banking was feasible and suitable for the local population. And still M-PESA would probably not have been so successful if the system was not aimed at filling a specific, well-defined gap in the market: the platform was, as reported by its creators, designed specifically for people who had no access to conventional banking, who constituted a large share of the demand for financial services in the nation (Hughes and Lonie 2007). The main features of the M-PESA platform make it adoptable by all those owning a mobile, as its functions are unrelated from conventional bank accounts, and can be entirely performed through mobiles.<sup>5</sup>

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<sup>5</sup> Transactions in M-PESA are not confined to mobile accounts, but can also be performed in a cross-sectoral way, from M-PESA to unbanked individuals. In that case, recipients have to purchase a one-time M-PESA voucher, and use it for withdrawing money. However, due to the regularity implicit in patterns of money flows under M-PESA, this system is comparatively less used, with respect to the one constituted by mobile-to-mobile transactions (Morawczynski and Pickens 2009).

	2006	2009
	Mean	Mean
Has Mobile Phone	0.272	0.467
Shares Mobile Phone	0.266	0.334
Has Mobile Phone Access	0.537	0.801
Has Landline	0.028	0.021
Has Multiple SIM Cards	.	0.081
Transfers Airtime	0.208	0.350
Sends Text Messages	0.292	0.411
Buys Ringtones	0.079	0.090
Uses phone to surf Web	.	0.050
Pays Bills by Phone	.	0.036
M-Pesa User	.	0.383
M-Pesa recipient	.	0.339
M-Pesa sender	.	0.291
Age 25 to 39	0.393	0.375
Age 40 to 54	0.213	0.224
Age Over 55	0.145	0.183
Male	0.440	0.413
Married	0.610	0.602
Completed Primary	0.314	0.315
Completed Secondary	0.161	0.165
Completed College	0.089	0.085
Has bank account	0.165	0.244
Urban	0.319	0.285
No of observations	4,418	6,598

Notes: Data from FinAccess 2006 and 2009 Surveys in Kenya. "-" implies that the service was not available in 2006, and therefore there were no adopters.

Figure 5: Summary Statistics on Mobile Phone Adoption and Use in Kenya  
Source: FinAccess studies, reported in Centre for Global Development (2010: 43)

A simple, well-targeted product concept, coupled with high uptake by early adopters, has made it possible for M-PESA to register more than 20,000 clients over its first month of operation, significantly exceeding the objectives in its initial business plan (Hughes and Lonie 2007). The service, launched and subsequently supervised by a local network operator (Safaricom-Vodafone), allows users to purchase airtime, pay bills, send and withdraw money from mobile accounts. Reasons for adoption can be classified under the three factors of cost, trust, and network effects, analysed by Morawczynski and Pickens (2009). Users are charged a small fee for transacting money with M-PESA; small when compared with money transfer through Western Union, and the riskier alternative of physical transport by buses and *matatus*, privately-run minivans. Secondly, trust is essential. In a study conducted by Morawczynski and Miscione (2010), trust in M-PESA is focused primarily on institutional operators, rather than interpersonal agents, e.g. Safaricom has maintained its reputation as a reliable network operator. Thirdly, network effects matter profoundly here, as the M-PESA concept is specifically tailored for those individuals that send money from urban centres, to their families and relatives in the countryside: adoption of M-PESA by the household breadwinner in the city tends to mean

adoption of the system from their family members, who receive money flows from them on a regular basis.

Lessons to be learned from M-PESA have been outlined by Mas and Radcliffe (2010):

*1. Recognition - and exploitation - of a strong latent demand for domestic remittances.* As mentioned above, Kenya is a nation characterized by an identifiable pattern of internal migration, wherein the household's breadwinner operating in urban centres sending money to his or her extended family in the villages. At the beginning of the project, it was estimated that 17% of families in Kenya depend on remittances as their primary source of income (FSD 2009); this is due both to domestic migration and to Kenyan conceptions of family as an ethnic rather than national. The strength and nature of this linkage led to a consolidated pattern of money transfer: this, coupled with underdevelopment of the banking sector, has created the window of opportunity in which the M-PESA product was strategically positioned. To this we would add that it took initiative and the capacity/willingness to innovate on the part of a private sector body - Safaricom - to take advantage of this demand.

