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Disruptive Innovation in Africa – Competing Against Non-Consumption

George F. Ward

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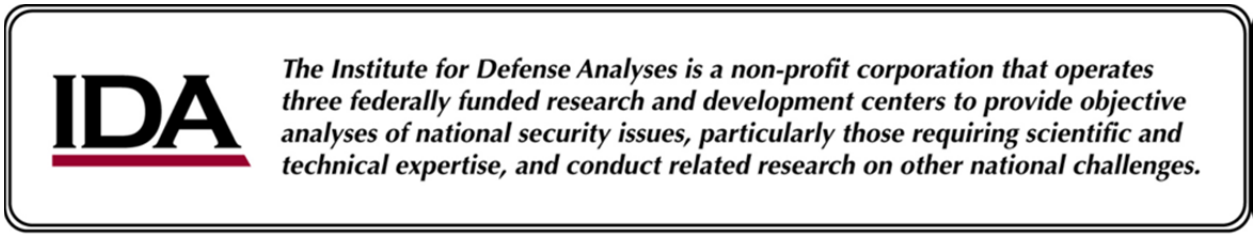

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Executive Summary

Established producers of goods and services often innovate by increasing the sophistication or added value of their products. Such "sustaining innovations" command high prices and help profitability. By behaving in this way, producers unwittingly open space for "disruptive innovations" that enter at the bottom of the market and provide access to a good or service to a whole new population of consumers. In effect, disruptive innovation is about "competing against non-consumption," creating totally new products for totally new consumers.

In the African context, mobile telephone technology has been an important disruptive innovation. Before the advent of cellphones, most Africans did not have easy access to telephonic communications because the landline network was inadequate. The number of mobile telephone connections in Africa rose from 17 million in 2000 to 620 million in 2010. In a few years, Africans became connected to each other and the world. More recently, simple cellphones have begun to be replaced by "smartphones." These devices are themselves spawning additional disruptive innovations in at least four fields: computing, banking and finance, education, and health care. In each of these areas, consumption has in the past been restricted because of the lack of available goods and services. Disruptive innovation is changing patterns of consumption by making new products available.

As was the case with the landline telephone network, the fixed-line broadband data network in Africa is inadequate. Mobile broadband technology is exploding into this underserved market. Smartphones, which in essence are hand-held computers, will be 40 percent of the mobile market in Africa by 2017. According to one estimate, by 2015 there will be 250 mobile broadband connections in Africa compared to only 15 million fixed-line connections. At least for the middle class, the smartphone – a disruptive innovation – will become the information engine of Africa, supplanting the personal computer – the disruptee – in that role. The principal risk to this scenario is that upgrades to regional and national "backbone" networks, the connections between international cables and local providers, might not keep pace with the proliferation of mobile broadband devices.

Cellphones have already fueled disruptive change in consumer financial transactions. Through the M-Pesa mobile money program, millions of consumers in Kenya and elsewhere who do not have each access to traditional banks are able to make financial transfers quickly and securely. Possible enhancements to M-Pesa and competitor systems show promise of providing additional banking services such as

payment of interest and access to credit. Provision of these services is currently constrained by regulatory issues, which will have to be resolved if mobile banking is to be fully realized in Africa.

Distance learning has long been a second-best alternative in Africa when places in traditional learning institutions were not available because of distance or shortages of spaces for students. In recent years, distance learning has gone on line. Student acceptance of the online format has not been high. Now, a disruptive alternative has become available worldwide in the form of Massive Open, Online Courses (MOOCs). These free courses with open enrollment are optimized for the online medium. Offered now by dozens of renowned universities, MOOCs have the capacity to become disruptive innovations in the African context by offering high-quality education, especially in technical fields, to students who do not have access to traditional universities. Barriers exist that will have to be surmounted. At present, many African students do not have broadband access. Arrangements for university credit for MOOCs have not been worked out in most cases. It is likely, however, that these barriers will be overcome faster than placements in brick-and-mortar universities can be provided for all the African students seeking education.

