ICTs, Statebuilding and Peacebuilding in Africa   Center for Global Communication Studies (CGCS)

1-2015

Who is ICT Innovation For? Challenges to Existing Theories of Innovation, a Kenyan Case Study

Eleanor Marchant
University of Pennsylvania

Who is ICT Innovation For? Challenges to Existing Theories of Innovation, a Kenyan Case Study

Abstract

Kenya, along with countries like Nigeria, South Africa, and Ghana, is leading the way on the continent in innovating new applications and programs that enable developments in the information communication technology (ICT) sector. This growth has not gone unnoticed. It has attracted substantial international interest, not just from non-profit organizations focused on development, but increasingly from for-profit actors interested in investing in the country.

In this environment, understanding how tech innovation happens in Kenya – the roles played by these many different international, local, for-profit, and not-for-profit actors – is a big part of understanding the shape of new technologies that will emerge. Yet many of the theories that exist to explain technology innovation were developed to describe processes in Western contexts, like Silicon Valley, far removed from the reality of innovation in Kenya.

This paper uses the technology innovation sector in Kenya to illustrate where existing innovation theories fall short. If we hope to understand the growth of these sector and help shape its development, ICT, communication, and management scholars need to work together to develop better theories to explain the unique context of innovation in African countries.

Disciplines
Communication Technology and New Media

Who is ICT Innovation For?
Challenges to Existing Theories of
Innovation, a Kenyan Case Study

Eleanor Marchant

CENTER FOR
GLOBAL
COMMUNICATION
STUDIES

Annenberg • Africa
ICT Research Observatory

Annenberg
SCHOOL FOR COMMUNICATION
UNIVERSITY of PENNSYLVANIA

Who is ICT Innovation for? Challenges to Existing Theories of Innovation, a Kenyan Case Study

Center for Global Communication Studies
Annenberg School for Communication
University of Pennsylvania
202 South 36th Street
Philadelphia, PA 19104
Phone: 215-898-9727
Fax: 215-573-2609
Email: cgcs@asc.upenn.edu
URL: www.global.asc.upenn.edu

By Eleanor Marchant

Design and layout: Jen McCleary

Contents

Introduction

Kenya's mobile communication industry is a fast growing innovative sector that increasingly produces technologies with a global significance. Examples include M-PESA, the mobile banking system that has made Kenya the global leader in mobile money (The Economist, 2013). Such achievements sit in stark contrast to perceptions, so prevalent among many outside of the continent, that Africa is 'backwards' or 'underdeveloped'. Working against such characterizations, the mobile communication industries in Kenya and a handful of other African countries have rapidly expanded in the last five years. This has attracted widespread international interest, not just from those interested in helping to 'save Africa', but increasingly from those interested in investing in it as well. In Kenya—the country that many have called the "tech hub of Africa" (Bloomberg, 2013) – these actors include development organizations as well as multinational technology companies and private equity firms. All these actors have the potential to influence the kinds of technologies that are created in the Information Communication Technology (ICT) sector.

The Kenyan government has also turned its attention towards the ICT sector. In the last few years, the government has launched, among other things, the Konza City project and Huduma. The Konza City project is intended to be the country's new home for technology innovation and has been branded as the "Silicon Savannah." Huduma is a new system for streamlining public-to-government communication and government service delivery, which includes a mobile platform and is slated to include an online platform before the end of 2014. Though the success of such projects is debatable, these projects, along with the new ICT Master Plan, help illustrate the importance that the government places on the growth of the ICT sector for the future of Kenya's economic growth and global position.[1]

In this environment, understanding the process by which innovations in the ICT sector are taking place is of central importance for the future development and sustainability of this sector. Yet many of the theories that exist to explain innovation were developed to describe processes in

Western contexts. While in recent years, more theories have been developed to describe information technology innovation in an increasingly globalized context, too many focus on these complicated global dynamics predominantly in relation to how they affect the innovation potential in Western multinational companies.

After providing a review of the existing international literature on technological innovation, which is largely situated in the business and management literature, I will examine the case of the Kenyan ICT innovation ecosystem to demonstrate where the existing theories may be insufficient. Through fieldwork conducted over two summers in the Kenyan technology innovation sector, I will outline some of the different players in the Kenyan ecosystem and many of the numerous and overlapping networks that allow it to function. This outline will be used to make the case that while the existing theories on innovation may be helpful, they should always be approached and used with a critical eye. In particular, I will argue they undervalue the contribution of the social, cultural, and historical contexts in which innovation takes place. In addition, existing theories overlook the ways in which those contexts intermingle and conflict in a transnational innovation ecosystem. In the Kenyan case, the particularities of the context have led to an innovation system whose structure differs from the ones described by existing theories, particularly in the role of universities and the incubators. It has also meant that the purpose of the sector – who technology in Nairobi is being created for – is constantly being renegotiated by the different individual and organizational actors currently engaged in the system, whether they are multinational or local, non-profit or for-profit.

It is my hope that this illustration might be a helpful word of caution for practitioners, policymakers, and innovators eager to fully adopt Western approaches to technology innovation in a transnational ecosystem where the motivations such as "social impact" and "economic growth" are constantly being renegotiated. Similarly, I suggest that this challenge to existing theories of innovation contextualized in such a hybrid and fluctuating innovation ecosystem may be useful for communication scholars interested in how such culturally divergent actors engage

---

1   The ICT Master Plan forms a central part of the current administration's new vision for the future.

with one another around a common interest: the growth of local mobile innovation in Kenya.

This article predominantly draws on two sources. First, it uses fieldwork conducted during two one-month long residential fellowships at iHub Research, a Kenyan research center affiliated with the iHub incubator, during the summers of 2013 and 2014. This fieldwork includes nineteen semi-structured interviews with individuals from a sample of Kenyan incubators and start-ups, the government, the media, and the multinational technology companies engaged in the sector. Secondly, it incorporates the analysis of publicly available documents, including official government reports, private sector reports, and journalistic coverage of the sector. Before proceeding, a few definitions are necessary to ensure a common frame of analysis, particularly regarding ICT innovation and the ICT innovation ecosystem.

"Innovation" is an illusive concept with many different interpretations in different industrial and scholarly communities. For the purposes of this paper, I will begin with the way in which management scholars conceptualize "ICT innovation." Rogers defines innovation as "the process of introducing new ideas to the firm which result in increased firm performance" (Rogers, 1998). Baregheh, Rowley, and Sambrook's definition of innovation as "the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace" (Baregheh, Rowley, & Sambrook, 2009, p. 1334), represents an attempt to encapsulate Rogers' definition and the many other different ways innovation is conceptualized within the management discipline. However, for the purpose of understanding ICT innovation in Kenya, we need to stretch beyond management scholarship and incorporate the definitions of innovation used by scholars in the ICT for development (ICT4D) field. The ICT4D field

has long been engaged with the Kenyan context. This field has advanced the concept of "participatory development," but has only recently been exploring innovation. They see ICT innovation more as a socially-embedded process or what Avgerou calls "innovation in situ" (Avgerou, 2010, p. 4). In other words, how might technological innovation be reflective of "what is locally meaningful, desirable, or controversial, and therefore, on how technology innovation and organizational change emerge (or are delayed) amid the local social dynamics" (Avgerou, 2010, p. 4)? I therefore offer the following composite of the two definitions: ICT innovation comprises of the actions or processes of inventing a new method, idea, or product for the ICT sector that derives from the social, political, and cultural background of the individuals, the organizations, and the physical context in which the innovation takes place.

