

Creation, Deployment, Diffusion and Export of Sub-Saharan Africa-originated Information Technology-Related Innovations

By: [Nir Kshetri](#)

Kshetri, Nir (2016). "Creation, Deployment, Diffusion and Export of Sub-Saharan Africa-originated Information Technology-Related Innovations," *International Journal of Information Management*, 36(6), Part B, pp. 1274–1287.

Made available courtesy of Elsevier: <https://doi.org/10.1016/j.ijinfomgt.2016.09.003>

© 2016. This manuscript version is made available under the CC-BY-NC-ND 4.0 license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

***© Elsevier. Reprinted with permission. No further reproduction is authorized without written permission from Elsevier. This version of the document is not the version of record. Figures and/or pictures may be missing from this format of the document. ***

Abstract:

A number of high profile innovations have been created in Sub-Saharan Africa. In this paper, we examine the mechanisms associated with the development, deployment, diffusion, and export of SSA-originated innovations. The paper gives special consideration to the relative roles and contributions of local and outside resources in the creation and deployment of innovations in SSA economies. A key focus of the article is on the roles of local infrastructural facilities, systems and services in affecting the diffusion of SSA-originated innovations. Also discussed are the features of SSA-originated innovations that explain the diffusion rates. It provides a detailed analysis and description of the key characteristics of SSA-originated innovations that can increase the possibility of being internationalized or exported to other countries. Finally, we analyze how such mechanisms vary across large and small scale innovations.

Keywords: Information technology-related innovations | iCow | Large and small scale innovations | mPedigree | Sub-Saharan Africa

Article:

1. Introduction

While most firms based in Sub-Saharan Africa (SSA) tend to be mere adopters of innovations, a number of high profile innovations have been created in these economies. Some SSA-based firms have been especially recognized as being the creators of innovations with high degree of adaptability to SSA-specific circumstances. For instance, the Foreign Policy magazine conducted a survey with the world's top Internet experts on Internet-related innovations. 7% of the experts viewed Africa as "the most innovative place for Internet-related technology". The corresponding proportions for other regions and economies were: Europe: 4%; China: 4%; India: 7%; and

Pacific Rim: 5%. The experts viewed Africa's Internet-related innovations as: "On-the-ground solutions designed by communities for communities" (Foreign Policy, 2010).

There are also intriguing models of innovation deployment in SSA economies. For instance, consider the Ghanaian start up mPedigree, which uses mobile and web technologies to fight drug counterfeiting. To deal with the unpredictable and unreliable electricity supply in Ghana, mPedigree has located data centers on three continents. The company prints labels in China and India (Yeebo, 2015). SSA-originated innovations have also been exported to other countries. For instance, in 2010, EpiSurveyor, developed by programmers in Kenya, which uses the cloud and mobile phones, was reported to have about 8000 users in over 170 countries (mhealthinfo.org, 2010).

Before proceeding further, it is important to note that this study focuses on information technology related innovations. In this regard, prior research indicates that information infrastructures have economic, social (informal institutions) and political (formal institutions) dimensions (Bowker, 1996). However, prior researchers have not yet examined how economic, social and political factors affect the creation, deployment and exports of SSA-originated successful innovations. Also prior research has not studied the different features of an innovation that affect diffusion. It is also argued that an innovation's scale is important (Oosterhuis, 2006). Nonetheless, the literature has not adequately addressed the question of how the scale affects the ways innovations are created and deployed in SSA economies. Also, it is not clear whether SSA-originated innovations of different scales vary in terms of their potential to be exported and internationalized.

Viewing innovations as entrepreneurial activities, it can be argued that creation and deployment of innovations requires combining unconnected resources that reside in separated networks (Granovetter, 2005; Schumpeter, 1934). Prior research has not paid sufficient attention to the roles of resource flows across different networks in order for an innovation to be successful in the SSA context. Likewise, prior researchers have noted that industrialized world-based multinational corporations (MNCs) globalize their innovations in order to exploit technologies in foreign locations. These MNCs also collaborate with public and private institutions in foreign countries and generate innovations (Archibugi & Michie, 1997; Iammarino & Michie, 1998). This has also been the case with SSA economies. What is not clear is the relative role and contribution of local inputs and foreign companies in the creation and implementation of innovations in SSA economies.

In light of the concerns raised above, this study examines the following research questions: RQ1) What are the relative roles and contributions of local inputs and support and resources from outside in the creation and deployment of innovations in SSA economies?; RQ2) What are the features of SSA-originated innovations that affect diffusion rates?; RQ3) What are the key characteristics of SSA-originated innovations that can increase the possibility being internationalized or exported to other countries?

We employ multiple case studies of SSA-originated innovations to address the above research questions. We develop propositions that serve as the basis for a general model of SSA-originated

innovations to explain how such innovations are created, how they diffuse and what factors explain their exports.

Before proceeding, we offer some clarifying definitions. Small-scale innovations are innovations which affect only a given firm, industry, product or process and benefit a narrow group of consumers. Large scale innovations, on the other hand, have effects on complete socio-technical systems (Oosterhuis, 2006).

The paper is structured as follows. We proceed by first discussing the method employed in the paper. Next, we discuss case studies of representative SSA-originated innovations. Then, we develop theoretical propositions from the cases. It is followed by a section on discussion and implications. The final section provides concluding comments.

2. Method

The approach of this study can be described as theory building from multiple case studies, which is becoming increasingly popular in social science (Eisenhardt & Graebner, 2007; Kshetri, 2016). Compared to a single-case study, multiple-case studies are likely to provide a stronger base for theory building (Rowley, 2002; Yin, 1994).

Connection with related literatures, establishment of theoretical gap that exists in the literature, and explicit statement of research questions to address the gap are the key features of strong empirical research (Eisenhardt & Graebner, 2007). In qualitative research, it is also important to make a strong case for the importance of the research questions that have been raised (Bansal & Corley, 2012). We have established theoretical and practical importance of research on Africa-originated innovations.

There has been a good deal of debate on whether case research should be based on theory specified a priori or on grounded theory. Whyte (1984) argues that, to be valuable, research should be guided by "good ideas about how to focus the study and analyze those data" (p. 225). On the contrary, Glaser and Strauss (1967) suggested that evolution of a theory from the data is the basis for development of grounded theory rather than an imposition of a priori theory. Likewise, Van Maanen, Dabbs and Faulkner (1982, p. 16) suggested that investigators avoid prior commitment to any theory. In this study, we follow Whyte's approach. As such, we provide a theoretical framework related to factors driving innovations in SSA economies.

2.1. Selection of cases

Broadly speaking the selection of cases in multiple case study research has the same objectives as in random sampling. That is, the cases should represent the population and there needs to be a useful variation on the dimensions of theoretical interest (Seawright & Gerring, 2008). A key difference is that in a multiple case study design, the choice of cases needs to be made more on a substantive rather than statistical basis in order to adequately represent a target population (Greene & David, 1984).

First, it is important to make it clear that case selection is also guided by pragmatic, logistical and financial reasons (Seawright & Gerring, 2008). We selected only cases for which we could obtain sufficient information from secondary resources. Eisenhardt (1989) suggested that about seven cases would be ideal for building theory. Following this recommendation, we selected seven cases. In order to select the cases, we combined two methods: extreme case method, and diverse case method (Seawright & Gerring, 2008). More specifically, the process started with extreme case method and morphed over time with implementation of different requirements and recommendations.

In the extreme case method, cases with extreme values on the independent (X) or dependent (Y) variable of interest are selected (Seawright & Gerring, 2008). The innovations selected in this paper are extreme in the sense that they are among the most successful in SSA economies. That is, we did not choose any unsuccessful or average African innovations. Seawright and Gerring (2008) suggest that if the researcher has some idea about additional factors that might have effect on Y (the outcome of interest), it would be better to pursue other case selection methods.

Following this recommendation, we utilize a diverse case method as a strategy to select specific cases of successful innovations with diverse characteristics originated in SSA economies. A key objective in this method is to achieve maximum variance along relevant dimensions (Seawright & Gerring, 2008). This method requires the selection of two or more cases to represent the full range of values characterizing X, Y, or some relationship between these variables (Seawright & Gerring, 2008).

As to the factors affecting Y, especially the incorporation of local inputs and resources emerged as a key driving factor for most of the successful innovations. Regarding this observation, the founder of the African Institution of Technology and Chairman of Fasmicro Group, Ndubuisi Ekekwe put the issue this way: “Building the AI [artificial intelligence] models for the African consumer cannot be optimally driven by Silicon Valley vendors; rather, African universities and research institutes who understand the nuances of being an African are better positioned for this task” (Ekekwe, 2016, para. 13). The role of this factor is under-appreciated in prior studies focusing innovations originated in developing countries.

In order to achieve diversity, we selected cases with different combinations of scale and incorporation of local inputs. It is also worth noting that the variables related to the importance of local inputs and scale are continuous. As suggested by Seawright and Gerring (2008) for such variables, we chose cases that represent the four different combinations of the levels of scale and importance of local inputs as shown in Table 1.

Table 1. The cases selected and their classification in terms of incorporation of local inputs and scale.

Scale	deg. of incorporation of local inputs	
	High	Low
Large	M-Pesa EpiSurveyor	mPedigree

Small	Kilimo Salama Lula iCow	biNU
-------	-------------------------------	------

A further way to increase diversity would be to include cases that have various causal paths that link the related variables to a particular outcome. For instance, three different independent variables (X1, X2, and X3) may have effect on Y, but they may do so independently and in different ways (Seawright & Gerring, 2008). In addition to incorporation of local inputs (X1), two additional independent variables low cost and compatibility with basic infrastructures emerged as having effects on the dependent variable. The case selection process thus morphed as we moved forward and had a better understanding of the drivers of successful innovations in SSA economies.

Table 1 presents the cases selected and their classification in terms of incorporation of local inputs and scale. Three replicated cases have been used in which large-scale innovations were involved. While both M-Pesa and EpiSurveyor are considered to be large scale innovations with high degree of local inputs they focus on different target groups. For instance, EpiSurveyor’s target markets include individual researchers and organizations conducting surveys as opposed to the general population for M-Pesa. mPedigree relies less on local inputs. These replicated cases thus have high and low degrees of different attributes of interest.

Four replicated cases of small-scale innovations were selected. The target markets for iCow and Kilimo Salama (KS) are small-holder farmers. On the other hand, Lula’s target users are informal businesses. These two groups are likely to have different cost considerations. Local inputs played an important role in the design of Lula. On the other hand, for KS, local affiliates such as wholesalers, retailers, dealers, resellers and channel partners helped to promote insurance products and increase consumer acceptance of such products. As are the cases of large scale innovations noted above, the replicated cases of small-scale innovations also have high and low degrees of different attributes of interest.