African consumption of health care services is low because those services are often not available. Physicians, nurses, clinics, and hospitals are in short supply. Disruptive innovations in mobile communications technologies have the potential to change this situation. Cheap plug-in devices for smartphones can be used by village-level providers to perform tests and diagnose diseases. Mobile communications can be used by physicians and nurses to follow patients located many kilometers away. But even these breakthrough systems need to be embedded in a healthcare delivery system, which is lacking in many areas of Africa. The advantage of the current wave of disruptive innovations in the health field in Africa is that the new devices can be utilized by providers with relatively low levels of technical expertise, thereby helping to compensate for the shortage of physicians and nurses.

These examples of disruptive innovation demonstrate that mobile broadband technology will continue to expand opportunities for African consumers and communities. The challenge is to build electronic and human systems quickly enough to keep up to the pace of innovation.

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GLOBAL COVERAGE ANALYSES PROGRAM – AFRICA

ECONOMIC AND DEMOGRAPHIC ISSUES

DISRUPTIVE TECHNOLOGIES: IMPACT ON DEVELOPMENT AND STABILITY

DISRUPTIVE INNOVATION IN AFRICA – COMPETING AGAINST NON-CONSUMPTION

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Disruptive Innovation in Africa – Competing Against Non-Consumption

"Disruptive innovation" is a term of art used by Professor Clayton Christensen of Harvard Business School to describe "a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors."[1] Christensen asserts that companies tend to innovate faster than their customers' needs evolve. They end up producing products and services that are too sophisticated for many customers in their market. These "sustaining innovations" command high prices from the most demanding consumers and thereby help companies maximize profitability. By behaving in this way, companies unwittingly open the door to "disruptive innovations" at the bottom of the market. According to Christensen, "an innovation that is disruptive allows a whole new population of consumers at the bottom of a market access to a product or service that was historically only accessible to consumers with a lot of money or a lot of skill."[2]

Some examples of disruptive innovation, according to Christensen, are listed in Table 1.

Table 1. Examples of Disruptive Innovation

Disruptor	Disruptee
Personal computers	Mainframe and mini computers
Mini mills	Integrated steel mills
Cellular phones	Fixed line telephony
Community colleges	Four-year colleges
Discount retailers	Full-service department stores

Truly disruptive innovation is not about building better products for the best customers, but about creating totally new products for totally new customers. Another way to think about disruptive innovation is "competing against non-consumption, creating products that are not really competing against another product but competing to get non-consumers to start using that product."[3]

Disruptive innovation, or competing against non-consumption, has had a notable impact in Africa during the early years of this century. As Figure 1 illustrates, the number of mobile telephone connections in Africa rose from 17 million in 2000 to 620 million in 2010, reaching a penetration rate of almost 57 percent. Africa is the fastest-growing

mobile market in the world and the largest after Asia.[4] This growth was possible largely because land-line telephone infrastructure was inadequate or, in many areas, nonexistent.