The "ICT innovation ecosystem" builds on this understanding of innovation and draws from arguments made by Fransman and others who conceptualize the many players and their interactions involved in ICT use as an "ecosystem." This becomes a useful metaphor to illustrate that it is "more than just a technological system" but instead a "social system within which ICTs are embedded" (Smith & Elder, 2010). These scholars also acknowledge the importance of the innovation process in ensuring that the ICT sector is relevant for society's broader social development. I would therefore propose that with the multitude of actors involved in innovating new technologies– telecom companies, start-ups, incubators, the government, banks, multinational technology companies, international NGOs, and others – an "ecosystem" is an equally useful metaphor through which to understand technology production as well as use. Keeping this metaphor in mind will help to visualize the ways in which the meaning and the purpose of the ICT sector in Kenya are constantly renegotiated by the interactions between very different actors.

Existing Theories of Innovation

Much of the existing literature on innovation stems from the work of the famous economist Joseph Schumpeter, who pioneered the now widely held view that innovation and entrepreneurship are key to ensuring continued economic growth. In the Kenyan context, a number of scholars have similarly argued for the central role of innovation, and particularly entrepreneurship, in supporting national growth (Ndemo & Maina, 2007; Tiffen & Mortimore, 1994; Africa Research Bulletin, 2007). There is a wide and continuously developing array of literature within business and economic journals on the role of innovation in economic growth (Jaffe & Trajtenberg, 2005; Carlsson, 2007), with an increasing emphasis on the role of innovation in a globalized system (Thoenig & Verdier, 2003; Freund & Weinhold, 2004). This reflects the increasing transnationalism of the innovation process. This literature tends to focus on either multinational companies and their innovation processes in countries outside their home countries (Nachum, Zaheer, & Gross, 2008; Freeman, 1995; Evangelista & Mastrostefano, 2006) or the role of larger local companies' innovation in the economic growth of emerging economies (Gorodnichenko, Sveynar, & Terrell, 2010; Morgan, 2007). In short, as Fichman has pointed out, the goal of much of the existing research on innovation in this area is "to provide guidance to [company] managers on questions of 'whether, when, and how to innovate with IT'" (Fichman, 2004, p. 315 citing Swanson and Ramiler, 2004).

While the focus is often still on business-led innovation, other theories in this field have argued for thinking beyond innovation internal to a business. For example, the concept of a "national innovation system" (NIS), the system of various actors involved in innovation in a national economy[2], argues that innovation cannot happen entirely internally and that partnerships are often necessary to spur innovation on a national scale (Lee & Park, 2006; Dodgson, Mathews, Kastelle, & Hu, 2008). Nonetheless, such partnerships are still often described in terms of "collaborative advantage" (Huxham, 1996) or "synergy" (Mackintosh, 1992), both of which tend to focus on company mergers or formal supply chain partnerships that give companies an advantage over competitors (Cao & Zhang, 2008).

2   For further discussion see for example Freeman, 2002; Balzat & Hanusch, 2004; or Fagerberg & Srholec, 2008

More progressively, Etzkowitz and others have conceptualized this 'national innovation system' as necessarily involving other actors, particularly the government and advanced research centers at universities (Lundvall, 2007; Mowery & Oxley, 1995; Adner & Kapoor, 2010; Bala & Davenport, 2008). Etzkowitz famously described this as a "triple helix" linking industry, government, and universities with an interactive exchange of research, funding, and production (2002), often involving business incubators that emerge from these partnerships and function as a key nexus between them.

In recent years, the university has featured more prominently in theories about innovation because of its role as a rich source of research and development (R&D) as a function of the flow of human capital in its student body (Mian S., 2011; Siegwart & Hess, 2013; Al-Mubaraki & Busler, 2011). The model of a university linked with an incubator to facilitate R&D for productive innovation has proliferated beyond the United States in places like Israel (Rothschild and Darr 2005), Mexico (Molina, Aguirre, Breceda, & Cabero, 2011), Portugal (Ratinho & Henriques, 2010), and Rwanda (Aggerwal, 2012).

Concurrent with the development of innovation theories involving universities, the "open innovation model" has become particularly popular for understanding innovation in the high-tech industries, of which ICT is certainly included (Gassman, Enkel, & Chesbrough, 2010). Among these scholars, open innovation is conceptualized as "the use of purposive inflows and outflux of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough, West, & Vanhaverbeke, 2006). While this definition again focuses on markets and companies, it also acknowledges the value of information exchange between companies and other actors. Gassman, Enkel, and Chesbrough describe nine different perspectives through which "open innovation" has been conceptualized by researchers in this field, including the spatial perspective (the geographic globalization of innovation), the user perspective (the integration of users into the innovation process), and the tool perspective (the integration of 'open' platforms to facilitate participation by a wider array of innovators) (Gassman, Enkel, &

Chesbrough, 2010, pp. 1-2). Ultimately, this line of theory – most typically attributed to Henry Chesbrough – is arguing that companies can no longer afford to innovate on their own, and that the boundaries between a company and its surrounding environment are, necessarily, more permeable than before. This has led, for example, to large companies recognizing the value of innovations at start-ups that they eventually acquire and integrate into their own operation. Such is the case of Google's 2013 acquisition of the Israeli traffic mapping start-up, Waze, or even by the models of incubation at fast-paced accelerator programs that measure a start-up's success by how much a large company is willing to pay to acquire it.

What Etzkowtiz's triple helix and the open innovation model have in common is their belief in the importance of the exchange of knowledge and information between various actors involved in the process of technology innovation. Another way in which scholars in the management field have articulated this has been through the importance of "networks" (Murray, 2002; Valverde, Sole, Bedau, & Packard, 2007). Saxenian, for example, has shown the importance of building networks for the success of innovation in Silicon Valley (Saxenian, 1996). Others have examined it in other contexts like the high-tech industry in Germany (Gemunden, Ritter, & Heydebrech, 1996)

The "network" as a metaphor has been so widely applied in the social sciences – from trade networks to computer networks to knowledge networks to the ubiquitous social networks – that a bit of specificity is necessary before proceeding. At its broadest, a network is an interconnected group of people or things. For business and management scholars, networks are largely conceptualized as formal and informal linkages, predominantly between firms, but also among other actors, like universities (Powell & Grodal, 2005; DeBresson & Amesse, 1991). Such networks are seen as an important part of the innovation process. Ritter and Germunden, for example, have argued that companies need to "develop network competence in order to link their organization to other players in the market to allow interactions beyond organizational boundaries" (2004, p. 548). This literature argues that fostering network ties, particularly ties between diverse players (Nieto & Santamaria, 2007), can expand a company's knowledge base (Hagedoorn & Duysters, 2002) and, in turn, enhance knowledge diffusion and technology development (Powell W. W., 1998). Often this is studied as more partnerships

across different levels of a supply chain (Soosay, Hyland, & Ferrer, 2008; Kim, Cavusgil, & Calatone, 2006; Lee & Whang, 2000) and is typically seen as motivated by an issue of resource dependence when a company has insufficient internal capacity to effectively innovate on its own (Wang, 2008; Teo, Wei, & Benbasat, 2003; Brass, Galaskiewicz, Greve, & Tsai, 2004; Hseih, Yeh, & Chen, 2010).