2.2. Sources and characteristics of data

Prior researchers have identified various dimensions of data quality, which are central to obtaining valid and reliable results (Golder, 2000; Gottschalk, 1969; Jayawardene, Sadiq, Indulska, 2013; Loshin, 2001; Mason et al., 1997). For instance, Gottschalk (1969) suggested that the sources of evidence as well as the evidence need to be evaluated using criteria such as time elapsed between events and reporting, openness to corrections, range of knowledge and expertise of the person reporting the events, and corroboration from multiple sources. Regarding the last point, previous researchers have recommended that data and information be triangulated from multiple sources (Stavros & Westberg, 2009).

First, it is important to make it clear that this study mainly relies on archival data, which is among a variety of recognized data sources for case studies (Eisenhardt & Graebner, 2007). For instance, Ansari, Garud, Kumaraswam (2015) mainly relied on archival data sources to examine how the digital video recorder TiVo, dealt with the disruptor's dilemma by adjusting its strategy, technology platform, and relation with various players in the TV industry ecosystem. As noted

above, this choice is due to pragmatic, logistical and financial reasons (Seawright & Gerring, 2008) as well as consideration related to ease with which data can be located and gathered (Stvilia, Gasser, Twidale, Smith, 2007; Wang & Strong, 1996).

We made attempts to assess the coherence and internal consistency of the data. As suggested by prior researchers (HIQA, 2011), we evaluated coherence by comparing different data items for the same point in time and the same data items for different points in time. For instance, for the numbers of farmers insured by KS (Case 5), data from two sources were matched for 2013 (ifc.org, 2016; Kalan, 2013) and for 2014 (Acre Africa, 2015; businessGreen.com, 2016). Likewise, data were compared for 2011, 2013 and 2014 to ensure that there are logical patterns.

A key dimension of data quality is reputation and trustworthiness. The idea here is to make sure that the source as well as content of data are trustworthy (Wang & Strong, 1996). A related characteristic is objectivity. That is, the data are unbiased and impartial (Wang & Strong, 1996). This is related to accuracy or correctness. The goal is to make sure that the information is free from distortion and bias (Eppler, 2006). Another key point that must be considered is an accurate mapping of the real-world phenomenon (Price & Shanks, 2005). In order to achieve these various goals, among other things, as noted above, we corroborated data and information from multiple sources. We also mostly relied on information reported by reputable third parties instead of taking descriptions directly from the websites of organizations chosen. It minimized potential self-reporting bias.

Another consideration is the timeliness and currency of the data (Wang & Strong, 1996). Case study researchers need to make sure that the information is up to-date and not obsolete (Eppler, 2006). In this regard, we made sure that the age of the data was appropriate to study the cases selected. We followed the latest news items that were related to the cases chosen. In addition, we visited the websites of the relevant companies.

Table 2 provides brief explanation of organization and innovations selected in this study and presents the non-SSA organizations involved. We briefly explain them in this section.

Table 2. Organization and innovations selected in this study.

Case No.	Organization/Innovations	Brief explanation	Non-SSA organizations involved
1	mPedigree's GoldKeys (L)	Helps track fake drugs	Hewlett-Packard
2	iCow developed by Safaricom and Green Dreams (S)	Helps small-scale dairy farmers track and manage cows' fertility cycles.	The U.K.'s Indigo Trust
3	EpiSurveyor (L)	Uses the cloud and mobile phones for collecting and analyzing data.	The World Bank, the United Nation Foundation and the Vodafone Foundation

4	Safaricom. M-Pesa (L)	Enables cell phones to send and receive money	The U.K.'s Department for International Development
5	Kilimo Salama (S)	Developed a weather-based index insurance to serve a vulnerable market that traditional insurance schemes have ignored.	Syngenta Foundation for Sustainable Agriculture
6	Nomanini's Lula (S)	Generates and prints codes, which can be used to add minutes to mobile phones.	Runs on Google App Engine. Google also provides middleware and runtime-related services
7	biNu (L)	Free mobile software platform, which is used to access books.	Worldreader

L: Large scale, S: Small scale.

2.3. Brief description of the selected cases

2.3.1. Case 1: mPedigree's GoldKeys to track fake drugs

The widespread distribution of fake drugs is a significant problem that has been linked to a large number of deaths in SSA economies. One study, published by the American Journal of Tropical Medicine and Hygiene, found that in just one year, fake and poorly made malaria drugs contributed to the deaths of more than 100,000 children in Africa (Yeebo, 2015). Fake drugs often completely lack active ingredients or just enough to pass quality-control tests. However, there are often no noticeable differences with real drugs in terms of their visual characteristics (Yeebo, 2015). One study conducted in 21 SSA countries found that a third of malaria drug samples failed chemical testing and one fifth were confirmed as fake (Lancet.com, 2012). Likewise, one in three medicines sold in Ghana is estimated to be counterfeit, compared to 1% in the U.S. and Europe (Yeebo, 2015).

The problem can be attributed to the system's porosity. For instance, most drugs sold in Ghana come from China, India, and Malaysia, which are imported by Ghanaian distributors. These drugs are then sold to chemical sellers, pharmacies and hospitals (Yeebo, 2015). Some manufacturers lack control over their supply chains. For instance, one drug distributor's warehouse manager was reported to be selling batches of a new malaria treatment drug from a different company (Yeebo, 2015).

The nonprofit organization, mPedigree has developed an innovative solution, known as GoldKeys (<http://goldkeys.org/>) to fight this problem. While buying a drug at a pharmacy store, a customer can find a 12-digit code by scratching a sticker on the surface of the package and then send a text message to a given number. The code sent by the customer is matched with the ones registered by pharmaceutical companies in the cloud database of Hewlett-Packard (HP). The

customer then receives a response back that tells whether the drug is counterfeit or genuine. In addition, information such as the batch number, expiry date and dosage can also be sent in the same message. In order to maintain the system's integrity, sophisticated enterprise technologies are required to incorporate the secure labelling process with industrial and logistic processes (Disrupt-africa.com, 2015). Although this application provides obvious commercial benefits to drug manufacturers and patients, one of the most important benefits is that it helps save lives by enabling the customers to check the authenticity of life-saving drugs.

Among the biggest needs of mPedigree was partnerships with major cell phone networks. mPedigree's founder Bright Simons persuaded Safaricom (a Vodafone subsidiary), MTN Group, and other mobile carriers to subsidize the cost of text messages (Yeebo, 2015).

As of September 2015, mPedigree had opened offices in Egypt, Ghana, India, Kenya, Nigeria, and Tanzania. However, only four—Egypt, Ghana, India, and Nigeria—had sufficient number of companies that had signed up to make mPedigree's solution profitable (Yeebo, 2015). It was exploring for business opportunities in Bangladesh, Rwanda, Sierra Leone, South Africa, Uganda, and Zambia.

2.3.2. Expanding to new market segments

mPedigree has expanded beyond medicine to fight counterfeiting. Its clients include manufacturers of veterinary medicine, electrical products, baby food, cosmetics and high-yield seeds used in agriculture (Douglas, 2015). For instance, Dutch luxury fabric company Vlisco adopted mPedigree's system since March 2015 to fight the problem of counterfeit and fake products in Ghana. Pirated versions of Vlisco's products were available in the market at a very low price, which cut the company's market share from 50% to 15% during 2005–2014. It uses mPedigree's system and uses the data to send text-message advertisements to customers (Yeebo, 2015).

Innovations like mPedigree become subject to a number of obstacles and constraints in SSA economies. A single authentication code was checked 1500 times in a period of few days (Yeebo, 2015). In another case, mPedigree used its data to track down a warehouse that was full of fake malaria medication. In still another case, a counterfeiter reportedly took a genuine code and used to make thousands of copycat labels, which were used on counterfeit morning-after pills. mPedigree called everyone who had tested the code to find out where they bought the drug. It then alerted regulators and law enforcement agencies (Yeebo, 2015).

While the service helped consumers to detect specific fake product packs at retail level, counterfeiters penetrated the parts of the market with a lower consumer education level. A problem was that there was the lack of coordinated actions to remove fake products from the shelf after the detection of a counterfeit product (Disrupt-africa.com, 2015).

In 2014, mPedigree added another product to the Goldkeys Suite – EarlySensor, which is a data-analytics, mass notifications framework. EarlySensor uses pattern-recognition algorithms to monitor for anomalies and irregularities in the consumer authentication ecosystem on a real-time basis. When certain conditions are breached it promptly sends location-based warnings to diverse

stakeholders such as brand owners, regulatory bodies and consumers (Disrupt-africa.com, 2015). In the near future, consumers are expected to receive warnings before purchasing products when suspicious activities are discovered in the supply chain near them (Disrupt-africa.com, 2015).

2.3.3. Case 2: iCow

Kenya-based Safaricom, in partnership with the local organization Green Dreams, envisioned and developed the iCow system (<http://www.icow.co.ke/>). It won the Apps4Africa Award. The app helps small-scale dairy farmers track and manage cows' fertility cycles. It informs farmers about important days of a cow's gestation period, collects and stores milk and breeding records, and sends best practices. It also provides advice regarding the diagnosis of pest problems, prevention of infection and selection of the types of grass that are appropriate to feed the livestock (Glickman, 2015). In addition, it helps find the nearest vets and other service providers. Green Dreams has developed a simple system involving Google Docs. If Green Dreams and a vet contacted by a farmer are unable to answer the farmer's question, it is uploaded on the system. The vets send messages among themselves and come up with the best answer, which is forward to the farmer. As of 2012, 42,000 farmers in 42 counties were using iCow, which increased milk production by two to three liters per cow per day (ILRI News, 2012).

A National Geographic article reported the story of a Farmer, named Thuo, who experienced substantial increase in his yields and improvement of his animals' health due to the adoption of iCow. By implementing the knowledge (e.g., fodder production, hygiene and animal diseases) that he received from iCow, he was able to double the production of milk from his cows. The iCow system also helped him manage challenges such as food shortages that he faced in the past. Before he started using iCow, Thuo lacked the knowledge and skills required to measure the cost per liter of milk. He started keeping records of his farming activities. Thanks to the confidence that iCow gave him as a farmer and a businessman, he was planning to expand into pig farming (nationalgeographic.com, 2014).