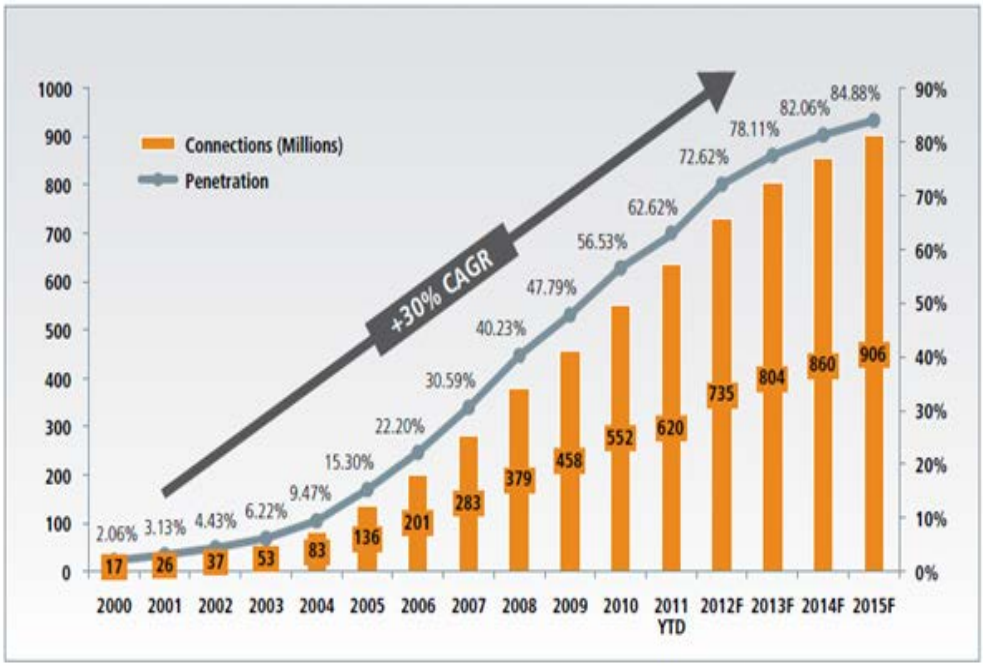

Figure 1.Total African Mobile Connections and Penetration Rate (million, %penetration)
Source: Badlani, Dilip, "Africa: Opportunities and Challenges in a Growing Economy," January 23, 2012, The Royce Funds

The mobile communications revolution in Africa could well be in its early stages. Simple cell phones are giving way to "smartphones." Mobile connections are still often slow, but they are now connected to fiber optic cables that transmit data at terabyte per second speeds, rather than kilobytes per second. The increase in speed is due to the recent landing of high bandwidth ocean cables in Africa. Mobile data transmission speeds will increase as base stations are modernized and connected to higher-capacity systems.

Innovation often stimulates additional innovation, and that is true for disruptive innovation as well. The mobile communications revolution in Africa is itself spawning additional disruptive innovations. In the remainder of this paper, we assess the prospects for disruptive innovation in four fields that are particularly important for economic and social development:

- Computing
- Banking and finance
- Education
- Health.

For each of these fields, we will discuss the current state of development and assess the significance of obstacles to further progress.

The Smart Phone – The Key Disruptor

As Figure 1 indicates, most Africans either possess or have access to a cellular telephone. Hundreds of millions of Africans have already been impacted by the first wave of disruptive innovation that these telephones triggered. A second wave of disruptive innovation in Africa has now begun. The new disruptor is mobile broadband technology for which the "smartphone," a mobile telephone with advanced computing capabilities, is the principal vehicle. Estimates of smartphone penetration in Africa ranged in mid-2012 from 3 percent to 17 percent. At the time, Samsung's estimate was 7 percent.[5] If smartphone penetration proceeds at roughly the same rate as cell phone penetration did, smartphones will be 40 percent of the mobile market by 2017. Noting that cutthroat competition between companies like Samsung and Huawei has brought the cost of a no-contract smartphone down to $100, at least one observer believes that the penetration rate could be even higher.[6]

Informa Telecoms and Media, a leading business information service, estimates that by 2015 one-fifth of the Internet traffic in Africa will be carried by mobile broadband networks. This compares to a global equivalent of just 3 percent.[7] Informa projects that by 2015 there will be 250 million mobile broadband connections in Africa compared to just 15 million fixed-line broadband connections.[8] If these projections, which are widely supported by other analysts, prove valid, the smartphone will become the information engine of Africa. It will bring the information content of the Internet within reach of hundreds of millions of Africans. The disruptee, in Christensen's parlance, will be the personal computer, which could become limited to settings in which wired broadband connections are available.