However, some of this literature also emphasizes the importance of *informal* networks between various firms, or what is often described as an "innovation milieu" (Keeble & Wilkinson, 1999; Camagni, 1995). This perspective stresses the importance of "soft factors" like "common understanding and behavioral attitude for starting and maintaining innovation processes" (Todtling & Lehner, 2009, p. 5). Many theories have subsequently developed around what kinds of factors encourage the growth of strong informal networks. The notion of 'proximity' proves particularly popular. This certainly includes geographic proximity (Lagendijk & Oinas; Furman, Porter, & Stern, 2002), which scholars argue can encourage network growth among firms through access to resources, local markets, and a similar business culture among other things. However, Boschma and others have argued that geographic proximity is insufficient on its own and is primarily useful in its ability to "facilitate interactive learning, most likely by strengthening the *other* dimensions of proximity" (Boschma, 2005, p. 62), including social, institutional, and cognitive proximities (Harrison, 1994; Howells, 2002; Letaifa & Rabeau, 2013; Boschma, 2005). The concepts of *social proximity*, what Letaifa and Rabeau describe as "the individuals' levels of relationships and includes trust based on friendship, kinship and experience" (2013, p. 2072), and *cognitive proximity*, what they describe as "the similarities in the ways actors perceive, interpret and evaluate the world" (ibid), are helpful here. They move us away from the conception of a network as largely links between inanimate firms or nodes and push us to think of the many individuals involved in those networks as well as the many networks that might develop between the numerous different categories of actors.

The literature in the business and management field illustrates an emphasis on the role of the company in innovation processes, increasingly examining how innovation is changing in a globalized context, and how networks and partnerships can be leveraged for more effective innovation. A few scholars in this field have

acknowledged the important role played by actors beyond these companies, most frequently emphasizing the role of universities for research and development and, at times, the role of government in providing financial and regulatory support. Finally, the research exploring open innovation and networks, both formal and informal, have further demonstrated the importance of 'nontraditional' actors, such as end-users, in innovation. With this in mind, the next section will explore the Kenyan case in more depth to assess the extent to which these existing theories are relevant in the Kenyan context and to examine ways in which they might need to be discarded, challenged, or adapted.

Case Study and an Evolving Theory

"God has been great to Africa by giving us so many problems, because problems breed innovation." – Dr. Bitange Ndemo, former Permanent Secretary to the Ministry of Information and Communication in Kenya, June 2014

While provocative, such a statement does seem to have some grounding in the context of Kenyan technology development. The two innovations that the country's tech industry is currently best known for, Ushahidi and M-PESA, both in some way can attribute their success to problems that Kenyans face. Ushahidi, the platform initially designed to map the election in 2007, made a name for itself in part because it became a vital tool for mapping, tracking, and responding to instances of violence when the post-election climate deteriorated. M-PESA, while not entirely Kenyan in origin as a central role was played by the British company Vodafone Group, took off so successfully in Kenya because its mobile banking platform appealed to many in the poorest communities who could not access the traditional banking system. A current Senior Fellow for Global Economy and Development at Brookings recently wrote that Kenya is "a leader in the information communication revolution in the region" and that "the overall performance of the [East African] region will to a great extent depend on what happens in Kenya" (Kimenyi, 2014). Interviewees from some of the multinationals present in Kenya have attributed the country's current appeal as a tech investment opportunity to the growing middle class, the growing urban population, and an economy that is not natural resource dependent as many of its competitors such as Nigeria and Ghana are often seen. With such attention and at such a crucial moment in Kenya's economic development, it is a particularly pivotal moment for a more detailed look at the context around technology innovation in Kenya in order to develop theories that are more reflective of the current state of this ecosystem and its underlying norms.

Transnationalism

As the case of M-PESA might indicate, many technological innovations in Kenya are not entirely domestic in origin. For example, Microsoft and Google both provide training and access to their mobile smartphone platforms for Kenyan developers to design apps. International donors, such as Omidyar Network and the World Bank's InfoDev program, have played a large part in helping to finance the country's new technology sector, like the highly trafficked tech hub, iHub.

The colonial history of most of the countries in Africa has meant a long history of foreign participation in economic affairs. Microsoft and IMB's recent decision to make Kenya their regional hub is in keeping with the country's geopolitical history as the regional hub for many contemporary international actors, like the United Nations and the US government. With numerous foreigners traveling to Kenya to establish their own start-ups (e.g. Map Kibera Project or Hummingbill), or coming to the country as venture capitalists (e.g. 1% Club) to fund others, the 'national innovation system' in Kenya is anything but exclusively national in structure. Multinational companies such as IBM, Google, Procter & Gamble, Nokia, Huawei, Intel, and Microsoft, for example, have all set up major, if not their principal, regional offices in Kenya.

Such a transnational innovation ecosystem may not seem to distinguish Kenya from the American ecosystem that many of the existing theories describe as increasingly globalized (Ernst, 2002; Florida, 1997; Archibugi & Iammarino, 2002). However, the nature of the transnationalism and the power

dynamics between the international and local actors in both varies significantly. At the risk of oversimplifying, the distinction between the two in large part comes down to the apparent groundedness of the largest companies in the respective ecosystems. What is meant by 'largest' here is the most economically powerful actors, or as Bourdieu might describe, those actors with the most "economic capital" (Bourdieu, 1986). In the United States the 'largest' such actors typically have their headquarters inside the country, pay taxes to the government there, and focus on American consumers as their initial user market. Even if their intention is to create more globally relevant products, the American context is the home ecosystem, and the home culture, from which many of these companies such as Apple, IBM and Intel emerged. Similarly, many of the venture capitalists and angel investors who help fund US start-ups in their initial stages and accelerator programs that aid their progress into sustainable companies are often US-based (Kaplan & Stromberg, 2004).

By contrast, many of the actors with the most economic capital in the Kenyan context have been largely foreign. These include the multinational technology companies (e.g. Google, Microsoft, and Hewlett Packard) that have helped to finance much of the innovation taking place in Kenya, as well as venture capital firms (e.g. Africa Media Venture Fund, Anonoa Sustainable Impact Fund, and CMA Investment Holdings), and international donor agencies (e.g. the World Bank, USAID, and the Ford Foundation) that see a market for innovations for social good in the Kenyan ecosystem. While these actors are undoubtedly global and not exclusively Kenyan in their focus, some of these actors have been involved in Kenya for quite some time. Interviewees at such companies describe the current Kenyan administration as economically competent, and few, if any, withdrew from the country following the recent increase in terrorist attacks along the coast or after the 2013 Westgate mall attack. Interviewees speculated that such events had scared away prospective, but not current investors in the ICT industry.