2.3.4. Case 3: EpiSurveyor (now known as Magpi)

A team of programmers in Kenya developed the EpiSurveyor system, (now known as Magpi) (Goldstein, 2012). EpiSurveyor is among the most popular and publicized tools involving the cloud and mobile phones for collecting and analyzing data. In the beginning, the team received grants from the World Bank, the United Nation Foundation and the Vodafone Foundation (Clozel, 2014).

It has been used in improving water supply availability and reliability. The non-profit organization, Aquaya.org employs EpiSurveyor to help operators of rural water systems submit water quality data to their managers (Kanyi, 2012). EpiSurveyor has also been used in healthcare, agriculture, business, research, and conservation (Goldstein, 2012). In 2008, the World Health Organization (WHO) and Kenyan health ministry used EpiSurveyor to fight against polio. Health workers used EpiSurveyor to track an emergency vaccination campaign, which helped stop a potential polio epidemic (mhealthinfo.org, 2010).

The survey forms can be downloaded to a mobile phone, which can be used to collect and upload data in real time to an EpiSurveyor account (Schuster & Brito, 2011). It was reported that as of April 2012, EpiSurveyor was reported to have about 8000 users in over 170 countries such as Kenya, Malawi, Tanzania, Zambia, India, Pakistan, the Philippines, Nicaragua, Brazil, Indonesia. The WHO's African Regional Office (WHO/AFRO) has implemented EpiSurveyor in 15 SSA countries (mhealthinfo.org, 2010). This Java-based application is free, web-based software for data collection which can be used on number of phone brands such as Nokia, Samsung, BlackBerry, and Sony Ericsson (Goldstein, 2012).

EpiSurveyor is probably the most relevant cloud-based mobile app specifically designed for improving healthcare outcomes in developing countries. The early non-cloud version ran only on Personal Digital Assistants (PDAs), in which EpiSurveyor was downloaded to a computer to create survey forms and then transferred to the PDA for data collection. The data was transferred back to the computer for analysis. Using the cloud-based version developed subsequently, known as Magpi, the survey forms can be directly downloaded to a mobile phone, which can be used to collect data and upload in real time on clouds. Magpi was first tested in a nationwide child health week campaign in Kenya in 2008. Kenyan health workers used it to track an emergency vaccination campaign, which helped stop a potential polio epidemic. The WHO's African Regional Office (AFRO) has implemented EpiSurveyor in 15 SSA countries (<http://tinyurl.com/olqperj>). One advantage of the cloud is that if a device fails or is lost, the information is secure. There is thus less need to worry about data loss due to theft and burglary involving cellphones and computer crash, which are not uncommon.

2.3.5. Case 4: M-Pesa

M-Pesa (Swahili for mobile money) is operated by Kenya's largest cell phone service provider, Safaricom. M-Pesa allows can be used to send and receive money using cell phones.

M-Pesa is used to make person-to-person transfers (P2PTs), receive mobile phone credits, pay school fees, pay electricity bills and save money. It can also be used for shopping. Many Kenyans use M-Pesa and other mobile payment systems (Talbot, 2011). As of 2011, Kenya had 10 million households but 14 million M-Pesa accounts, which held 40% of the country's savings (Rosenberg, 2011). About 70% of the Kenyan adult population used M-Pesa to make five times as many transactions as credit and debit cards combined together (Aglionby, 2016). In the 2015 financial year, the value of M-pesa transactions reached \$50 billion or 79% of the country's GDP (Aglionby, 2016).

In 2011, Safaricom launched Safaricom Cloud, arguably Africa's "largest native cloud deployment" (Mbuvi, 2011). It started hosting M-Pesa mobile money services locally and launched new cloud offerings including hosting platforms for government agencies and corporations. As of 2011, the company invested US\$150 million in clouds and announced plans to invest additional US\$200 million (Wanjiku, 2011). Safaricom teamed up with Cisco for storage facilities, EMC for security and Seven Seas Technology for training managers.

In SSA economies, only about a quarter of adults have accounts at formal financial institutions, and only 3% have credit cards (economist.com, 2013a, 2013b). As of 2015, about 33% of the

Kenyan adult population lacked a bank account (Aglionby, 2016). M-payment is much more convenient for consumers in the developing world, where financial and banking services are not easily accessible. As of mid-2010, there were over 17,600 retailers as M-Pesa agents in Kenya and only 840 bank branches (Economist, 2010).

In developing economies, most transactions are small. The average mobile transaction conducted via M-Pesa is about a hundredth of the average check transaction and half of the average ATM transaction (Jack & Suri, 2010). In South Africa, for example, before the availability of m-payment, individuals paid \$30 to \$50 to couriers to deliver cash to relatives.

Regarding the P2PTs, it is worth noting that families in Africa's rural areas travel far to pick up remittances, adding significant travel costs and time to the already high transfer fees.

2.3.6. Case 5: Kilimo Salama's weather-based index insurance to serve small farmers

The social enterprise Kilimo Salama (safe agriculture in Swahili) has brought together actuarial science, agronomy, climate science, economics and remote sensing to develop a weather-based index insurance in an attempt to serve a vulnerable market that traditional insurance schemes have ignored. Its micro insurance scheme attempts to protect small farmers in Kenya against poor weather conditions. KS is a partnership between the Syngenta Foundation for Sustainable Agriculture, the Kenyan insurance company, UAP, and Safaricom. It also gets financial assistance from the International Finance Corporation, a sister organization of the World Bank (Rosenberg, 2011).

KS started a pilot project in 2009, insuring 200 corn farmers in the region of Nanyuki in Kenya and subsequently started also covering wheat, sorghum, cotton, beans and coffee. By 2011, it insured 22,000 farmers and became the largest insurance project in Africa (Rosenberg, 2011). As of 2013, KS had insured over 187,000 small farmers in Kenya and Rwanda (ifc.org, 2016; Kalan, 2013). The number of farmers insured by KS increased to over 233,000 in Kenya, Tanzania and Rwanda in 2014 (Acre Africa 2015). For some farmers the cost of insurance amounts to as little as 1 kg of maize, seed or fertilizer (un.org, 2014).

In order to reduce transaction costs and build trust with clients, the index insurance mainly relies on solar-powered weather stations and cellphones. Kenya's weather stations traditionally employed manual rain gauges. KS modernized 32 of them with solar power and computerized gauges. Weather stations are equipped with wireless sim-cards that transmit data on rainfall levels, sun and temperature every five minutes to a cloud-based server.

The insurance is completely automated. KS uses cellphones for signing up farmers and paying out insurance claims. It does not have to rely on insurance agents. Policies are distributed through dealers, who sell seeds, fertilizers and chemicals to farmers. The dealers are provided with camera phones to record the purchase. They use an advanced phone application with camera and phone functions to scan and capture policy information through a code. The information is uploaded to Safaricom's mobile cloud-based server, which administers policies. Farmers instantly receive information about their policy and pay-outs in SMS messages

(Schneider, 2013). At the end of the growing season, pay-outs go electronically to the farmer's cell phone account (Rosenberg, 2011).

A farmer who buys insurance is linked to the nearest weather station, which is within 20 kilometers. At the end of a season, the data is aggregated and combined with satellite data in order to map out rain patterns. KS works with agronomists to calculate the index and identifies the locations that experienced too much rain, too little rain, or rain at the wrong time. Farmer pay-outs are calculated based on crops, location, and the amount invested in seeds (Kalan, 2013). If the rainfall is insufficient early in the growing season, or too late in the corn season, farmers in that area get an automatic pay-out. Farmers are not required to file a claim. In the case of extreme weather that destroys the whole harvest, they get the full amount. No farm visit is necessary (Rosenberg, 2011). Insurance claims are normally settled within four days (Gulati & Doves, 2015).

Farmers can buy the insurance at the beginning of the season for about 10–20% of the amount they invest in seeds and inputs (Kalan, 2013). However, paying 10% of their costs for insurance is a huge burden for many farmers. KS recruited partners such as Syngenta who cover half the cost of the premium if farmers buy their products. In this way, local firms can facilitate the adoption by creating trust with local communities.

The availability of weather stations and cell phones dramatically lowered the cost of writing policies. Indeed, sending the text message welcoming the new client has been the biggest component of cost associated with providing insurance for KS (Rosenberg, 2011).

2.3.7. Appropriateness of index insurance

Researchers and practitioners have advocated the development and use of index insurance contracts to manage the risks faced by farmers and agricultural producers. Whereas conventional insurance compensates an insurer based on verifiable losses, under an index insurance scheme such as that of KS, payment to an insured farmer depends on the observed value of a specified index (Miranda & Gonzalez-Vega, 2011). The benefits of index insurance are greater to lending institutions such as agricultural/industrial development banks and microfinance institutions (MFIs) than to borrowers (Skees & Barnett, 2006). Historical data on corn and the other crops insured by KS indicated that pay-outs based on weather-based index are about the same as payouts for crop damage by bad weather (Rosenberg, 2011).

2.3.8. Benefits to farmers

The benefits go far beyond the crop damage insurance. KS regularly sends up-to-date climate data to farmers with SMS. Farmers also receive information regarding the ways to increase agricultural productivity, and protect crops in case of bad weather (Omolayo, 2015). Another benefit to farmers is that banks and MFIs are more comfortable in giving loans to farmers thanks to the insurance scheme. In this way, access to essential credit is becoming easier for farmers.

2.3.9. Case 6: Nomanini's Lula

The South African start-up, Nomanini sells a “business in a box”, a cloud-based mobile prepaid airtime machine, to small informal entrepreneurs, which allows them to set up a “mini-business”. It is called Lula (meaning “easy” in Zulu language), which is especially useful to provide services to support individuals engaged in small business and informal economic activities such as taxi drivers and “on the go” vendors. Lula generates and prints codes, which people purchase to add minutes to their mobile phones. Lula runs on the Google App Engine, which is the same infrastructure that powers Google’s own applications such as Google Calendar, Gmail and Google Docs. That is, Google provides the framework and storage and manages servers for Lula. Google also provides services to software applications associated with Lula beyond those that are available from the operating system (known as middleware). In addition, Google provides runtime-related services such as supporting the execution of programs required to print vouchers using Lula.

Namibia’s Paratus Telecom has diversified its offering by launching a new mobile airtime distribution service called “Katiti”. The service runs on Nomanini's cloud-based mobile point of sale platform and is designed to be used by informal traders and budding entrepreneurs. Local vendors are given a brightly colored and virtually indestructible terminal, or “business in a box” from which they can sell prepaid airtime vouchers. The platform is cloud-based, so vendors simply ‘upload’ airtime when they have Internet access (allafrica.com, 2014).