Realizing the potential of an African broadband revolution depends upon improvements in what Mark D.J. Williams, a World Bank expert, calls a "supply chain" of network elements, processing, and business services.[9] Four of the levels in the supply chain specified by Williams are of particular interest in the African context. The first level is the international connectivity that provides the link to the rest of the world. The second consists of the domestic and regional networks that carry traffic from the landing point of the international connection to other points within the country served. The third is the "intelligence" in the switching and routing protocols that ensures traffic is directed correctly. The fourth link is the one between the service provider and the customer, whether an individual or institution.

All four of these levels in Africa require considerable improvement, but much progress has already been made. At the first level, at least five major submarine cables have come into operation since 2007, bringing a huge increase in Africa's international bandwidth capacity.[10] Capacities in the third and fourth links in the supply chain have also increased vastly in the past few years. Figure 1 above portrays the increase in the number of mobile customer connections.

It is at the second level, the regional and national "backbone" networks, that the most work needs to be done. Without improvement, the backbone will become a choke point. The principal limitation of the current backbone is not its geographic reach. As Williams points out, an extensive backbone infrastructure already exists in sub-Saharan Africa. Terrestrial backbone infrastructure (microwave and fiber-optic cables) serves around three-quarters of communications users.[11] Satellite connections serve the remainder. The problem is that only 12 percent of the total terrestrial backbone is fiber-optic cable, which is needed for high-traffic applications.

The existing microwave infrastructure suffices for cellular telephony, but will be overwhelmed by rapidly expanding smartphone usage. Building out the fiber optic networks, especially to the rural areas of the larger African, countries will be a challenge. The expert consensus seems to be that market-based approaches to this task are most likely to succeed, and that substantial regulatory reform in many countries is necessary in order to facilitate investment.

Banking and Finance

The best known financial application of cellular telephone technology is M-Pesa ("M" for Mobile, "Pesa" for "Money" in Swahili). This mobile money program was introduced in 2007 in Kenya and has since been introduced in other countries, including Uganda and Tanzania. It features a variety of financial transactions for its users, such as purchasing airtime, transferring money, and paying bills.[12] M-Pesa succeeded largely because it was competing against non-consumption, offering banking to the unbanked. In its first three months of operations, M-Pesa registered 256,000 customers in Kenya.[13] After two years, M-Pesa had 8 million subscribers and a network of 13,000 agents in Kenya. Almost 40 percent of Kenyans had used the service to transfer a total of more than $3.7 billion.[14] More recently, M-Pesa has acquired competitors. This has stimulated innovation and kept prices affordable.

M-Pesa and its competitor products already have networks of agents that are much more extensive than the formal banking system in Kenya. In 2006, the latter had only 450 bank branches, or less than two bank branches per 100,000 people. Only 27 percent of the population participated in the formal banking sector.[15] The question of whether mobile money systems will supplant banks, at least for most Kenyan consumers, is still, however, open. Several factors are worth noting in this regard:

- First, most M-Pesa transfers occur in urban areas, and users of the system are wealthier and better educated than average. For many of these consumers, M-Pesa is used in parallel with a formal bank account. More recent evidence indicates that, although it took much longer for M-Pesa to penetrate rural areas than urban ones, the rural areas are catching up. Today, 80 percent of Kenyan rural households use M-Pesa.[16]

- Second, M-Pesa lacks some essential elements of a banking system, including provision for payment of interest, access to credit from formal institutions, and deposit insurance. In high-inflation economies such as those in East Africa, the absence of interest payments is a significant disincentive. Despite these deficiencies, there is evidence that members of informal savings groups in Nairobi are using M-Pesa to deposit individual savings into a group account.[17]
- Third, a robust regulatory framework of mobile financial transactions in Kenya has not been established. Analysts have pointed out that the transformation of financial systems by mobile payment services might be constrained by financial and other regulations.[18] It remains to be seen whether regulations can be put in place without constraining the innovative and nimble technologies and business practices that have made mobile money transfer possible.