While the balance between local and international actors in the Kenyan case does not exactly resemble that of the United States, business and management scholars might argue that the particularly transnational nature of the ecosystem would be supportive of progressive innovation (Bartlett & Ghoshal, 1990; Saxenian, 1996; Ernst, 2006). Nonetheless, even with multinationals or foreign donors

that have been in Kenya for a while, there are likely varying levels of long-term investment in the local ecosystem. This is rarely at issue when dealing with a more 'national' or at least more 'nationally-based' network of actors. For example, a number of the managers of Kenyan tech incubators reported that they were increasingly looking for local sources of financial support—from local banks such as Equity Bank or from local telecoms like Safaricom— as the "long-term commitment" of the multinationals to growing the local innovation ecosystem is in doubt. As one manager stated:

> …we were very deliberate about local sponsorship this year, from Chase Bank [a local Kenyan bank not to be confused with the American company, JP Morgan Chase] for example. When you have someone that's making their money locally and not reliant on the ups and downs of the international market, they are more likely to have priorities more aligned with what's happening on the ground.

Such local actors have clearly begun questioning the commitment and investment of large international actors in the local ecosystem. Yet the link between the locality of a company's headquarters and the depth of their investment in Kenya is not so clear-cut. Would the financial dominance of this market by international actors necessarily mean that technology created in Kenya is *less attentive* to the needs of the wider Kenyan tech ecosystem, or to the "many problems" that Dr. Ndemo argued Africa has been blessed with? Would a transition to local funders necessarily mean that technological developments are *more attentive* to such problems? Even if the answers are not so straightforward, existing theories of innovation rarely problematize for whom the particular technologies are being developed beyond advocating for 'user' research.

Robert Fichman argues this may be a result of the widely held view discussed earlier that innovation is an intrinsic part of continued economic growth and therefore, beneficial in its own right. It could be argued, particularly in an ecosystem with so many foreign actors with large amounts of economic capital, that it may be dangerous to assume that the impact—especially the social and cultural impact, but even the economic impact—of new technology adoption is necessarily a good in and of itself. As the next section will show, the emphasis on a positive "social impact" of technological developments among a diverse array of

actors in the Kenyan ICT innovation ecosystem is another factor that sets the Kenyan case apart from the ones existing theories usually describe.

The Social Impact Factor

As mentioned earlier, both of Kenya's most well-known tech innovations, M-PESA and Ushahidi, can in some way attribute their success to the problems faced by Kenyans. Yet, most innovations across the globe could also, in some way, be described as problem solving. At a very basic level, the mobile phone and the laptop computer were both inventions that solved the problem of physical restraint posed by their predecessors. Improvements in computer processors have made computers ever faster and more efficient enabling us to do ever more things on them. While people in countries such as the United States are certainly using technological advances to solve serious social problems such as road safety, or Hurricane Sandy communication logistics, it would be difficult to argue that these social problems are the primary drivers of the American tech industry. By contrast, in Kenya, innovation "for the social good" is a conception that permeates the ecosystem even as some entrepreneurs desperately try to avoid it. I would argue that this is largely a result of the particular historical context in the country, the legacy of the dominant aid discourse that permeates much ITC for development work in Africa, as well as the more recent ways in which multinational tech companies view their purpose in the country.

Even if many of these multinationals have had a presence in Kenya for a long time, international development workers and donor organizations, whose missions are focused around solving such social problems, have been there significantly longer. Whether through the United Nations, the World Bank, or other humanitarian and development not-for-profit organizations such as Internews or Medecins Sans Frontieres, these organizations have represented a significant economic and discursive presence in the Kenyan capital for quite some time. Setting up its office in Kenya in 1992, Medecins Sans Frontieres is in fact a relative newcomer compared to organizations such as Oxfam that have been in the country since soon after its independence in 1963. In recent years, many of these organizations, that have *social impact* at the top of their agendas, have begun integrating new technologies into their development work. The language of social impact motivation has in large part guided the growth of the field of ICT for development.

More recently (largely since 2008), some organizations have begun investing in technologies that are being generated locally with the hope that they will be better able to solve real "social problems" than technology brought from abroad (Lewis 2014). Such social problems include access to education for children or access to information for farmers. The new focus international NGOs have on *locally-generated* technology reflects the popularity of "participatory development" approaches in general within the field of ICT and development. Participatory development advocates argue that "local participation" is a key component of ensuring that a new development project is adopted more sustainably and is more reflective of local needs (Nelson & Wright, 1995; Hickey & Mohan, 2004). The ICT innovation ecosystem in Kenya represents a confluence of local participation and the potential for "social impact" making it particularly appealing to international NGOs.

Behaving like what Etzkowitz might call "public venture capitalists" – a word he uses to describe government support of entrepreneurs, rather than non-profits – these organizations have partnered with incubators to support access to resources for local entrepreneurs (Omidyar Network), have provided technological expertise to Kenyan journalists to improve their coverage of social issues particularly in the health sector (Internews), and have provided support for Kenyan entrepreneurs developing sustainable climate technologies (InfoDev). Even if they do not represent the largest financial support for the Kenyan tech innovation sector, the current pervasiveness of interest in technological innovation among development practitioners makes it difficult for the technological innovation sector to disassociate itself from such development objectives. As a result, "social impact" has become, at least discursively, a central motivation of many in the ICT innovation ecosystem in Kenya, an ecosystem that were it situated in a country without Kenya's long history of international NGO engagement might be a much more for-profit dominated arena.

For example, tech incubators frame their objectives within the "social impact" discourse, even though their business models prioritize building profitable sustainable businesses over developing technologies expressly to solve social problems. Some interviewees, for example, have echoed Schumpeter in arguing that support for economic development through support for start-ups is itself a 'social good' because it is a catalyst for economic growth. One

incubator manager, agreeing that economic growth and financial sustainability for their start-ups was a worthwhile goal, explained that they avoid supporting more expressly 'social enterprises' because they are "easily dismissed as things around NGOs which are largely ineffective."

This kind of perspective has in turn penetrated many of the NGOs, some of whom now describe their objectives in the tech sector as not simply supporting innovations for direct social impact, but as supporting financially sustainable innovations as well. InfoDev, for example, explains one of their motivations for engaging in tech innovation as follows: "Entrepreneurs in the developing world often struggle to get the know-how, the know-who, and the funding to take their ideas to market, to establish viable companies and create sustainable jobs" (infoDev, 2013). While few would dispute that economic growth would be good for Kenya, some – often those focused on what they call the "bottom of the pyramid" – point out that overall national economic growth is less useful than ensuring that some of the growth is able to help the poorest communities and does not simply lead to increased economic inequality (ESW, Enterprise for a Sustainable World, 2013). This interplay between the desire for economic growth and the desire for growth with a social impact is, I would argue, one of the defining features of the current ICT innovation ecosystem in Kenya.