*2. Presence of a supportive and collaborative banking regulator.* The M-PESA platform concept was created by two innovators from the UK, Nick Hughes and Susie Lonie, who believed it possible to use mobile phones to make banking services available to the rural poor. The idea was explored and enabled by Safaricom in Kenya, but, crucially, it was permitted by the proactive, supportive behavior of a key regulator (the Central Bank of Kenya (CBK)) which limited its interventions to close monitoring and formalized specific regulations at a later stage of product development. By approaching regulation in a cautious and gradual way, the CBK has shown awareness of the fact that premature regulation may stifle innovation and has partnered with the innovator to prevent negative effects.

*3. Proactive support by international donors.* In the whole process of creation and development of M-PESA, international donors - primarily DFID - have played a major role in enabling key phases in the development of the project. Firstly, DFID financed the first FinAccess surveys mentioned above, which revealed the state-of-the art of mobile technologies in the nation, and uncovered the gap in terms of mobile banking services that Kenya displayed. Secondly, it has funded Vodafone in order for the M-PESA concept to be tested, and for it to be tailored to the specific needs of Kenya. The mobile market in Kenya already presented a structure that made it favourable to mobile banking (Safaricom firmly holds a dominating share in the market, and relatively low airtime commissions, which add to its recognition as a trustable provider), but flexibility by donors is also paramount, especially when the projects to be launched mark a radical rupture with previous systems.

These features have increasingly enabled M-PESA to "bank the unbanked" and reach the poorer segments of the population. Jack and Suri (2009) provide an analysis of the customer perspectives on M-PESA, focusing 2008 and 2009; they report that the share of below-poverty line users of M-PESA has moved, in that year, from 28% to 51%, the share of rural users from 29% to 59%, and that of previously unbanked population adopting the service has doubled, from 25% to 50%. The share of users reporting usage of M-PESA with the specific purpose of saving money has moved, in that time interval, from 12% to 22%: M-PESA seems to be at the root of a specific change in saving behavior, which makes the terrain for innovation even more fertile at the national level. The story of M-PESA constitutes a strong example of ICT entrepreneurship in developing nations.

## 4 Innovation in Mobile Technologies for Development: Sectors to Be Explored

The M-PESA story, with its impressive rates of uptake and its transformative effects on the local banking sector, displays many lessons to be learned. We now turn to sectors in Kenya where developmental innovation still needs to be maximized and that are prone to innovation based on mobile phone devices. These sectors need to satisfy the same requirement that has triggered the conception of M-PESA, including the presence of a strong market demand. The choice of focusing on mobile health and agriculture originated from the socio-economic profile of Kenya.

It is widely recognized that Kenya experiences poor health conditions and unreliable government capacity to cope with health crises.<sup>6</sup> The situation calls for major improvements in terms of public health through cost-efficient programmes that are able to reach the rural areas.

Secondly, as reported by PriceWaterhouseCoopers (2012), agriculture still constitutes the dominating sector in Kenya's economy, contributing around 30% of GDP, and despite the shifts in the patterns of job creation induced by industrial growth, accounting for 80% of national employment. Improvements in this sector have significant impacts in terms of national productivity and are also prone to generate externalities at the social level: agricultural employment tends to be concentrated in the rural areas, which are more likely to suffer from the problems of isolation and voicelessness. We therefore focus our attention on mobile applications for agriculture, or m-agriculture.

### 4.1. Best Practice in M-Health

Mobile systems and applications designed for the health sector tend to combine two factors. The first factor is health emergencies, from generally poor health conditions to massive crises induced by famine, epidemics or disasters. The second factor is massive rates of adoption and usage of mobiles in the developing world (as above). Here we review some examples of best practice in the field of m-health in developing countries, and identify a combination of factors capable of enabling the development of successful innovation in this field.