Education

Distance learning has a long history in sub-Saharan Africa. The University of South Africa (UNISA) became a fully fledged correspondence university in 1959. Today, it is a comprehensive open- and distance-learning institution with more than 350,000 students.[19] The rural nature of much of Africa and the absence of adequate boarding arrangements at existing campuses made distance learning at the tertiary level a necessity, at least in South Africa.

In other instances, online learning has not fared well when traditional university courses were available as an alternative. In a study involving a group of undergraduate students at the Regent University College of Science and Technology in Ghana during the 2006-2007 academic year, students did not react well to the online format, and indicated a preference for traditional means of instruction. They did not participate widely in the electronic discussion forums that were provided, and they missed the traditional format of classroom lectures, note taking, and written examinations. One conclusion of the researcher was that greater maturity might be required of online learners than traditional ones.[20]

Perhaps because participants possess high levels of maturity, online learning has been successful in in-service training applications in Africa. In Kenya in 2005, the National Meteorological Service began to deliver online a course in Statistics in Applied Climatology that was considered essential to transition its personnel from short-term forecasting to analysis of longer-term trends. The course, which included ample provision for discussion and feedback, was highly successful. It cut in half the need for in-person training in statistics and significantly accelerated the implementation of a nationwide statistical system.[21] There have been similar positive experiences in training health professionals on line.[22]

A vehicle that can bridge the online acceptance gap for many African students may now be available. As *The New York Times* put it, 2012 was "The Year of the MOOC," – Massive Open, Online Courses.[23] What are the characteristics of MOOCs?

- Traditional courses charge tuition, carry credit, and limit enrollment. MOOCs are usually free, carry no credit, and are massive in size.
- Because MOOCs enroll so many students, faculty cannot interact personally with each student. This means that course design – building interactivity into every part of the course – is very important. Students learn from each other in study groups – both in-person and online – and grade each other's work.
- As in the MOOCs' antecedent, open coursework, the lecture is the medium; however, lectures in a MOOC are typically only 8 to 12 minutes long and are followed by a quiz to ensure that students are grasping the material.
- Feedback is electronic, and teaching assistants may monitor discussion boards. There may be homework and a final exam.
- Students often organize study groups in their physical locations.

An excellent introduction to MOOCs is contained in a talk given by Dr. Daphne Koller, one of the founders of Coursera, a pioneer company in the field, at TEDGlobal 2012.[24] In September 2012, Coursera was reported as hosting about 200 courses from 33 international and domestic schools and reaching more than 1.3 million students around the world.[25] Five months later, February 6, 2013, the Coursera website reported that the number of "Courserians" had grown to 2,586,414. The institutions using Coursera as a learning platform are among the finest in the world.[26] Other organizations offering MOOCs include Udacity, which originated at Stanford University, and EdX, which has its roots in Harvard and the Massachusetts Institute of Technology. Both of the latter organizations focus heavily on courses in mathematics, science, and technology.

MOOCs are not a panacea, and they have attracted some criticism. Coursera does not offer credit for its courses, although individual institutions that offer courses through the Coursera platform may do so for a separate fee. Funding for Coursera for the long term is a work in progress. Courses offered through Coursera are free, and the organization itself, although nominally for-profit, so far has been sustained by university donations. At least in their early stages, MOOCs seem to be better adapted for learning in science and technology than in the humanities and social sciences. MOOCs have also been criticized at a more fundamental level for reflecting mindsets rooting in the Global North and excluding institutions based outside of the industrialized countries.[27]

These criticisms aside, MOOCs seem to fit the paradigm of "competing against non-consumption." They are a disruptive technology that is spreading worldwide with

amazing rapidity. As of July 2012, 65 percent of Coursera's student population was outside the U.S.[28]