Local designers of a technology can find an appropriate way so that the observability of the innovation is ensured. For instance, Lula owners wear a lanyard around their necks to carry the device so they are instantly noticed in places such as a busy train stations (acceptingpayments.quora.com, 2010). Africa’s prepaid airtime market was estimated at US\$60 billion in 2013 is expected to increase to US\$85 billion by 2015 (Douglas, 2013). A key reason behind the increasing success and popularity of Lula is that pre-paid minutes can be used as cash or spent in shops in a number of African countries such as Côte d’Ivoire, Egypt, Ghana, Uganda, and Nigeria (economist.com, 2013a, 2013b). In November 2013, Nomanini entered the Kenyan market. The company also announced its plan to enter Zambia, Nigeria and Tanzania (nomanini.com, 2014). Many people in Africa, especially in rural areas, use such vouchers to pay for services such as electricity, water, insurance and airtime for mobile phones. The low penetration rates of computers, Internet and smartphones, and the fact that a large proportion of the population lacks a documented home address make this an attractive option economically and technologically. Mobile prepaid services do not require Internet access or a bank account and can be purchased them in small or large amounts. A further reason for the popularity of such a voucher is that it is difficult to distribute physical vouchers because of theft and fraud risks.

2.3.10. Case 7: biNu

biNu (<http://www.binu.com/>) is a free mobile software platform, which is used to access books. biNu moves much of the processing to the cloud instead of doing it on the phone. In 2013, biNu was reported to have over 4 million monthly users. Worldreader, which describes its mission as: “make digital books available to children and their families in the developing world, so millions of people can improve their lives”, uses [Amazon’s] AWS to download books (Hardy, 2012).

Worldreader has made thousands of free books available on the cloud. biNu's Worldreader app was released as a beta version in April 2013, which had been installed on about 5 million mobile phones as of 2013-end (Ruz, 2013).

The app is designed to run on a moderately priced and multipurpose phones (feature phones)¹ rather than high-end smartphones. In this way, biNu allows feature phones and low-end smartphones to have a smartphone-like experience through cloud-based apps and services (Mirza, 2013). The books can be accessed through a free mobile software platform biNu. Most of the processing is performed in the cloud's servers instead of on the phone (Ruz, 2013). According to biNu's developers, by moving processing to the cloud, biNu works ten times faster than regular mobile web browsers. It makes graphics and text on the cloud and the data is sent back to the phone as tiny images. An advantage of sending the data as images is that the text can be displayed in any language irrespective of the language a phone is programmed to handle. Each image consists of only one or two packets of data of less than 1 kilo byte (KB) each. Information is not sent twice. The servers remember the information that is sent before and only provides new instructions that are needed to change the content on the screen (Ruz, 2013).

3. Theoretical propositions developed from the cases

Eisenhardt and Graebner (2007) suggested researchers to briefly explain the emergent theory in the introduction. They recommended that case study researchers write each proposition implicitly or explicitly in the body of the paper. They further suggested that each proposition should be linked to supporting empirical evidence for each construct and for the relationship that has been proposed between the constructs. As suggested by Eisenhardt and Graebner (2007), a brief outline of the theory has been provided in the introduction.

It is also crucial to write the underlying theoretical arguments that provide the logical link between the constructs within a proposition (Eisenhardt & Graebner, 2007). As suggested by prior researchers (Eisenhardt & Graebner, 2007; Whetten, 1989), the arguments are based on the cases (Tables 1 and 2) or from other detached logical reasoning and knowledge (cases not listed in Table 2 or other contexts).

Eisenhardt and Graebner (2007) also suggested providing a visual theory summary in the form of "boxes and arrows" diagram. To this end, Fig. 1 presents a preliminary conceptual framework described by the propositions developed in this paper, which could explain the creation, deployment, diffusion and export of SSA-originated innovations.

FIGURE 1 IS OMITTED FROM THIS FORMATTED DOCUMENT

Fig. 1. Creation, deployment, diffusion and export of Sub-Saharan Africa-originated information technology-related innovations: A framework.

Eisenhardt and Graebner (2007) also suggested that case study researchers provide a visual theory summary in the form of a summary table. In well-done case study research, theory and data are likely to be "patternmatched" and the propositions are consistent with most or all the cases (Eisenhardt & Graebner, 2007). In this regard, Table 3 also matches the emergent theory

with the cases to explain how the framework developed can be applied to understand key factors that drive creation, deployment and diffusion of innovations in SSA economies.

Table 3. Creation, deployment and export of SSA-originated IT-related innovations.

Case No.	Organization/Innovations	Brief explanation [Case numbers]
P ₁	Supports and resources from outside → successful creation	Outside organizations such as foreign MNCs and bring technologies, skills and other resources, which are not likely to be created locally [1–7]
P ₂	Large scale innovations → more dependence on outside supports and resources	Help of large corporations interested in humanitarian and charitable causes and/or PR appeal to mPedigree [1] Department for International Development helped develop the M-Pesa system [4]
P ₃	Involvement of industrialized world-based organizations → successful deployment	biNU by Worldreader [7] Lula runs on Google App Engine and runtime-related services [6].
P ₄	Deployment of large scale innovations → more dependence on outside resources	HP runs the data centers to host mPedigree's codes [1]
P ₅	Proportion of local inputs → faster diffusion	Nomanini: founders' in-depth and intimate understanding of the African market [6] M-Pesa: local members know how to exploit regulatory loopholes [4] KS: local agents are more capable of building trust with the local community [5]
P ₆	Compatibility with basic infrastructure → faster diffusion	Lula system does not require Internet connectivity or electricity [6]
P ₇	Low costs in usage → faster diffusion	mPedigree and EpiSurveyor free for users [1,3]. biNu, highly compressed data reduces the price for users [7]
P ₈	Large scale innovations → higher likelihood of being exported	EpiSurveyor in Guatemala [3] M-Pesa in Romania [4]
P ₉	SSA-originated innovations → exported to other developing countries	EpiSurveyor in Guatemala [3] M-Pesa in Romania [4]

3.1. Creation of innovations

SSA-based firms complain that they are not viewed favorably by various sources of outside power and resources. For instance, Simons reported that pharmaceutical companies showed an unwillingness to do business with mPedigree. Venture capital firms often do not find local funds attractive to fund. Regulators show tendency to ignore local companies. A further problem noted by Simons was that talented developers do not like to work for local companies. Supports and resources from outside are thus even more critical and essential for SSA-based innovators.

Entrepreneurs such as iCow's founders Sue Kahumbu and Charles Kithika (eLearning Africa, 2010) and mPedigree's founder Bright Simons established ties with multiple networks that were largely separated from one another. In this way, they enjoyed strategic advantage in the SSA context. Put differently, these entrepreneurs sit "astride structural holes in networks" and thus are well positioned to innovate (Granovetter, 2005, p. 46). Nomanini's Chief executive and founder Vahid Monadjem was raised in the U.S. and Swaziland, and worked in the consulting firm McKinsey as a global fellow for emerging market product development. His assignment in Johannesburg was to understand the challenges in reaching consumers (Grant, 2013). He had an understanding of what resources are available and how they can be used to reach consumers who lack computers, Internet access, or smartphones. Note too that many consumers lack a documented home address.

Innovations involve entrepreneurial activities. According to Schumpeter (1934) entrepreneurs need to combine unconnected resources in order to create new opportunities. Note that important resources are often unconnected because they reside in separated networks (Granovetter, 2005). Different parts of networks thus need to be bridged and resources need to flow from one network to another for an innovation to be successful (Burt 1992; Granovetter, 2005). Individuals and organizations that have ties to multiple unconnected networks thus make an innovation possible (Burt, 1992). If such individuals and organizations constitute the only route for resources to flow from one network to another, they are said to engage in activities, which exploit "structural holes" in the network (Burt, 1992).

In general, innovation requires departures from established routines and practices (Granovetter, 2005). Successful innovators thus connect themselves to a wider world and access resources and information from individuals and organizations of different kinds. Emphasizing the importance of exploiting the strength of weak ties by moving in different circles, Granovetter (2005) noted: "Because our close friends tend to move in the same circles that we do, the information they receive overlaps considerably with what we already know" (p. 34). Granovetter (1983) also noted that new information and ideas diffuse more efficiently through weak ties.

The cases discussed above make it clear that foreign MNCs, development agencies and philanthropic organizations have played an important role in the creation of innovations in Africa. For instance, the U.K.'s Indigo Trust, which is a grant making foundation mainly in technology-driven projects in Africa, awarded £15,000 (about US\$25,000) to iCow in 2012 (indigostrust.org.uk, 2012).

Foreign MNCs have brought technologies and skills into SSA economies, which are not likely to be created locally. Prior researchers have identified three processes driving the globalization of technologies (Archibugi & Michie, 1997; Iammarino & Michie, 1998). The first process relates to the international exploitation of technological capabilities export, movement of production activities abroad, licensing and other activities. The second process is the collaboration among public and business institutions. Sharing of costs and risks of industrial research motivate such collaborations. The third process is the generation of innovations across more than one country. The research activities of MNCs in foreign locations and the amount of R&D financed from abroad empirically support this process (Iammarino & Michie, 1998).

Large scale innovations often incur higher costs and risks because of their size. SSA-based organizations can reduce the costs and risk by collaborating with other organizations. For instance, mPedigree needed the help of large corporations interested in humanitarian and charitable causes and/or PR appeal with budgets for projects related to such efforts (Yeebo, 2015). Similarly, the Department for International Development, which manages the U.K.'s aid to developing countries, helped develop the M-Pesa system (Kshetri & Acharya, 2012). Based on the above discussion, the following propositions are presented:

Proposition 1: Support and resources from outside are positively related to the successful creation of an innovation in SSA economies.

Proposition 2: Support and resources from outside are more important in the creation of large scale innovations compared to small scale innovations in SSA economies.

3.2. Deployment of innovations

Access to resources is important during all stages of innovation cycles such as creation and implementation. For instance, in order for, mPedigree's GoldKeys to be successfully deployed, it is necessary to have access to data centers to match codes sent by customers and respond back to them regarding the genuineness of the drug. Since blackouts can last as long as 24 h in Ghana, outside data centers provide more reliable operations. The company also needs to perform other non-core tasks such as printing labels. mPedigree relies on support and resources from outside for such activities. Among the biggest needs of mPedigree, for instance, were cloud servers to manage data. In December 2010, HP announced it would run the data centers to host mPedigree's codes. mPedigree's founder estimated that it saved his company US\$10million in infrastructure costs (Yeebo, 2015). Its data centers are on three continents. MPedigree's labels are printed in China and India.

SSA-originated innovations can ensure successful deployment by utilizing outside resources in the implementation. The use of biNU by Worldreader (case 7) indicates that philanthropic and charitable causes work as a mechanism for the flow of outside resources into Africa.