The relative merit of allowing or relying on donor funding with a social impact focus has also been debated among Kenyan tech entrepreneurs for as long as the sector has been around. One prominent figure in the sector made the case in an interview that the long history of foreign development aid distribution in Kenyan and the attention that community is currently giving to the Kenyan tech entrepreneurs runs the risk of making these innovators dependent on this kind of funding, making it harder to build financially sustainable companies. Another argued that this kind of funding is essential for helping innovative ideas initially get off the ground. This article certainly does not attempt to resolve this debate. Instead, I propose that the existence and prominence of such a debate is emblematic of the complex and overlapping ways in which the various actors in this ecosystem conceptualize the system's ultimate purpose. The predominance of the conflict between social impact motivations and profit motivations represents a significant divergence from the environments in which most of the business innovation theory we examined earlier was developed.

This ecosystem is further complicated by the fact that this conflict between social impact and for-profit motivations appears to extend to the actors that might be viewed as the most economic growth focused: the multinationals. Many of these companies admit to being in Kenya for market gains, but they also emphasize social goals. Those involved in mobile technology are certainly in Kenya with the intention of capturing the growing African mobile phone market (a fact of which Kenyan mobile entrepreneurs are largely well aware). In keeping with Kenya's historical position as a kind of site of R&D for international actors (Tignor, 1998), one interviewee from a multinational explained their belief that if they could figure out how to engage in the mobile market in Kenya, then they would know better how to engage in other African countries. Kenya, for them, was the first major site of entry into the African markets.

But many of the technology multinationals also portray themselves as fundamentally interested in helping to "encourage and strengthen an innovative culture" in Kenya. IBM, for example, expressly describes its mission in the country as focused on helping to solve Kenyan social problems like sanitation, transportation, and education. The international trend of civil society pressure on private companies to do more for the communities that they benefit from, known as corporate social responsibility (Holme & Watts, 19999; Lindgreen & Swaen, 2010; Portney, 2005), helps to partially explain this trend. Microsoft's 4Africa initiative, for example, which it describes as a "new effort through which the company will actively engage in Africa's economic development to improve its global competitiveness" (Microsoft, 2014), is clear corporate social responsibility. Google has an entire "social impact team" working at its office in Nairobi. Many also talk about supporting the growth of local knowledge production or improving local skills and training as well as engaging in projects, such as Microsoft's role in the government's "white spaces project" to distribute internet access to rural schools (Microsoft Research, 2014).

While some of this rhetoric could certainly be interpreted as consistent with the view of economic growth as a social good unto itself, it also demonstrates how such large economic actors might have a difficult time justifying their participation in the ecosystem without referring in some way to "social impact." Some of the academic business literature has begun to theorize about "social innovation" (Mulgan, Tucker, Ali, & Sanders, 2007; Mulgan, 2006;

Gardner, Acharya, & Yach, 2007). Too few of the existing models, however, are equipped to explain a context where "social impact" frequently overlaps with profit and economic growth as a central driving factor of a national innovation system.

Local Actors

The engagement of such large international organizations and companies certainly is one element that sets Kenya apart from the nation innovation systems in many Western countries. The roles played by the various domestic actors similarly illustrate a context that diverges from what many of the existing theories describe. Erkowitz's triple helix model of innovation, emphasizing the importance of government and universities as well as industry, is a step in the right direction, but by examining the different roles played by the incubators, the universities, and government, I will demonstrate how this model needs to be expanded if it is to be useful for understanding this context.

Incubators & Universities

It is impossible to talk about the current ICT innovation ecosystem in Kenya without talking about the role that has been played by the incubators. Actors in the ecosystem largely agree that even if the success of the incubators in building new companies varies, they have certainly been at the center of the changes in the ecosystem in the last five years. As told by members of the current iHub team, in 2010, after Ushahidi and M-PESA both made names for themselves, what is believed to be the first technology business incubator in Africa, iHub, opened its doors on Ngong Road in Nairobi. The genesis of iHub was in conversations among Kenyan "techies," including members of the Ushahidi team, eager for a physical space for their growing community of programmers and developers, who felt disjointed in the existing ecosystem.

A technology business incubator is typically understood, even internationally, by the definition used by the US-based National Business Incubation Association (NBIA): "a business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services" (NBIA, 2012). Many of the most successful incubators in the US like Y-Combinator or DreamIt Ventures, responsible for supporting the growth of companies as well known as Reddit, AirBnB, and Dropbox, operate on a for-profit basis. They run accelerator programs to help turn ideas into profitable companies or companies that can be acquired by much larger firms.

By the NBIA's definition, iHub is an incubator, but in comparison to many incubators in practice, iHub might better be described as a "pre-incubator" (Mian, Sarfraz;, 2014) because it operates as a not-for-profit and does not provide any formal accelerator program or direct funding for start-ups that use its space. Particularly in its early years, it attracted young computer science students and aspiring entrepreneurs as well as prospective funders and representatives from some of the multinationals who would cross paths in the halls or at the many organized networking or training events. In part because of its perceived strength facilitating these kinds of casual encounters (or as innovation scholars might say, its strength at increasing the *geographic proximity* between the different actors), it has at times been described as "the unofficial headquarters of Kenya's tech movement" (Munford, 2013).

This 'hub' model now represents something of a trend across Africa (Moraa & Gatheye, 2013; Kelly, 2014). While there are more formal incubators emerging across the continent such as Growth Hub or Nairobi Start-up Garage, which offer intense, well-funded accelerator programs, many countries across the continent have seen the opening of at least one office using the iHub model of pre-incubation, or what has also been described as simply co-working spaces (Morara, 2014). More formal incubators also opened in Kenya soon after iHub, including the iHub offshoot, m:lab East Africa, and iHub's neighbor, Nailab.

Scholars of innovation have increasingly been discussing the particular role these incubators might play in spurring entrepreneurial tech innovations in a market economy (Aernoudt, 2004; Colombo & Delmastro, 2002). Returning to Etzkowitz, his argument that incubators, as well as science parks and even venture capital firms, are "hybrid organizations that embody elements of the triple helix [Universities, Government, Industry] in their DNA" (Etzkowitz, 2010, p. 1), fits well into this body of theory. While the success of incubators like Y-Combinator in the US or ATP Innovations in Australia, are acknowledged, the true strength of the incubator is typically understood as a linkage between industry and universities, between knowledge production and building businesses around them, and as Etzkowitz argues, government as well. In fact, this link to sources of knowledge production seems to be one of the key elements scholars have identified about successful incubators. They are "often sited within a technology park and affiliated to a technical university or research institute" (Lalkaka, 2002, p. 167). Even if they are

not situated in universities, incubators usually have strong linkages of some sort with them (Archer, Garrison, & Anderson, 2013; Mian S. A., 2011).