How will MOOCs impact Africa? Although data on enrollments in MOOCs via Coursera, EdX, and Udacity are not available, there are frequent references in media coverage of MOOCs to Africa-based students. Dr. Daphne Koller cited the shortage of spaces at universities in Africa as one of her motivations for launching Coursera.[29] At least in the areas of science, mathematics, and technology, MOOCs provide access to world-class scholarship that is not commonly available in traditional African university settings. On the other hand, successful study in a MOOC requires access to a broadband connection, which is often not available to African university students. Given the development of mobile and internet technologies in Africa over the past decade, it is likely that the broadband-access problem will be solved before traditional university access becomes available to all students desiring university educations. As questions of accreditation, testing, and academic honesty (cheating is a problem) are addressed and solved, MOOCs will likely play a large role in the training and education of the next generation of African technologists.

Health

African consumption of health care services is low in large part because those services are often not available. In the 28 most doctor-deficient countries of sub-Saharan Africa, there is a median of 20,000 people per physician, which is 52 times the ratio in the U.S.[30] There is little likelihood that the shortage of trained health practitioners will be relieved by traditional educational means. According to McKinsey and Company, 820,000 additional doctors, nurses, and midwives are needed to provide even the most basic health services.[31] Training such a large number of practitioners is clearly beyond the capability of the 100 or so medical colleges in sub-Saharan Africa. Exacerbating the problem is the fact that many African health practitioners emigrate once they have completed their training. As of 2007, only 50 of the 600 doctors trained in Zambia since independence continued to practice in that country. More Malawian physicians may have been practicing in the British city of Manchester than in Malawi.[32] The emigration of nurses, who are so essential to the provision of basic health services, is also a serious problem for many African countries.

The health care services market in Africa is a classic case of a situation ripe for disruptive innovation. Although the innovations that will transform African health care are emerging only gradually, it seems clear that mobile communications will play a significant role. Chris Ross, an executive at the British-South African mobile telecommunications company Vodafone, asserts that healthcare will provide the next wireless breakthrough in Africa. "Someone who is ill often cannot travel, but now we can

reach them. Doctors, who are in short supply in Africa, can give mobile health workers all the information they require to run community health clinics."[33]

Technical innovations that could contribute to disruptive change in the healthcare field are beginning to appear. With support from Microsoft, researchers in Australia have developed a cheap ($10.00) tool that can be plugged into a mobile telephone and used to diagnose pneumonia. The same team is developing a cell phone electrocardiogram that will cost less than $5.00 and a suite of software applications that can be used to accurately estimate drug dosage schedules and fetal development in pregnant women.[34] The UN Office for the Coordination of Humanitarian Affairs has compiled a list of many other applications of mobile phone technology in the health field, including the following:[35] Some of these are the following:

- Health checkups by text message
- Text message reminders to patients regarding medications
- Monitoring stocks of medicines in remote locations and their distribution
- A self-test device based on a computer chip that can be plugged into a mobile phone for identification of sexually transmitted infections.

Missing, at least so far, is the human network that will bind applications such as these together. The success of M-Pesa, discussed above, was due not only to a simple, disruptive innovation, but also to the network of agents that Vodafone built to support the system. The M-Pesa shows that considerable commercial rewards flow to those that deploy disruptive technologies in Africa. The dilemma in the government-dominated healthcare field may be how to provide those incentives and opportunities to the private sector.

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14. ABSTRACT

Disruptive innovations enter at the bottom of a market and provide access to a good or service to a whole new population of consumers. In effect, disruptive innovation is about "competing against non-consumption." In the African context, mobile telephone technology has been an archetypal disruptive innovation. Mobile telephone connections rose from 17 million in 2000 to 620 million in 2010. So-called "smartphones" are generating new waves of disruptive innovation in many fields. This paper examines disruptive innovations in the African context in the fields of computing, banking and finance, education, and health care

15. SUBJECT TERMS
Disruptive innovation, Africa, mobile telephony, computers, health care, education, banking, finance, MOOCs

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