#### 4.1.1. Case Study 1: Sproxil Inc.

Sproxil Inc., now a global brand protection company, was founded as a start-up by Dr. Ashifi Gogo in 2009 for the purpose of developing an easily usable system of medicine verification. This venture, firstly piloted in Nigeria in 2010, has exploited market demand generated by a problematic segment of the pharmaceutical industry: counterfeit drugs. As reported by the UNODC (2010), counterfeit medicines account for a US\$1.6 billion annual market in Africa and Asia alone, with a prevalence rate between 10% and 30% in the

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<sup>6</sup> According to the Global Health Initiative, basic health conditions still constitute a major problem in the country: the HIV prevalence rate is 6.3%, one woman out of 39 still dies of childbirth, and tropical infections still represent a global burden for the nation. <http://www.globalpost.com/dispatch/news/health/110504/healing-the-world-kenya>, accessed 15th February 2013.

developing world.<sup>7</sup> In the global South, counterfeit medicines are estimated to cost the industry \$75 billion a year.<sup>8</sup> In order to tackle this massive-scale problem, Dr. Gogo developed a verification application that enables end-users to verify the authenticity of medicines.



Figure 6: Sproxil's SMS Verification Service

Source: <http://mobihealthnews.com/18348/sproxil-deal-offers-free-mobile-drug-authentication-in-17-african-countries/>, accessed 26<sup>th</sup> February 2013

This application, known as Mobile Product Authentication (MPA) technology, is now the world's only patented consumer SMS verification service conducted and enabled via mobile phones. The application (figure 6) is very easy to use: consumers simply scratch a label on the packaging and text an identification code to a toll-free phone number, to verify if a medicine is authentic. The system automatically sends an SMS in response, instantly received by the user, which indicates whether or not a drug is legitimate. This system is the first national mobile-based anti-counterfeit service in Africa and has already sold millions of anti-counterfeit labels.

Sproxil piloted its mobile verification application between February and May 2010 in Nigeria, a nation characterized by an environment that presented, at least, two remarkable elements of fertility for innovation in this field: proactivity of the government in the fight against drugs, and a high degree of mobile penetration and usage. Now, Sproxil is selling its application directly to pharmaceutical companies, drug manufacturers and distributors. Success of the application has triggered massive donor funding: recently, the company has received \$1.8 million from Acumen to kickstart the technology in India, as well as in several East African countries - including Kenya.<sup>9</sup> A simple business concept, a gap in the market and donor proactivity at several stages of project development are at the root of the success of Sproxil, now ranked no.1 in the Fast Company's List of "Most Innovative Companies in Healthcare".<sup>10</sup>

<sup>7</sup> <http://www.businesscalltoaction.org/news-highlights/2012/02/now-available-bcta-case-study-on-sproxil/>, accessed 16<sup>th</sup> February 2013.

<sup>8</sup> <http://www.sproxil.com/for-the-press.html>, accessed 26<sup>th</sup> February 2012.

<sup>9</sup> <http://www.pharmabiz.com/PrintArticle.aspx?aid=63625&sid=1>, accessed 16<sup>th</sup> February 2013

<sup>10</sup> <http://www.sproxil.com/blog>, accessed 16<sup>th</sup> February 2013

Rates of adoption are extremely high: Sproxil's drug anti-counterfeiting technology, now operated in five different countries, has reached 1 million users in January 2012.<sup>11</sup> Such a massive rate of adoption, and the trust demonstrated by global institutions for mobile health (which have corroborated the success of Sproxil with numerous prestigious prizes),<sup>12</sup> make it possible for Sproxil to generate a real impact in reducing the market for counterfeited products.

#### 4.1.2. Case Study 2: RapidSMS

RapidSMS in Malawi is a technology that has been adopted as a result of the 2002 famine. To cope with the dire situation generated at that time, a set of partners - including UNICEF, the European Union, and Action Contre la Faim (ACF), supported by the Malawi government - developed a system known as the Integrated Nutrition and Food Security Surveillance (INFSS), aimed at monitoring basic health and nutrition indicators in children all over the country. Children are randomly selected from the population of children visiting medical centres, and monitored every month for one year. However, the INFSS system faced several serious challenges such as poor quality of data, delays in transmission, and high operational costs of maintenance and data entry.

As a result, the Malawi RapidSMS platform was designed to replace the paper-based system by transmitting nutrition data via SMS. Using RapidSMS, health workers can transmit information to healthcare centres quickly and easily, maximising efficiency and minimising data entry. RapidSMS substitutes a one-way flow of information with a two-way one, which enables experts to analyse data, identify children at risk, and provide information to staff in the field. Again, it seems here that the success of this mobile-enabled platform has been achieved because of a specific set of ingredients: a strong market demand (rendered stronger by the famine crisis), government support in the form of proactive coordination of efforts, and the collaborative presence of a well-coordinated and supportive board of donors.