In some cases, what is important is the knowledge of what resources are out there already that the company can use. For instance, Lula runs on the Google App Engine. Google also provides runtime-related services to print vouchers using Lula (Case 6). Entrepreneurs do not need to

recreate the wheel. An essential point here is that outside supports motivated by philanthropic and charitable causes are not always needed to deploy innovations in SSA.

Especially large scale innovations depend more on outside supports and resources. For instance, HP runs the data centers to host mPedigree's codes (Case 1). In these cases, the mechanisms associated with globalization of technologies (Archibugi & Michie, 1997; Iammarino & Michie, 1998) are relevant in the deployment of innovations.

Overall, mechanisms noted above such as connecting unconnected resources (Granovetter, 2005), bridging networks to enable the flow of resources (Burt, 1992) are also relevant in the deployment of innovations. The above leads to the following:

Proposition 3: Support and resources from outside are positively related to the successful deployment of an innovation in SSA economies.

Proposition 4: Support and resources from outside are more important in the deployment of large scale innovations compared to small scale innovations in SSA economies.

3.3. Diffusion of innovations

3.3.1. Local inputs

Local inputs such as knowledge of local regulations and markets play a key role in the successful diffusion of an innovation. M-Pesa's case (Case 4) indicates that local members are likely to know how to exploit regulatory loopholes. For example, when M-Pesa was launched in 2007, there were no clear regulatory guidelines for m-payments. M-Pesa exploited the loophole and operated without a banking license (Kshetri & Acharya, 2012).

For KS (Case 5), local entrepreneurial firms are more capable of building trust with the local community, which is especially important in the insurance industry and similar other sectors. Insurance companies in SSA economies also suffer from a bad reputation. Many SSA-based farmers have not heard of insurance. A small proportion of farmers, who are aware of insurance, have had bad insurance-related experience in the past. Some have been cheated because the insurance company went bankrupt. In some cases, insurance agents took money and then disappeared. In other cases, a middleman took the insurance payout money and did not reach the farmer (Rosenberg, 2011).

A key factor affecting the diffusion of an innovation is the availability of information and skills required to use a new technology or 'inter-relatedness' among users and producers of the technology (Cassiolato & Baptista, 1996). Local designers are likely to possess knowledge and experience, which is likely to be helpful to overcome various barriers to the implementation. This means that having local designers and managers in the design of an innovation is likely to lead to a higher degree of inter-relatedness among users and producers of an innovation. Developers of technologies intended for SSA economies have recognized the relevance, importance and value of local design teams. For instance, the Farmforce platform was developed in 2011 by a team based in Switzerland with inputs from a team based in Kenya (Sambira, 2013).

Rogers (1995) identified various characteristics of a technology affecting its diffusion pattern: relative advantage, compatibility, complexity, observability and trialability. The involvement of local manpower and expertise is likely to lead to the inclusion of features and processes that can positively influence the diffusion of an innovation. For instance, local researchers are likely to include features that are likely to make the innovation more compatible with local economic factors as well as formal and informal institutions (Table 4). Nomanini’s success (Case 6) can be largely attributed to the founders’ expertise in ICTs and in-depth and intimate understanding of the African market. The founders noted that Lula is a uniquely “South African born-and-bred solution” that targets the needs and interests of the local population (Grant, 2013).

Table 4. Characteristics of a technology influencing its diffusion: An assessment of SSA-originated innovations.

Dimension	Explanation	Situation in developing countries
Relative advantage	<ul style="list-style-type: none"> Perceived benefits of a technology over previous technologies and the extent to which it is better than the idea it supersedes. 	<ul style="list-style-type: none"> EpiSurveyor is cloud-based. If a device fails or is lost, the information is secure (Case 3) Families in Africa’s rural areas must travel far from home to pick up remittances, adding significant travel costs and time to the already high transfer fees and services of couriers are expensive: P2PT feature of M-Pesa offers higher benefits (Case 4) iCow increased milk production by two to three liters per cow per day (Case 2).
Compatibility	<ul style="list-style-type: none"> The degree to which a technology and the tasks it performs are perceived as being consistent with the existing values, beliefs, past experiences, and needs of potential adopters. 	<ul style="list-style-type: none"> biNu: highly compressed data reduces the price for users, which meets the low cost needs of SSA users. It can be used with low-end smartphones/feature phone (Case 7). Kilimo Salama provides low-cost insurance services (Case 5)
Complexity	<ul style="list-style-type: none"> The level of difficulty of installing and using a technology (variety and uncertainty increase complexity). 	<ul style="list-style-type: none"> M-Pesa’s simple, low-tech mechanism for providing money transfers (Case 4) iCow was designed to function via SMS, which means that it is available on any phone and an average dairy farmer can access it (Case 2)
Observability	<ul style="list-style-type: none"> The degree to which the features and benefits of a technology are visible, noticeable and understandable to self/others, the results are can be described to non–users. 	<ul style="list-style-type: none"> Lula: Local vendors are given a brightly colored “business in a box” to sell prepaid airtime vouchers (Case 6).
Trialability	<ul style="list-style-type: none"> The ability to experiment or try (on a limited basis) before formally adopting. 	<ul style="list-style-type: none"> biNu is a free mobile software platform (Case 7). EpiSurveyor is free for the users (Case 3). mPedigree’s GoldKeys are free for users (Case 1)

Source: Based on Rogers (1995) and author’s research.

In summary, innovations with significant inputs from SSA economies are likely to be more effective in addressing local problems. In line with these arguments, the following proposition is presented:

Proposition 5: For a given level of innovative input in an innovation, the proportion of local input is positively related to the speed of diffusion in SSA economies.

3.4. Infrastructural facilities, systems and services

The Lula system (Case 6) is ideal for rural areas because it does not require Internet connectivity or electricity. A vendor can simply select the type and amount of airtime to be sold. A voucher is then printed within seconds. The battery used in the device lasts for five days. It can be fully charged in eight hours (allafrica.com, 2014). Likewise, KS used Kenya's weather stations, which traditionally employed manual rain gauges.

iCow was originally designed to function via SMS, which means that it is available on any phone, which means that an average dairy farmer can access it (Mbuvi, 2013). In order to serve this market better, iCow is available in English and Kiswahili (safaricom.co.ke, 2013).

For some farmers with low-end phones, the limited storage capacities have presented barriers to fully utilize iCow's potential. For instance, a Kenyan dairy farmer who received 310 SMSs from iCow found that his phone ran out of storage (Mbuvi, 2013). Potential inhibitors also include the lack of English language competency among the target users.

Likewise, biNu is appropriate for SSA's overcrowded narrow band 2G networks, which are primarily used for voice transmission but are also capable of transferring data, but only very slowly and unreliably. Note too that 2G networks are less compatible with the functions of smart phones. biNu also gives users free airtime on pre-paid mobile phone for completing surveys (binu.com, 2013).

The diffusion rate of a technology is tightly linked to the market and infrastructure factors controlling the availability to potential adopters (Brown, Malecki, Spector, 1976). A related point is that countries with a small base of high technology and innovative capital goods are likely to experience lower rates of diffusion of advanced technologies (Antonelli, 1986). Organizations in a country with low degree of inter-relatedness with other complementary technologies often find it difficult to obtain the information, skills and other resources needed for the diffusion of a new technology (Allen, 1998). For instance, prior research has noted that the lack of sufficient bandwidth and supporting infrastructures and availability of credit influence relative advantages of Internet and e-commerce (Kshetri, 2001). SSA economies perform poorly in the availability of advanced infrastructural facilities, systems and services. Thus products and services are based on basic infrastructures are likely to perform better in SSA economies. It is proposed:

Proposition 6: Innovations that are compatible with basic infrastructural facilities, systems and services are likely to diffuse more rapidly in SSA economies than those that require advanced infrastructural facilities, systems and services.

3.5. Importance of low cost

A look at SSA-originated innovations shows the importance of this consideration in consumers' adoption decisions. For instance, mPedigree has made its services free for users, which makes the service accessible. It tells potential clients it can keep costs within 1% of a product's wholesale value (Yeebo, 2015) (Case 1). Similarly, EpiSurveyor is free for the users (Case 3). Likewise, in the case of biNu, highly compressed data reduces the price for users, which is a key concern for many people in Africa (Case 7). For small transactions, a typical m-payments transfer on M-Pesa costs around 1% of the transferred amount. The common denominator to the above examples is that low cost is key to succeed in SSA economies.

Prior research indicates that economic factors such as income availability and price structures of ICT products and availability of credit influence relative advantages of Internet and e-commerce (Kshetri, 2001). High costs of innovations are thus often the biggest roadblock for their adoption in SSA economies. Thus, we propose that:

Proposition 7: Innovations that aim at low costs in usage are likely to diffuse more rapidly in SSA economies.

3.6. Export and internationalization of innovations

As of September 2016, M-Pesa was also used in Tanzania, South Africa, Afghanistan, India, Romania and Albania (the Star, 2016). In 2014, M-Pesa was launched in Romania, where about 35% of the population lacks access to formal banking (Shadbolt, 2015). Romanian M-Pesa customers can transfer as little as one new Romanian leu (0.22 euro cents) up to 30,000 lei (€715) per day (Vodafone.com, 2014).

As noted above, M-Pesa in Kenya is used to make P2PTs, receive mobile phone credits, pay school fees and electricity bills and save money. Institutional and economic environments vary more from one country to another. To put things in context, Romania and Kenya are two countries with very different socio-economic profiles. M-Pesa has drawn Romanian customers with different uses and needs. For instance, in Romania, M-Pesa teamed up with the digital money transfer company, Azimo to deploy the app for international remittances. Anyone in Europe can send money to users registered with M-Pesa in Romania. Recipients can collect funds from more than 2100 M-Pesa locations in Romania. There are more than 3 million Romanian migrants in other parts of Europe, who sent over \$3.4 billion to Romania every year (Finextra, 2015).

The mechanisms described above are not likely to be relevant for small-scale innovations. As noted earlier, small-scale innovations affect only a given firm, industry, product or process. Such innovations often benefit a narrow group of consumers. Safaricom is a Vodafone subsidiary. Vodafone Romania played a key role in M-Pesa's entry into Romania. Small-scale innovation such as iCow lack access to resources and supports. Small scale innovations such as iCow are less likely to be put to new and different uses in foreign countries.