In Kenya, some incubators are indeed based at universities, the most successful of which is @iLab at Strathmore University. However, in this particular ecosystem, formal partnerships with universities have been the exception rather than the rule. Rather, the origin of most of the Kenyan incubators, including Start-up Garage (formerly 88mph), was in industry, typically as mentioned before, with funding from multinationals or donor agencies. This is not to say that meaningful and productive linkages with universities are not possible in Kenya. Rather, the crux of the difference between the Kenyan case and many others is that the knowledge production propelling new technology development in Kenya is taking place within industry, or within the incubators themselves, and not predominantly at universities.

This is not to say that there is no crossover between universities and industry. Many of the developers and designers that have propelled Kenya's ICT innovation ecosystem over the past few years are recent graduates of Kenyan universities,. Many come to join the incubators while they are still students, while others have been hired by the research centers at the big multinationals like Intel and IBM. When I interviewed start-up founders who fell in this category, many explained that their universities could network them into jobs in the more formal sector of the tech industry, but offered no guidance and few resources if they were interested in starting their own company. Because of the international attention the tech entrepreneurial sector was getting, many graduates wanted to be a part of it rather than find more traditional jobs, something one incubator interviewee described as being attracted to the "mindshare" quality of the incubators.

Some of the universities have recognized this and have slowly begun to create networks with the tech community. @iLab at Strathmore provides an interesting counter example to the other Kenyan incubators. Emmanuel Kweyu, the operations director at @iLab, explained that their location at a university is a strength because it has enabled them to build a reputation as a "research center and non-profit so they know we're not interested in profit." In addition to running an accelerator program like the other incubators, @iLab also offers a Masters program in mobile technology and innovation with financial support from

Safaricom, providing another link between industry and the university. Kweyu believes that one of the weaknesses of other incubators is their isolation from universities, something @iLab is hoping their model will fix.

However, one of the primary limitations to engaging universities with industry and vice versa may be the disjointedness of knowledge production at the universities in Kenya. As one prominent member of the ecosystem stated, "most university departments are siloed so that there is very little crossover between programming, computer science or even agriculture programs and the business schools," something he believes would help universities play a more central role in technology innovation. At the same time, knowledge production, particularly in the form of R&D, is happening at multinationals, like IBM Research, and at the incubators, like iHub Research.

As a result, I propose adapting Etzkowitz's triple helix model, rather than discarding it entirely for the Kenyan context. While universities can serve an important role, the key element of that role is as *knowledge producers*. In the Kenyan context, *knowledge production* is currently more disbursed. We can instead expand Etzkowitz's model by replacing the university node, with a "knowledge production" node, acknowledging the diverse ways in which, and locations where, knowledge around technology is currently being produced in Kenya. In response, Etzkowitz might argue "the competitive advantage of the university, over other knowledge-producing institutions, is its students...in contrast to the research and development units of firms and government laboratories that tend to ossify, lacking the 'flow-through of human capital' that is built into universities," (Etzkowitz, 2010, p. 1). In the Kenyan case, I would argue that the current siloing within universities means that they are not seeing the "flow-through" of human capital that they need. Instead, even as it is at times criticized for being disconnected from the local, non-techie community, the sites of the greatest fluctuation of "human capital," individuals who are involved in tech innovation or who aspire to be, are currently the incubators.

Government

Another site of knowledge production that is often integrated into models of innovation is the government R&D lab. It is seen as a starting point from which to launch companies (Carayannis, Rogers, Kurihara, & Albritton, 1998) or as a key node in Chesbrough's open innovation system (Chesbrough, West, & Vanhaverbeke, 2006). In

the Kenyan case, the government does not operate any of its own technology R&D labs. As we have seen earlier, the government does regularly emphasize a rhetorical interest in the ICT industry, and its newly created ICT Authority has certainly been working on ways to innovate in its own use of ICT. The ICT Authority recognized that the government did not have sufficient internal skills and knowledge to build new government R&D labs. Instead of channeling money into creating new government labs they chose to fund an existing incubator, Nailab, to grow and expand its own operations. They also offered Nailab additional financial support to set up satellite incubators in other cities around the country. However, the ICT Authority lacked familiarity with the needs of start-ups and the incubators that support them, which led them to underestimate the amount of funding needed for Nailab's expansion. The funding was thus channeled into trainings and hackathons in different cities instead of the creation of new physical incubation offices.

This is emblematic of the Kenyan government's current approach to the ICT ecosystem. That is, it does not have the existing in-house capacity to enable the development of new technologies but it wants to be a part of the new innovation process. It directs funding towards others who it thinks might have the capacity but often misdirects the funding because it does not yet fully understand the industry. As one former government official stated, "government is not an innovative entity" and "it has never quite understood the tech sector." The government has also been criticized for introducing some of its projects too quickly without thoroughly understanding the industry or the industry's user base. For example, the Huduma platform described earlier crashed soon after it was launched, and the government's push to create Konza City to centralize the tech innovation ecosystem has been criticized for misunderstanding the existing nature of the ecosystem (The Star, 2012).

Another role that theorists typically ascribe to government is to "intervene by helping create a new market or otherwise changing the rules of the game." (Etzkowitz & Leydesdorff, 2000). This normally refers to the formation and implementation of policies that influence innovation (Chesbrough, West, & Vanhaverbeke, 2006). When Dr. Ndemo was the Permanent Secretary of the Ministry of Information, the government made noticeable changes in infrastructure that have helped the industry to develop. Because of the access to fiber optic cables that were spread throughout much of the country, access to broadband internet has made working online far more efficient, enabling a lot of the mobile developments on which the industry relies. However, one of the current criticisms of the Kenyan ICT innovation sector is that it has underdeveloped IP legislation and the legal processes for forming a company are still quite complicated.

Such criticisms arguably come from a lack of perceived government engagement with the tech community, particularly among the young entrepreneurs. While donor NGOs and multinational companies appear at events held at the incubators, government attendance has been much less frequent. The government held its own technology conference, called Connected Kenya, in 2014, but such government conferences have ironically been disconnected from ecosystem conferences that already exist, such as one of the country's major competitions for identifying new entrepreneurial talent, Pivot East. The government has previously supported projects such as code4kenya and launched the well-received open data platform, but support for both of these seems to have stalled.

However, at this point I would draw our attention to Etzkowitz and Keydesdorff's assertion that the balance and interactivity between the various actors in an innovation ecosystem are regularly in flux and constantly being renegotiated and reorganized. As they put it, "The Triple Helix hypothesis is that systems can be expected to remain in transition." (Etzkowitz & Leydesdorff, 2000, p. 113). This certainly seems to be the case in the current state of this new industry in Kenya. For example, the government has not always been criticized for being disengaged. The Ministry of Information was perceived as much more involved and responsive than other actors in the ecosystem when Dr. Ndemo was Permanent Secretary. He attended events frequently, engaged on an online platform with members of the community, and responded to industry demands by pushing for the government to launch the aforementioned open data platform making tech developments centered around government data feasible. Similarly, while the incubators in general were widely praised for bringing disparate actors involved in mobile innovation in Kenya together during my first visit in 2013, in 2014 some interviewees criticized them for becoming disconnected from the larger community in which they are situated, focusing disproportionately on appealing to foreign-based funders.