In terms of outcomes, the adoption of RapidSMS has had impressive effects on speed of data transmission, magnitude of errors, and the reduction of operation costs. Thanks to this new technology, "transmission times that previously took from two to three months were reduced to an average of two minutes: this is essentially 64,800 times faster than the paper-based system".<sup>13</sup> Moreover, as mentioned above, there has been a dramatic decrease in data entry errors, which were reduced from an estimated 14.2% to 2.8% with the introduction of the system. Finally, the need for centrally-based full-time staff dedicated to manually inputting the data was eliminated, along with the high cost of transporting the documents, resulting in a massive reduction in operational costs, which leaves more resources available for further technology development and diffusion.<sup>14</sup>

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<sup>11</sup> <http://www.sproxil.com/for-the-press.html>, accessed 26<sup>th</sup> February 2012.

<sup>12</sup> <http://www.sproxil.com/awards-and-recognition.html>, accessed 26<sup>th</sup> February 2012.

<sup>13</sup> <http://www.rapidsms.org/case-studies/malawi-nutritional-surveillance/>, accessed 18<sup>th</sup> February 2013

<sup>14</sup> <http://www.rapidsms.org/case-studies/malawi-nutritional-surveillance/>, accessed 18<sup>th</sup> February 2013

### 4.1.3. Case Study 3: WelTel Kenya1

WelTel Kenya1, unlike the cases above, does not focus on a business or donor-created operation in mobile pharma, but on a clinical trial centred on a technology that is yet to be scaled up. The system, described in detail by Lester et al. (2010), consists in the automatic submission of text messages to HIV-affected patients that remind them to take their anti-retroviral (ARV) drugs. Patients in the SMS group received, and were expected to respond to, weekly text messages that asked about their general wellbeing. If a patient reported a problem or did not reply within 48 hours, a follow-up phone call was made by a health provider.

The development of this technology builds on increasing access to antiretroviral treatment across sub-Saharan Africa. Lester et al. reveal that ARV treatment has now been started by nearly 3 million people in the area, an increase of almost 30 times since 2003. The programme, devised to reach a population where HIV prevalence is now estimated at 6.3%, seems cost-effective: the estimated cost of less than \$8 per patient per year, compared with the alternative constituted by second-line therapy. A clinical trial like the one above is, therefore, capable of expanding the very concept of innovation, from an exclusively private-entrepreneurial domain to a broader one, of interest to public health providers in developing nations.

Results of the study fall in two macro areas: namely, self-reported adherence to the programme, and suppression of plasma HIV-1 viral load, a parameter related to the severity of the virus' effect. On the former, WelTel Kenya1 has registered a high and significant impact on self-reported adherence (participants were termed as adherent if they reported taking more than 95% of the provided pills, at both the follow-up visits that were set up at 6 and 12 months from the beginning). Even if, as the authors highlight, "self-reported adherence" is a parameter that tends to overestimate adherence, the increase here is large enough to suggest that this technology has had a positive impact. On the latter, reduction in viral load (as a result of better usage of ARV) has also been achieved.

### 4.1.4. Lessons from Best Practice in M-Health

The case studies outlined here tell three different stories of mobile innovation for the health sector, focusing respectively on a private-sector innovator, a donor-designed application, and the clinical trial of a potential innovation in public health. There are, however, common ingredients for innovation. First, all three examples of best practice have responded to strong market demand, driven by pressing problems like counterfeited medicines, famine, and HIV/AIDS prevalence respectively. Secondly, the role of the government is of paramount importance, as an "innovation champion" in the case of the fight against counterfeited medicines, or as a proactive promoter of public health initiatives as in the cases of RapidSMS and WelTel Kenya1. Donors have played an important role in translating innovation concepts into reality. It is with these lessons in mind that we should look at m-health, a sector on which Kenya, with its impressive rates of mobile penetration, can leverage highly in order to reach global development goals in terms of improvements in health<sup>15</sup>.