To illustrate the above point, let us consider two countries A and B. Assume that a small scale innovation is created in country A. Despite some similarities between the two developing countries, A and B, the product, industry, process or consumer groups affected by Is in A may not exist in country B. Large scale innovations, on the other hand, have effects on complete socio-technical systems (Oosterhuis, 2006). This means that if a large scale innovation, Il is created in country A, it is likely to have some use in country B. But there is another point that is perhaps even more important. Exploration of an innovation in foreign countries often requires a huge amount of resources. Compared to the creators of Il, the creators of Is are likely to have more limited resources to export or engage in other forms of internationalization activities.

Regarding the environment, prior researchers have noted that an innovation is embedded in a social system, which plays an important role in its diffusion. A social system is “a set of interrelated units that are engaged in joint problem solving to accomplish a common goal” (Rogers, 2003: 23). It varies in forms—formal as well as informal. Social systems also exist at different levels (individual, organization, network, or national). For instance, the social structure and communication structure affect information flow and other factors that are critical for the adoption of the innovation by the adopting units. Various societal norms also affect the behavioral patterns of the members of a social system. This conclusion is similar to the observation made by Bowker (1996) that information infrastructures have economic, social (informal) and political (formal) dimensions.

Developing countries exhibit a higher degree of similarity and share several features of institutional and economic conditions. Thus innovations created in SSA tend to have a higher degree of usefulness and value for individuals and organizations in developing countries than for those in developed countries. For instance, consider EpiSurveyor, which has been effective in enhancing transparency and fighting corruption in Guatemala. In 2010, a national survey of the beneficiaries of Mi Familia Progresiva (Mifapro) was administered with low-cost mobile phones and EpiSurveyor (free software) for data collection. Mifapro was then President Alvaro Colom’s flagship social program. It was a conditional cash transfer (CCT) aimed to improve the quality of life of poor families. Before 2010, similar surveys were carried out using paper-based data collection methods, which suffered from drawbacks such as frequent errors, storage burdens and high costs of double data entry. While handheld devices not connected to the cloud, such as PDAs are sometimes used to replace paper-based methods, they have their own shortcomings. The data need to be downloaded to laptops in frequent intervals, are not available in real-time, and may be corrupted or even lost if PDAs are damaged, misplaced, or stolen. In this way, mobile-based clouds perform well from the standpoint of disaster recovery.

The 2010 CCT survey relied on EpiSurveyor installed on entry-level mobile phones to collect information from 500 Mifapro beneficiaries, mainly indigenous women. It was funded by the United Nations Foundation, Vodafone Foundation, and a World Bank Development Marketplace Grant. It drastically reduced the cost and enhanced survey accuracy. The results accelerated the implementation of a nationally-representative beneficiary survey of the CCT program (Kanyi, 2012). In sum, we argue that:

Proposition 8: SSA-originated large scale innovations are more likely to be exported to other countries compared to small scale innovations.

Proposition 9: SSA-originated innovations are more likely to be exported to other developing countries compared to developed countries.

4. Discussion and implications

This research highlights the complementary roles of local and foreign firms in the creation and deployment of innovations in SSA economies. Industrial world-based organizations' resources and technological capabilities are key to the success of some of the innovations generated and deployed in SSA economies.

Among the factors that affect diffusion of SSA-originated innovations include compatibility with basic infrastructural facilities. In this regard, the lack of advanced infrastructure highlights a fundamental dilemma facing some innovative solutions. Consider, for instance, local cloud providers' efforts to provide high quality cloud services. When Safaricom hosted M-Pesa services in foreign locations, the company faced problems related to downtimes. On the other hand, when it started to host the services locally, it remained difficult for the company to convince local businesses, which have shown concerns regarding reliability issues associated with connectivity and power availability (Wanjiku, 2011).

Firms such as M-Pesa epitomize the evolving role that SSA-based firms can play in changing the global innovation landscape. These firms have demonstrated that with creative business models and innovative products, they can compete in modern industries that are often atypical for local firms to have a competitive advantage. For instance, as indicated above, the cost structure of the cloud industry—high fixed costs and low marginal costs—cause great difficulties for SSA-based firms to compete in the cloud markets. However, some SSA-based firms such as M-Pesa have developed unique offerings that are tailored specifically to the need of the continent. This is in contrast with widespread observations that SSA-based firms lack capability to launch successful innovations in the modern economic sector.

mPedigree's case indicates that innovations focusing on developing countries must tackle a host of challenges and obstacles associated with infrastructures, regulations, and economic conditions. Such challenges, however, can be highly rewarding. The case also shows that such challenges can be overcome by developing new and creative business models and products and utilizing appropriate resources inside and outside the country. Often foreign MNCs are a source of key resources upon which SSA-based firms depend. mPedigree's case also indicates that some foreign MNCs' actions, which have combinations of philanthropic and commercial motives, can greatly facilitate the creation and implementation of innovations in SSA economies.

mPedigree's case (case 1) also demonstrates that successful innovations can bring favorable regulatory changes. For instance, in Nigeria, scratch-off codes have become mandatory on all malaria drugs and antibiotics (Yeebo, 2015). Changes like this can create a virtuous circle of innovations.

SSA-originated low-cost solutions are especially attractive for the bottom of the pyramid entrepreneurs. To take an example, microinsurance is not an attractive business for most

insurance companies due to high transaction costs. For instance, consider a farmer who pays an insurance premium of \$1 to insure seeds worth \$10. In case of bad weather such as drought, an insurance agent may need to visit the farm to verify the farmer's loss. The insurance company also needs to do paperwork to pay the farmer \$10. The insurance company's expense is the same irrespective of the amount of the insurance policy, whether it is a \$10 or a \$10,000 policy. It is possible for insurance companies to offer small insurance policies to poor farmers if the costs associated with signing up people, verifying claims and paying for the damage are close to zero. In light of these challenges, a number of key features of micro-insurance products such as those offered by Kilimo Salama (Case 5) are likely to have a powerful impact on smallholder farmers in SSA economies.

4.1. Managerial and policy implications

The findings of this study suggest that innovators and policy makers need to pay attention and try to understand the role of key stakeholders, resources and factors in shaping innovations in SSA economies. This paper has demonstrated the important and diverse roles that indigenous knowledge, local inputs and resources play in the diffusion of innovations. For instance, KSrelies on dealers of agricultural products rather than insurance agents to sell its policies. Farmers are likely to have higher levels of trust and confidence in dealers than in insurance agents. In the case of M-Pesa, local members possess capabilities, competencies and resources to exploit regulatory loopholes. However, exploitation of the loophole has had a positive impact upon the society and the economy.

Another way to view actors such as the founders of M-Pesa is to see their roles in changing the society's rules of the game. These rules are also referred to as institutions (North, 1990). The research literature provides abundant evidence that actors with key strategic resources or power have significant impacts on the evolution of institutions and institutional fields (Lawrence & Suddaby 2006). Institutional researchers have come up with the influential concept of institutional entrepreneurship to examine the role of these actors in creating new institutions (DiMaggio, 1988). DiMaggio (1988, p. 14) notes that "new institutions arise when organized actors with sufficient resources (institutional entrepreneurs) see in them an opportunity to realize interests that they value highly". Institutional entrepreneurs are "interest-driven, aware, and calculative" (Greenwood & Suddaby 2006, p. 29).

Specifically the actions of M-Pesa fit into what Li, Feng, Jiang, 2006 refer to as *ex ante* investment with *ex post* justification. In this form of institutional entrepreneurship, a business is formed or expanded by breaking existing laws. If such a business generates jobs, tax revenues and other forms of social benefits, the entrepreneur reports to the government and persuades policy makers to bring changes in existing laws and regulations.

Regarding institutional changes that are likely to drive an innovation's success, an important point that must not be overlooked is that outsiders lack a wide legitimacy and thus can do little to bring such changes (Almond & Verba, 1980). Prior research has suggested that some governments in developing countries oppose institutional change pressures that are imposed from outside (Kshetri & Ajami, 2008).

While low cost is generally a key driver of innovation diffusion in developing countries, the relative importance of this factor may depend upon the nature of innovation being investigated. For instance, for solutions such as mPedigree, the clients are mainly large established companies from industrialized countries. These companies often care less about low cost compared to the users of innovations such as iCow.

Most of the successful ICT-related innovations in SSA economies tend to make use of basic infrastructure available in the region. Nonetheless, for some innovations, locally available infrastructure may not be sufficient, and would require outsourcing of infrastructural needs to industrialized countries. Such a need is especially apparent in the case of large-scale innovations such as mPedigree. At the same time, the case of M-Pesa indicates that the rapidly developing infrastructures and services in the region may change the outsourcing requirements.

For Western multinational companies and developmental agencies, the SSA economies provide a number of opportunities that can be leveraged in realizing philanthropic aims and commercial goals. More effective philanthropic practice will require identifying the key missing elements and ingredients in the SSA innovations landscape and making sure that they can acquire or develop the missing means. For instance, the critical missing ingredient for mPedigree was cloud servers to manage data, which was provided by HP. On the other hand, enterprises such as Kilimo Salama and iCow just needed economic and military assistance to sustain their business development efforts.

SSA economies also offer significant profit opportunities to Western multinationals, especially in areas in which local firms have underdeveloped capabilities to offer appropriate solutions. Western multinationals can take advantage of such opportunities, especially in areas related new and cutting-edge technologies. For instance, in M-Pesa's case Cisco provided storage facilities, EMC provided security and Seven Seas Technology trained managers.

Western companies operating in SSA can use SSA-originated innovations to make their businesses more competitive and successful. Since Western companies often have a different focus and orientation, they may be able to find new uses of SSA-originated innovations that have not yet been implemented. As noted above, mPedigr/ee's system opened up a new area of use for Vlisco: that of fighting counterfeit and fake products.

Finally, a successful innovation makes it more attractive for introduction of other related innovations and creates a virtuous circle of innovation and socio-economic development. It was reported that a reason why Rose Goslinga, Kilimo Salama's founder (Case 5), chose Kenya was M-Pesa's (Case 4) popularity in the country (Rosenberg, 2011). With the deepening penetration rates of cellphone and mobile money such as M-Pesa in Africa, the markets for KS insurance products are likely to widen.