The Kenyan government's role in the ecosystem has both commonalities and differences with the role of government as described by existing theories, and this is likely to continue to fluctuate. The Kenyan government certainly has the power to influence the ecosystem through policy changes, but it is currently much less engaged than governments in other countries, such as Sweden (Bergek & Norman, 2008) or Rwanda (Aggerwal, 2012), and likely much less engaged than it wants to be. What is clear is that, unlike many of the countries where the existing models were developed, the government in Kenya does not operate its own R&D labs for developments beyond its own e-government projects like Huduma. This means that the Kenyan government is not able to play the knowledge production role that might be expected of it from the triple helix model. Yet the government does have the power to "influence the rules of the game" in how it chooses to form new policies that affect the sector as well as to what extent it chooses to *engage* with other actors in the ecosystem. The next and final section of this case study looks more in-depth at this question of *engagement*, or of networks, both formal and informal, between the various actors in the ecosystem.

Networks

Of all the areas of existing theory on innovation, the theories around the role of networks, particularly informal networks may be the most directly useful for understanding the Kenyan context. As we saw in the review of theory, scholars of innovation, such as Nieto, Santamaria, and Powell, have made a convincing case for the importance of networks for stimulating greater innovation for companies, particularly in the case of formal networks like partnerships. Whether it be partnerships between incubators, donors and multinationals, between government and multinationals, or between government and incubators, formal partnerships have certainly been an important part of the evolution of the Kenyan ecosystem thus far. In interviews, the multinational and the government were particularly likely to talk about such formal partnerships when asked about engagement in the ecosystem than were the incubators or the start-ups. One government representative typified the rhetoric around this position: "We don't believe we have all the expertise. So we develop partnerships with others... Cisco, Huawei, Microsoft, Indian firms, iHub, Nailab, consultants...." This reflects a theme of scholarship within the governance literature that champions the importance of public-private partnerships (Mazouz, Facal, & Viola, 2008). Scholars such as Stewart, for example, have argued

that public-private partnerships are especially useful where issues the government is tackling are intransigent, which can be helped by bringing together different individuals and organizations able to offer different perspectives on the issue (Stewart, 1996). From the government's perspective, the question of how to get the most impact nation-wide out of the growth of this particular ICT sector certainly falls into the seemingly "intransigent" category.

Yet even those who talk predominantly about the importance of formal partnerships acknowledge that they are not always successful. One representative from a multinational, for example, explained "it would be arrogant if you said you'd figured it out. Not all partnerships work. It's a process; something we evolve through. Some of the sectors...we've not been very successful with our partnerships." The incubators, by contrast, have evolved around much more informal kinds of networks. They certainly have formal partnerships; their partnerships with funders and with start-ups are certainly often formal. But a network of informal linkages often intersects at incubators connecting many of the various actors at formal fireside chat type events, at conferences and competitions, or informally over coffee.

Boschma's theory about "proximity" is a useful tool for thinking about these informal linkages and the various 'proximities' they afford. As a reminder, in addition to geographic proximity, Boschma argued that other elements of proximity are at play, which influence innovation networks, both formal and informal. One of these is "cognitive proximity" or the "similarities in the ways actors perceive, interpret and evaluate the world" (Letaifa & Rabeau, 2013, p. 2072). In the Kenyan context, the ICT innovation ecosystem clearly includes many different kinds of extremely diverse actors with very different ways of seeing the world. These instances, which lack cognitive proximity, or what I would call 'cognitive divergences,' cut many different ways and overlap to varying degrees throughout the ecosystem. In the Kenyan case, they include divergences between multinationals and start-ups, between multinationals and NGOs, between international actors and the government, between the government and the private sector, between the old established actors (like larger Kenyan telecom companies and the government) and the young entrepreneurs, and between those who prioritize economic growth in the industry and those prioritize social impact.

However, innovation theories are actually conflicted on the impact of cognitive proximity, with some arguing that excessive cognitive proximity might "reduce the scope for learning" (Boschma & Frenken, 2010, p. 125). Even if applied directly, there is a limit to its usefulness for practitioners interested in making the ecosystem more "productive." However, it is still a helpful way to identify the different kinds of cultural divergences that cut particularly widely across this ecosystem, such as those between government and industry and between those interested in economic growth and those invested in social impact.

Another proximity that might be more relevant in this case is that of "social proximity." Social proximity essentially refers to the informal, interpersonal networks between various individuals at the different organizations. As Boschma and Frenken explain, social proximity involves

> …trust that is based on friendship, kinship and experience through repeated interaction. Such relationships carry information and potential partners and thereby increase the probability of organizations to engage in innovation networks. What is more, the perceived risk of conflict is also lower as social proximity adds to trust among organizations. (2010, pp. 122-123)

Other studies have also shown that increasing social proximity can, at times, help to cross difficult cognitive divergences (Lundquist & Trippl, 2013)

Numerous actors in the Kenyan ICT ecosystem outside of iHub have pointed to the moment iHub opened as a bit of a turning point for Kenyan tech innovation. One interviewee pointed out that before iHub and the recent tech boom that it represents, the private sector and civil society really did not work together. I would argue that the ability of pre-incubators like iHub to bring people together, to increase the geographic proximity of individual actors as we saw earlier, can be a key component that can help increase social proximity among many different actors from very different cognitive positions.

However, my interviews also revealed a general feeling that key individuals could be central in helping disparate groups cross cognitive divergences and communicate more effectively. In the majority of the interviews I conducted, Dr. Bitange Ndemo was cited as one such key individual.

Dr. Ndemo was not only the former Permanent Secretary to the Ministry of Information. He has also been on the board of iHub, has convinced multinationals to engage more in the Kenyan ecosystem, gives monthly talks to tech entrepreneurs, and has been working with universities to try to encourage inter-departmental collaboration for innovation. Interviewees described him as "an important spokesperson and mouthpiece in terms of transforming culture in government," "very visionary; pretty much the reason we are all here," and "really able to excite the environment for technology around the same time as the incubators." Around the same time that the incubators were transforming the networks between industry and civil society, Dr. Ndemo was a government official who "actually listened" to other actors and who helped ensure government policy was supportive of these changes.