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Besides constituting a basic component of the main indicators of human development health is also related to Millennium Development Goals 4, 5 and 6, focused respectively on reducing child mortality rates, improving maternal health, and combating HIV/AIDS, malaria and other diseases. Innovation can be tailored, as noted by the World Bank (2012), to development projects specifically

## 4.2. Best Practice in M-Agriculture

As noted above, mobile technologies have enormous potential for improving market dynamics - as well as consumers' and producers' welfare - in the agricultural sector in Kenya. This is due, once again, to the combination of a supply and a demand factor: on the one hand, mobile penetration is extremely high in the nation, even in the rural regions, where agricultural and farming activities are concentrated. On the other hand, demand for improvements in the agricultural sectors is boosted by the predominant role of agriculture in the national economy, coupled with a problematic situation in terms of food security: Kenya features asymmetric agricultural endowments, resulting in internal food shortages that could be alleviated by better management of the agricultural supply chain. Experiences from the developing world at large, including Sub-Saharan Africa, show that mobile technologies can effectively pursue these improvements. Below we review a set of examples of best practice in this field.

### 4.2.1. Case Study 1: M-Farm Ltd.

There is a small set of new, successful Kenyan start-ups in mobile farming. An example is M-Farm Ltd., a “software solution and agribusiness company” whose product concept is based on the necessity of providing relevant, ready-to-use information to farmers across the nation as a whole. Developed in 2009 and led by Jamila Abass, M-Farm has started its operations with the mission of empowering Kenyan farmers, whose problems include misbehavior of middlemen with respect to the price of produce, ineffective mechanisms for information on market prices, and the relatively high cost of farm inputs.

To alleviate these problems, the company developed an SMS-based technology, through which farmers only need to send an SMS, to access several services in m-farming: they can get information pertaining to the retail price of their output, buy their farm inputs directly from manufacturers at favorable prices, and be matched with optimal buyers for their products. The product was designed to address informational asymmetry and a lack of coordination, which minimize the bargaining power of farmers in their interaction with middlemen. By providing a SMS-based technology for information and communication, M-Farm attempts to provide an easily accessible solution to the problem: the platform also enables farmers to sell collectively, and aggregate their orders when they need to connect with farm input suppliers.

The rates of adoption of the M-Farm platform are remarkable, especially for a new venture focused on the specific segment of the national farming community. As reported by CEO Jamila Abass, M-Farm recruited more than 3000 subscribers (adding to the initial 2000) in the first month after that project was launched. Abass reports that most of the individuals subscribing to M-Farm doubled their profits as a result of the application, and created new, stable market relations with other customers of the same platform.<sup>16</sup>

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aimed at reaching these goals: for example, the RapidSMS case cited above is aimed at the improvement of child health and nutrition, and therefore relates directly to MDG no. 4, as well as to no.1 (eradicating global poverty and hunger). The case of WelTel Kenya1, aimed at combating HIV/AIDS as per MDG no.6, constitutes remarkable progress towards the use of mobiles in this field, given its capability of acting on *therapy* - rather than solely on prevention, as many ICT-based toolkits deployed in the past. The MDGs constitute, therefore, a useful framework to tailor development projects, and to establish specific targets for mobile-based intervention.

<sup>16</sup> <http://unreasonableinstitute.org/profile/jabass/>, accessed 27<sup>th</sup> February 2013

#### 4.2.2. Case Study 2: M-Krishi - TCS' Mobile Agro-Advisory Service

Conceived in 2006, for agents operating in agricultural markets in India, M-Krishi (“M” stands for “Mobile”, and “Krishi” means “agriculture” in several Indian languages) is a mobile platform developed by Tata Consultancy Services (TCS), in order to provide personalized advice to farmers on low-end mobiles. This experience mirrors at least two of the traits that we have reviewed in the Sub-Saharan African context: firstly, the necessity of targeting agricultural markets as a specific segment of the economy, and secondly, the choice of providing a custom mobile app based on low-end technologies, due to the low propensity of developing county farmers to purchase high-tech mobiles. What makes the M-Krishi experience unique is that this platform provides *personalized* advice to farmers. As a result farmers gain access to information on the weather, soil, fertilizer and pesticides that correspond to their plot of land.