4.2. Future research implications

Before concluding, we suggest several potentially fruitful avenues for future research. First, future research can increase our understanding of the internationalization of SSA-originated innovations. Specifically, the above cases suggest that most SSA-based innovations are likely to

engage in export over foreign direct investment (FDI). The export market selection process is thus more relevant to the context of SSA-originated innovations than foreign market selection or international market selection (Papadopoulos & Denis, 1988). Note that the latter pertain to the evaluation of markets for possible entry by means of modes other than export such as FDI. Future researchers could thus study how SSA-based firms engage in export market selection process and how decisions are made in various stages of the process. For instance, prior researchers have identified screening, identification, and selection as the key stages in export market selection process (Kumar et al., 1994). For the screening stage, future researchers can investigate how political, sociocultural and other macro-level factors are used to select or rule-out countries based in the firm's objectives. For the identification stage, researchers could provide a detailed picture of variables that are specific to the product-based industry to generate a short list of countries that warrant further investigation. For the selection stage, future researchers could look at firm specific criteria that are used (e.g., profitability) by SSA-based firms to make the final selection of one or more export markets from the short list generated during the identification stage.

The above discussion indicates that philanthropic and charitable activities of international organizations such as the World Bank, the United Nations Foundation, non-profit organizations such as Worldreader as well as private sector organizations such as HP have played key roles in the creation, deployment and diffusion of innovations in SSA economies. However, activities of these organizations might have different focus areas, goals and impacts. Another intriguing avenue for future research is to compare philanthropic and charitable activities of these diverse organizations in terms of motives and values.

Finally, future researchers could study orientations of SSA-based businesses and consumers towards products based on SSA-originated and foreign innovations. Prior researchers have suggested that consumers react differently to domestic and foreign products and brands (Balabanis, Diamantopoulos, Mueller, Melewar, 2001; Kshetri, 2007; Kshetri, Palvia, & Dai, 2011; Schuiling & Kapferer, 2004). For instance, while many Chinese arguably pride themselves on using foreign brands, a sizeable segment of Chinese consumers is reported to exist that prefers China-originated products due to strong national pride (Kshetri et al., 2011; Kshetri, 2007). Balabanis et al. (2001) reported several mechanisms that lead to consumers bias for domestic products. In some cases, local brands may also enjoy a higher degree of consumer trust than foreign ones (Schuiling & Kapferer, 2004). Thus how products based on SSA-originated and foreign innovations are perceived, evaluated and acted upon by businesses and consumers in the region might be a worthwhile target of study.

5. Concluding remarks

In light of the stereotypically different expectations that surround SSA-based organizations' innovative capability, it is worth noting that some of these organizations are creating innovations that are creatively meeting the economic and socio-political challenges facing these economies. For instance, M-Pesa and mPedigree are high profile examples of companies that have made a creative use of big data and the cloud to address the social and economic challenges facing the developing world.

The cases shed light on distinctive and complementary roles that the foreign and domestic resources and organizations play in the creation and deployment of innovations in SSA economies. For instance, Western MNCs are better endowed with economic resources and technological capabilities than SSA-based companies. Local organizations, on the other hand, are in a better position to understand the unique needs and opportunities in these economies.

Acknowledgements

The author is grateful to IJIM Regional Editor, Paul Solomon for his generous, insightful and constructive comments on earlier versions, which helped to improve the paper drastically.

Notes:

1. Compared to a basic mobile phone, which can only be used for voice calling and text messaging, a feature phone has additional functions but not as many as in a smart phone.

References

acceptingpayments.quora.com. (2010). *This orange box you've never seen before is changing payments*. <https://acceptingpayments.quora.com/This-Orange-BoxYou%E2%80%99ve-Never-Seen-Before-Is-Changing-Payments> Accessed 09.07.16

allafrica.com. (2014). *Namibia 'Katiti' mobile airtime distribution service launched in Namibia*. <http://allafrica.com/stories/201411041022.html> Accessed 09.07.16

Acre Africa. (2015). *Implementation of Agricultural Insurance..* www.acreafrica.com Accessed 09.06.16

Aglionby, J. (2016). *New payments service to launch in Kenya..* <http://www.ft.com/cms/s/0/fa4acc9c-7c9d-11e5-98fb-5a6d4728f74e.html> Accessed 09.07.16.

Allen, D. (1998). *New Telecommunications Services: Network Externalities and Critical Mass. Telecommunications Policy*, 257–271.

Almond, G., & Verba, S. (1980). *The civic culture revisited*. Boston: Little, Brown and Company.

Ansari, S., Garud, R., & Kumaraswam, A. (2015). *The disruptor's dilemma: TiVo and the U.S. television ecosystem. Strategic Management Journal*.

Antonelli, C. (1986). *The international diffusion of new information technologies. Research Policy*, 3, 139–147. Milano.

Archibugi, D., & Michie, J. (1997). *Technological globalization or national systems of innovation? Futures*, 29(2), 121–137.

binu.com. (2013). *Help.*. <http://m.binu.com/help.php> Accessed 09.07.16

businessGreen.com. (2016). *Microinsurance and the new market for climate equity.*.
<http://www.businessgreen.com/bg/feature/2441996/microinsurance-and-the-new-market-for-climate-equity> Accessed 09.07.16

Balabanis, G., Diamantopoulos, A., Mueller, R. D., & Melewar, T. C. (2001). The impact of nationalism, patriotism and internationalism on consumer ethnocentric tendencies. *Journal of International Business Studies*, 32(1), 157–175.

Bansal, P., & Corley, K. (2012). Part 7: what's different about qualitative research? *Academy of Management Journal*, 55(3), 509–513.

Bowker, G. C. (1996). The history of information infrastructures: The case of the international classification of diseases. *Information Processing & Management*, 32(1), 49–61.

Brown, L., Malecki, E., & Spector, A. (1976). Adopter categories in a spatial context: Alternative explanations for an empirical regularity. *Rural Sociology*, 41, 99–118.

Burt, R. (1992). *Structural holes: The social structure of competition*. Cambridge: Harvard University Press.

Cassiolato, J. E., & Baptista, M. (1996). The effects of the brazilian liberalization of the IT industry on technological capabilities of local firms. *Information Technology for Development*, 7(2), 53–73.

Clozel, L. (2014). *How two health aid workers created an app before the age of apps existed.*.
<http://technical.ly/dc/2014/10/14/two-health-aid-workers-createdapp-apps-existed/> Accessed 9.10.16

DiMaggio, P. J., 1988. Interest and agency in institutional theory Institutional patterns and organizations: culture and environment.

Disrupt-africa.com. (2015). *MPedigree EarlySensor: Ahead of its time.*.
<http://disruptafrica.com/2015/08/mpedigree-earlysensor-ahead-of-its-time> Accessed 9.10.16

Douglas, K. (2013). *How Nomanini wants to replace airtime scratch cards 5.*.
<http://www.howwemadeitinafrica.com/how-nomanini-wants-to-replace-airtimescratch-cards/28794/> Accessed 9.10.16

Douglas, K. (2015). *How mPedigree built a business by combating counterfeit products.*.
<http://www.howwemadeitinafrica.com/how-mpedigree-built-abusiness-by-combating-counterfeit-products/51384/> Accessed 9.10.16

eLearning Africa News. (2010). *iCow transforming animal husbandry in Kenya.*.
<http://ela-newsportal.com/icow-transforming-animal-husbandry-in-kenya/> Accessed 09.07.16

economist.com. (2013a). *Giant reality-check four of the world's biggest lenders must face some nasty truths..* <http://www.economist.com/news/finance-and-economics/21584331-four-worlds-biggest-lenders-must-face-some-nastytruths-giant-reality-check> Accessed 9.10.16

economist.com. (2013b). *Airtime is money..* <http://www.economist.com/news/finance-and-economics/21569744-use-pre-paid-mobile-phone-minutescurrency-airtime-money> Accessed 9.10.16

Economist.com. (2010). *Out of thin air 10..* www.economist.com/node/16319635 Accessed 9.10.16

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, 50(1), 25–32.

Eisenhardt, K. M. (1989). Building theories from case study research. *The Academy of Management Review*, 14, 532–550.

Ekekwe, N. (2016). *What africa's banking industry needs to do to survive july 28.* <https://hbr.org/2016/07/what-africas-banking-industry-needs-to-do-to-survive>

Eppler, M. J. (2006). *Managing information quality: Increasing the value of information in knowledge-intensive products and processes.* Berlin: Springer.

Finextra.com. (2015). *Azimo romia integrates with M-Pesa..* <https://www.finextra.com/news/announcement.aspx?pressreleaseid=62434> Accessed 09.07.16

Foreign Policy.com. (2010). *Think again: The internet..* <http://foreignpolicy.com/2010/04/26/think-again-the-internet/> Accessed 09.10.16

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research.* Chicago: Aldine.

Glickman, D. (2015). *How cell phones can help end world hunger..* <http://news.nationalgeographic.com/2015/06/150610-hunger-nutrition-cell-phonefarming-agriculture-africa-world/> Accessed 09.10.16

Golder, P. N. (2000). Historical method in marketing research with new evidence on long-Term market share stability. *Journal of Marketing Research*, 37(2), 156–172.

Goldstein, S. (2012). *Mobile data collection: A leapfrog technology for health improvement..* <http://www.k4health.org/blog/post/mobile-data-collectionleapfrog-technology-health-improvement> Accessed 09.10.16

Gottschalk, L. (1969). *Understanding History: A primer of historical method.* New York: Alfred A. Knopf.

Granovetter, M. (1983). The strength of weak ties: A network theory revisited. *Sociological Theory*, 1, 201–233.

Granovetter, M. (2005). The impact of social structure on economic outcomes. *Journal of Economic Perspectives*, 19, 33–50.

Grant, R. (2013). *Startup Spotlight: Nomanini's orange box helps poor South Africans see more green*. <http://venturebeat.com/2013/02/07/startup-spotlightnomaninis-orange-box-helps-poor-south-africans-see-more-green> Accessed 09.10.16

Greene, D., & David, J. L. (1984). A research design for generalizing from multiple case studies. *Evaluation and Program Planning*, 7, 73–84.

Greenwood, R., & Suddaby, R. (2006). Institutional entrepreneurship in mature fields: The big five accounting firms. *Academic Management Journal*, 49, 27–48.

Gulati, A. Drones, Doves, (2015). <http://indianexpress.com/article/opinion/columns/drones-and-doves/> Accessed 09.10.16.

HIQA. (2011). *International review of data quality health information and quality authority (HIQA)*. <http://www.hiqa.ie/press-release/2011-04-28-internationalreview-data-quality> Accessed 09.06.16

Hardy, Q. (2012). *Active in cloud amazon reshapes computing..* http://www.nytimes.com/2012/08/28/technology/active-in-cloud-amazon-reshapes-computing.html?_r=0 Accessed 09.10.16

indigotrust.org.uk. (2012). *Grant Awarded to iCow..* <http://indigotrust.org.uk/2012/04/02/grant-awarded-to-icow-2> Accessed 09.10.16

IFC. International Finance Corporation. (2016). *Agriculture and climate risk enterprise (ACRE)..* http://www.ifc.org/wps/wcm/connect/industry_ext_content/ifc_external_corporate_site/industries/financial+markets/retail+finance/insurance/agriculture+and+climate+risk+enterprise Accessed 09.06.16

ILRI News. (2012). *Cows in the cloud: Kenyans are registering their cows, and increasing their milk yields on their mobile phones..* www.ilri.org/ilrinews/index.php/archives/10173 Accessed 09.10.16

Iammarino, S., & Michie, J. (1998). The scope of technological globalization. *International Journal of the Economics of Business*, 5(3), 335–353.