The initiative for M-Krishi stemmed from appraisal of farmers’ needs, which clearly addressed the necessity of an integrated system to answer specific queries. The product has been conceived as a mobile agro-advisory system that would allow farmers to send queries to agricultural experts in their local language, and receive information from them in the same language, overcoming the barrier of illiteracy often found with respect to ICT projects in developing nations.

The business impacts reported at M-Krishi are quite impressive: according to TCS, expert advice to farmers using the service has increased yield by 20%, and reduced pesticide costs by almost 40%. Furthermore, TCS reports increased awareness of farmers of new technologies such as Integrated Pest Management, which is likely to result in further yield increases. Further, seeing an opportunity to reduce costs, stakeholders approached the company to start paid pilots in order to reach more farmers.<sup>17</sup>

#### 4.2.3. Case Study 3: Intuit Fasal

Conceived in 2010, Intuit Fasal is an initiative in Bangalore, southern India, at the laboratories of Intuit, an American software company primarily focused on developing applications for small businesses. Deepa Bachu, the director of emerging market innovation at Intuit, developed the concept of Intuit Fasal (where Fasal means “harvest” in Hindi) in order to maximize the power of technology for optimizing agricultural markets in Karnataka. Fasal is a free SMS-based product that enables farmers to connect with potential buyers and to access real-time price information. Developed on the basis of an ad hoc algorithm, Fasal functions as a “basic supply-and-demand calculator”: once farmers have registered for the service, a profile of their produce and activity is captured, and the service starts sending personalized messages. The system knows when the farmer is ready to harvest, and starts providing several things: price information, advice on techniques and connection with potential local buyers.

What makes Fasal special is its capacity of exploiting the resources and intelligence of a global software innovator, traditionally focused on business segments, to develop agricultural markets in a developing nation. This service has reached more than 500,000

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<sup>17</sup> <http://www.bitc.org.uk/our-resources/case-studies/tata-consultancy-services-mkrishi-%E2%80%93-innovative-platform-deliver>, accessed 27<sup>th</sup> February 2013.

users who earn an average of 20% more income because of the technology.<sup>18</sup> Once again, the traits of innovation revealed above with respect to m-agriculture are portrayed by Fasal, whose complex algorithm does not need complex devices to be operated: simple mobile phones are sufficient for the use of this platform, whose informational activity is performed entirely through the use of voice message and SMS.

#### 4.2.4. Lessons From Best Practice in M-Agriculture

As compared to m-health, mobile applications for farming and agriculture seem more prone to bottom-up, independent entrepreneurship. In both sectors we see similar reasons for success: firstly, success of ventures seems to be built on specific characteristics of the local demand for m-services, or on the capability of identifying specific farmers' needs through personalization. Secondly, the regulatory/supportive role of governments makes the environment favorable and prone to the diffusion of innovation: moreover, capital funding by donors (as in the case of M-Farm) or by big developers in the industry (e.g. TCS and Intuit) is of paramount importance, to translate innovation concepts into reality. It is to be noted that, even though the health and agriculture sectors differ significantly, in both we see that demand-based entrepreneurship and local enablers of innovation processes are crucial in the development of successful mobile applications.

The role of private entrepreneurship in creating projects on m-agriculture in the developing world also makes it important to note that innovation expenses do not constitute fixed costs: instead, they increase over time, as products need commercialization to fully reach the market. These expenses can make it difficult for projects to become sustainable, and firms may not have sufficient resources to achieve commercialisation. Industry- and region-specific strategies are needed to maximize financial viability of innovation processes.

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<sup>18</sup> <http://www.fastcoexist.com/1679081/intuit-taps-text-messages-economics-to-boost-farmer-incomes-in-india>, accessed 18<sup>th</sup> February 2013.

## 5. Discussion: The Key Factors of Mobile Innovation in Developing Countries

In order to identify factors enabling mobile-based innovation in developing nations, with a specific focus on Kenya, we first reviewed the mobile banking and finance sector in Kenya which already shows an example of best practice where M-PESA is widely recognized as a powerful enabler of development. We then looked at two sectors where mobile-based best practice in Kenya is still to be developed: health and agriculture. The examples of best practice in the developing world, recounted here under the domains of m-health and m-agriculture, point towards a set of enabling factors for innovation both for Kenya and for developing contexts more broadly.

Cases of innovation for development, in m-banking, m-health, and m-agriculture, point towards the relevance of a set of “ingredients” that can be classified under the three macro-headings of market demand, government support, and donor intervention. It is the mutual interaction of these factors, persisting and consolidating over time, which has been at the root success. These factors can be detailed as follows:

- A specific and wide **market demand** for the innovation. M-PESA filled a gap left by conventional banking. In the health sector, emergencies and epidemics drive demand. The same feature is found, finally, in m-agriculture, where mobile applications are taken up by those customers that see the products as valuable, and capable of providing locally relevant content. A well-defined, urgent demand seems to be, therefore, a key factor at the root of developmental innovation as a whole.
- A **supportive government**, supervising the innovation process, tailoring regulation, and acting as an “innovation champion”. We have observed government support taking various shapes: in the mobile banking sector, the role of the banking regulator has been paramount, in refraining from strong regulation and maximizing the capacity of Safaricom to develop its product. Government support to m-health includes action to highlight the need for innovation (the Nigerian government has set itself as a first-line agent in the fight against counterfeited goods) and supervision (the government of Malawi with the board of donors involved in RapidSMS). M-agriculture is proactively fostered primarily by the Indian government, both at the central and at the state level, and m-government has been adopted in the national development strategy. Government support is essential in maximizing the power of innovation: these findings mirror that of standard economic literature (summarized in World Bank 2012a), but to that we add, here, the importance of considering the many forms of action that governmental support, when applied to innovation, can take in different developing contexts.
- A proactive, well-coordinated **donor intervention**, supporting innovation projects at all stages. Flexibility, trust, and consequent considerable investments, by donors are, at the root of practically all the experiences reviewed here: by DFID for M-PESA, by Acumen Fund for Sproxil, by Tech4Trade for M-Farm, and so forth. Donor action, other than providing the practical conditions to make innovation possible in the complicated contexts of developing countries, also represents a major source of trust-building for projects, which is a key factor for user adoption and for the development of a critical mass of customers. These considerations seem to identify proactive and coordinated

donor action as the third major ingredient needed for mobile-based innovation in the LDCs.

The major lesson drawn from research here is not just the existence of these factors but the identification of their **interaction** in the three-pronged system described above. While a well-defined market demand boosts the creation of successful products, government support and well-coordinated donor action constitute the main factors that enable the innovation process. Identifying market demand properly, and tailoring products to users' needs in specific contexts, is the main way to enact a virtuous circle of innovation that involves, if successful, all the main actors in the economy.

## 6. Conclusions

The query for this helpdesk review asked us to identify best practice in stimulating innovation in developing nations, with specific reference to Kenya. In this review, we have started by identifying innovation in mobile technologies for development, on the basis of evidence that mobile phones are the main technology owned by poorer people in developing nations. Having reviewed the main facts and figures on mobile technologies for development worldwide, we looked at best practice in Kenya, in particular mobile banking and the striking success of M-PESA. We then reviewed sectors where best practice, in Kenya, is still to be achieved: namely, m-health and m-agriculture, both of which feature high demand by the Kenyan population. For each of these sectors, we have identified a set of examples of best practice.

The main lesson extracted by this helpdesk review is exemplified by M-PESA. On the basis of this experience, innovation, if it is to be fostered in mobile technologies in developing countries, requires the presence of three factors: (1) a specific and wide **market demand** for innovation recognised by creative private sector actors taking initiative, (2) a **supportive government** coordinating the process, and (3) committed board of **international donors** supporting the innovation in all its phases. The first factor - demand - is present in Kenya, with reference to both health and agriculture, which have therefore been selected here as key areas in which Kenya can expand through mobile technologies. We have seen various case studies of best practice in these fields.

The second lesson is that on the one hand, best practice in m-health seems to leverage crucially on demand, and on the role of the government in facilitating innovation mechanisms. On the other hand, m-agriculture leaves more room for private entrepreneurship, and seems to entail high path-dependence with previous experiences of mobile-based development (the strong interrelation between M-PESA, and the entrepreneurial venture developed under M-Farm, is an example of these dynamics). Therefore, we conclude this report with the remark that innovation is cross-sectoral, and maintains this intrinsic feature even when “exported” into the imperfect markets that characterize developing nations.

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