Jack, W., & Suri, T. (2010). *The economics of M-PESA..* <http://www.mit.edu/~tavneet/M-PESA.pdf> Accessed 09.06.16

Jayawardene, V., Sadiq, S., & Indulska, M. (2013). *An analysis of data quality dimensions. ITEE technical report 2013–01. school of information technology and electrical engineering.* The University of Queensland.

Kalan, J. (2013). *Tech fix for Africa's big farming challenge.*
<http://www.bbc.com/future/story/20130408-tech-taps-africas-farm-potential> Accessed 09.10.16

Kanyi, M. (2012). *Case studies: Who uses magpi (formerly EpiSurveyor).*
<https://datadyne.zendesk.com/entries/21282536-Case-Studies-Who-Uses-Magpiformerly-E>
Accessed 09.10.16

Kshetri, N., & Acharya, S. (2012). Mobile payment in emerging markets. *IEEE IT Professional*, 14(4), 9–14.

Kshetri, N., & Ajami, R. (2008). Institutional reforms in the gulf cooperation council economies: A conceptual framework. *Journal of International Management*, 14(3), 300–318.

Kshetri, N., Palvia, P., & Dai, H. (2011). Chinese institutions and standardization: The case of government support to domestic third generation cellular standard. *Telecommunications Policy*, 35(5), 399–412.

Kshetri, N. (2001). Determinants of the locus of global E-Commerce. *Electronic Markets*, 11(4), 250–257.

Kshetri, N. (2007). The adoption of E-Business by organizations in China: An institutional perspective. *Electronic Markets*, 17(2), 113–125.

Kshetri, N. (2016). Big data's role in expanding access to financial services in China. *International Journal of Information Management*, 36(3), 297–308.

Kumar, V., Stam, A., & Erich, A. J. (1994). An interactive multicriteria approach to identifying potential foreign markets. *Journal of International Marketing*, 2(1), 29–52.

thelancet.com. (2012). *Poor-quality antimalarial drugs in southeast Asia and sub-Saharan Africa.* <http://www.thelancet.com/journals/laninf/article/PIIS1473-3099%2812%2970064-6/fulltext> Accessed 09.07.16

Lawrence, TB., Suddaby, R. (2006). Institutions and institutional work. In S. R. Clegg, C., Hardy, W. R. Nord & T. B. Lawrence (Eds.), *The Sage Handbook of Organizational Studies* (pp.215-254). London.

Li, D., Feng, D. J., & Jiang, H. (2006). Institutional entrepreneurs. *American Economic Review*, 96(2), 358–362.

Loshin, D. (2001). *Enterprise knowledge management: The data quality approach.* Morgan Kaufmann Publishers.

- mhealthinfo.org. (2010). *EpiSurveyor mobile health data collection.* ,
<http://www.mhealthinfo.org/project/episurveyor-mobile-health-data-collection> Accessed 09.10.16
- newswatch.nationalgeographic.com. (2014). *Introducing iCow: The Virtual Mobile Midwife for Cows Ken Banks of National Geographic Emerging Explorer.*
<http://newswatch.nationalgeographic.com/2014/05/13/introducing-icow-thevirtual-mobile-midwife-for-cows/> Accessed 09.10.16
- nomanini.com. Nomanini (2014). <http://nomanini.com/news/2013/11/19/nomanini-expands-operations-east-africa> Accessed 09.10.16.
- Mason, R. O., McKenney, J. L., & Copeland, D. G. (1997). An historical method for MIS Research: Steps and assumptions. *MIS Quarterly*, 21(3), 307–320.
- Mbuvi, D. (2011). *Safaricom launches africa's largest native cloud CIO east africa.*
<http://news.idg.no/cw/art.cfm?id=B8F54E5E-1A64-67EAE4A7382D8CDA5A69> Accessed 09.10.16
- Mbuvi, D. (2013). *Kenyan dairy farmers to benefit from Safaricom's partnership with iCow.*
<http://www.cio.co.ke/news/main-stories/kenyan-dairy-farmers-tobenefit-from-safaricom%27s-partnership-with-icow> Accessed 09.10.16
- Miranda, M. J., & Gonzalez-Vega, C. (2011). Systemic risk, index insurance, and optimal management of agricultural loan portfolios in developing countries. *American Journal of Agricultural Economics*, 93(2), 399–406.
- Mirza, I. (2013). Frontline SMS and biNu,
<http://www.ghdonline.org/innovation/discussion/frontline-sms-and-binu/> Accessed 18.08.14.
- North, D. C. (1990). *Institutions, institutional change and economic performance.* Harvard University Press.
- Omolayo, O. (2015). *These 10 apps will boost agriculture in Africa.*
<http://venturesafrica.com/these-10-apps-will-boost-agriculture-in-africa/> Accessed 09.10.16
- Oosterhuis, F. (2006). *Innovation dynamics induced by environmental policy.* Institute for Environmental Studies, Vrije Universiteit. IVM Report, 07/05.
- Papadopoulos, N., & Denis, Jean-Emile. (1988). Inventory, Taxonomy and Assessment of Methods for International Market Selection. *International Marketing Review*, 5(3), 38–51.
- Price, R. J., & Shanks, G. (2005). Empirical refinement of a semiotic information quality framework. *System Sciences*.

- Rogers, E. M. (1995). *Diffusion of innovations* (Fourth edition). New York: Free Press.
- Rogers, E. M. (2003). *The diffusion of innovations* (5th ed.). New York: Free Press.
- Rosenberg, T. (2011). *Doing more than praying for rain..*
[http://opinionator.blogs.nytimes.com/2011/05/09/doing-more-than-praying-for-rain/? r=0](http://opinionator.blogs.nytimes.com/2011/05/09/doing-more-than-praying-for-rain/?r=0)
Accessed 09.10.16
- Rowley, J. (2002). Using case studies in research. *Management Research News*, 25(1), 16–27.
- Ruz, C. (2013). *Cloud computing key to improving literacy in Africa..*
<https://sciencenode.org/feature/cloud-computing-key-improving-literacy-africa.php> Accessed 09.10.16
- Sambira, J. (2013). *Simple invention brokers peace between humans and wildlife..*
www.un.org/africarenewal/magazine/august-2013/africa-wired Accessed 09.10.16
- Schneider, S. (2013). *Five ways cell phones are changing agriculture in Africa..*
<http://foodtank.com/news/2013/04/five-ways-cell-phones-are-changingagriculture-in-africa>
Accessed 09.06.16
- Schuilung, I., & Kapferer, J.-N. (2004). Real differences between local and international brands: Strategic implications for international marketers. *Journal of International Marketing*, 12(4), 97–112.
- Schumpeter, J. (1934). *The theory of economic development*. Cambridge: Harvard University Press.
- Schuster, C., Brito, P.C., 2011. Cutting costs, boosting quality and collecting data real-time –Lessons from a Cell Phone-Based Beneficiary Survey to Strengthen Guatemala’s Conditional Cash Transfer Program, En Breve, 166.
- Seawright, J., & Gerring, J. (2008). Case-selection techniques in case study research a menu of qualitative and quantitative options. *Political Research Quarterly*, 61(2), 294–308.
- Shadbolt, P. (2015). *Africa’s mobile money makes its way to Europe with M-Pesa..*
<http://www.cnn.com/2014/11/20/tech/mobile/tomorrow-transformed-mpesa-mobile-payments/>
Accessed 09.10.16.
- Skees, J. R., & Barnett, B. J. (2006). Enhancing microfinance using index-based risk-transfer products. *Agricultural Finance Review*, 66, 235–250.
- Stvilia, B., Gasser, L., Twidale, M. B., & Smith, L. C. (2007). A framework for information quality assessment. *Journal of the American Society for Information Science and Technology*, 58.

safaricom.co.ke iCow. (2013). <http://www.safaricom.co.ke/personal/value-added-services/social-innovation/icow> Accessed 09.10.16.

Stavros, C., & Westberg, K. (2009). Using triangulation and multiple case studies to advance relationship marketing theory. *Qualitative Market Research: An International Journal*, 12(3), 307–320.

the Star Letter from Berlin – From politics to the Olympics to M-health: The brotherly competition between Kenya and Ghana. (2016). <http://www.thestar.co.ke/news/2016/09/01/letter-from-berlin-from-politics-to-the-olympics-to-m-health-the-c1411336> Accessed 09.07.16.

un.org Africa Wired, (2014). www.un.org/africarenewal/magazine/special-edition-agriculture-2014/africa-wired Accessed 09.10.16.

Talbot, D. (2011). *Chasing the african cloud*.. <http://www.technologyreview.com/news/425922/chasing-the-african-cloud/> Accessed 09.07.16

Van Maanen, J., Dabbs, J. M., & Faulkner, R. R. (1982). *Varieties of qualitative research*. Beverly Hills, CA: Sage.

Vodafone.com Vodafone M-Pesa comes to Europe for the first time. (2014). <http://www.vodafone.com/content/index/media/vodafone-group-releases/2014/mpesa-romania.html#> Accessed 09.06.16.

Wang, R. Y., & Strong, D. M. (1996). Beyond accuracy: What data quality means to data consumers. *Journal of Management Information Systems*, 12, 5–33.

Wanjiku, R. (2011). *Safaricom offers locally hosted cloud service: Plans to run its M-Pesa pan-African mobile money offering on new platform Computerworld Kenya*.. <http://www.pcadvisor.co.uk/news/mobile-phone/3314899/safaricom-offers-locally-hosted-cloud-service/> Accessed 09.10.16

Whetten, D. A. (1989). What constitutes a theoretical contribution? *Academy of Management Review*, 14(4), 490–495.

Whyte, W. F. (1984). *Learning from the field: A guide from experience*. Beverly Hills, CA: Sage.

Yeebo, Y. (2015). *fake drugs in Africa*.. <http://businessweekme.com/2015/09/28/taking-on-fake-drugs-in-africa/#cnn> Accessed 09.10.16

Yin, R. (1994). *Case study research: Design and methods* (2nd ed.). Newbury Park: CA: Sage.