Many scholars of Africa have similarly pointed out the important role that these kinds of social networks – and key individual nodes in those networks like Dr. Ndemo – have played in the development of other African economies (Gregore and Labazee 1993; Hansen and Vaa 2004, Hyden 1990, MacGaffey and Windperger 1990). However, the impact of informal social networks is not always so clearly beneficial. Meagher and others have shown how informal social networks can at times "operate as mechanisms of parochialism or collusion that disrupt economic development." (Meagher, 2005, p. 221). While the theories about networks from innovation scholars may indeed be useful for understanding the interactional nature of the Kenyan ICT innovation ecosystem, they are not prescriptive. Applying them to the complex ecosystem, with various overlapping power relationships and networks, in the urban transnationalism that is the Kenyan context should be done with caution. As the famous sociologist Andrew Sayer notably argued:

> Networks do not necessarily fuse the self-interest of different actors into a harmonious and egalitarian whole; they may be characterized by inequalities of power, strategic coalitions, dissembling and opportunistic collaboration. …Even where groups are associated with kinship networks, as many are, these are likely to be characterized by power asymmetries as well as a sense of moral obligation. What appears to indicate trust may be largely a consequence of domination or lack of alternatives, or simple mutual dependency. (Sayer, 2001, p. 699)

Conclusion

The pioneering French economic geographer Aydalot once hypothesized that "local environments play a determinant role as innovation incubators." He believed that "a firm is not an isolated innovator; it is part of an area which makes it act and react. The history of an area, its organization, its collective behavior and its internal structure of unanimity are the principal components of innovation" (Aydalot, 1986). I would argue that the particularities of the *local environments* where ICT developments are increasingly taking place around Africa have been insufficiently integrated into our theories of technology innovation. This is true of the business and management theorists who have typically been some of the stewards of technology innovation scholarship, but who have disproportionately focused on the role of the company in this process. It is also true of scholars in the ICT and development field, who have advanced a substantial body of literature around the impact of new ICTs, or around the adoption and diffusion of these technologies, but who have thus far under-theorized the process of technology innovation "in situ" within developing countries (Avgerou, 2010).

While the theories developed to better understand innovation processes in countries such as the United States can be a useful place to start when looking at Kenya, they are just that, a place to start. On a continent with such a long history of international involvement, either through governments, development projects, or multinationals to name but a few examples, it is impossible to understand the current state of technology innovation in Kenya without incorporating into our theories both the impact of foreign actors with economic capital as well as the inclusion of innovations with a social impact objective in addition to an economic one. The anthropologist, Jane Guyer, theorized in her seminal text, *Marginal Gains*, that the economic history of the African continent is a "co-production of Africa and Europe over centuries of economic and political engagement" (Guyer, 2004). The nature of the relationship between African, European, and American actors involved on the continent has certainly changed over time. It would be counterproductive, however, to ignore many of the underlying social and economic power dynamics that are historically embedded in a context as transnational as the ICT innovation ecosystem in Kenya. A greater body of

theory is needed to understand the particular nature of technology innovation in these transnational post-colonial contexts. It is my hope that the analysis provided in this article can serve as a stepping-stone to developments in this direction.

I have shown that despite their limitations, some of the existing innovation theories can in fact be helpful. Etzkowitz's triple helix model of the fluctuating relationships between government, universities, and industry, as well as the theories around informal networks and innovations, particularly those of cognitive and social proximity, can inform our understanding of the structure of the Kenyan ICT innovation ecosystem. Yet the nature of the current roles played by the government and by the universities in Kenya notably differ from those conceptualized in the triple helix, with incubators possessing some of the characteristics Etzkowitz would likely ascribe to universities, like the 'flow-though' of human capital advantageous to knowledge production. Even if the existing theories on innovation may be helpful in some regard, they should always be approached with a critical eye.

The aspect of the Kenyan ICT innovation ecosystem that is particularly challenging to existing theories lies in its purpose. In many technology industries the end goal of market-based profits or economic growth is expected to dominate. In Kenya, with such a long history of international NGO engagement, economic growth necessarily has to compete with "social impact" for dominance of the industry. This challenges many of the underlying neoliberal assumption of many existing theories of innovation. That is not to say that it is such a dichotomous either/or exchange. Instead, these regularly overlapping goals, which are able to even influence the objectives of multinationals, are constantly renegotiated and rebalanced. Yet this unusual need for regular renegotiation has an advantage. It can allow space to regularly question the objectives of the ecosystem – objectives that too frequently lay unchallenged. Is the purpose of developing an ICT industry in Kenya to enable the development of new technologies – new software programs, new hardware, new applications – that better reflect the local culture and better reflect the needs of the local community as articulated by them? Or is the purpose

to provide a space for Kenyan entrepreneurs to develop their own products that can be globally distributed and accelerate the growth of this middle-income country? Can the purpose be some combination of the two? Can it be something else entirely? In reality, the 'purpose' is not some unified thing that is defined by the ecosystem as a whole. Rather it is regularly constructed individually by all of the many different actors involved in the space.

Once we have examined critically the nature of the actors and relationships around innovation as I have begun to do in this paper, those engaged in the ecosystem may be better placed to figure out how to achieve particular goals, to make innovation and the ICT sector more economically efficient, or more socially impactful for example. It is my hope that this illustration might be a helpful word of caution for practitioners, policymakers, innovators as well as theorists eager to fully adopt existing technology innovation theories in such a transnational ecosystem without critiquing the socio-economic impact of doing so.

Bibliography

Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technology interdependence affects firm performance in new technology generations. *Strategic management journal, 31*(3), 306-333.

Aernoudt, R. (2004). Incubators: tool for entrepreneurship? *Small Business Economics, 23*(2), 127-135.

Africa Research Bulletin. (2007). Kenya: Pro-Business Administration. *Africa Research Bulletin: Economic, Financial & Technical Series, 44*(6), 17442-17443.

Aggerwal, R. (2012). Research on the State of Business Incubation System in Rwanda: Lessons from an African Country. *Journal of US-China Public Administration, 9*(6), 707-717.

Alexander, E. (1995). *How organizations act together: Inter-organizational collaboration in theory and practice.* New York, NY: Gordon and Breach.

Al-Mubaraki, H. M., & Busler, M. (2011). The development of entrepreneurial companies through business incubator programs. *Journal of Emergin Sciences, 1*(2), 95-107.

Alter, C., & Hage, J. (1993). *Organizations work together.* Newbury PArk, CA: SAGE Publications.

Archer, W., Garrison, R., & Anderson, T. (2013). Adopting disruptive technologies in traditional universities: Continuing education as an incubator for innovation. *Canadian Journal of University continuing Education, 25*(1).

Archibugi, D., & Iammarino, S. (2002). The globalization of technological innovation: definition and evidence. *Review of International Political Economy, 9*(1), 98-122.

Avgerou, C. (2010, Fall). Discourse on ICT and Development. *ITID, 6*(3), 1-18.

Aydalot, P. (1986). *Milieux innovateur en europe.* Gremi.

Bala, I., & Davenport, T. H. (2008). Reverse engineering Google's innovation machine. *Harvard Business Review, 86*(4), 58-68.

Balzat, M., & Hanusch, H. (2004). Recent trends in ther esearch on onational innovation systems. *Journal of Evolutionary Economcis, 14*, 197-210.

Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management Decision, 47*(8), 1323-1339.

Barnwell, N. (2013, August 29). verify? (E. Marchant, Interviewer)

Bartlett, C. A., & Ghoshal, S. (1990). *Managing innovation in the transnational corporation.* Routledge: London.

Bergek, A., & Norman, C. (2008). Incubator best practice: A framework. *Technovation, 28*(1), 20-28.

Bloomberg. (2013, April 18). *Silicon Savannah: Kenya' Billion-Dollar Tech Bet.* Retrieved from Bloomberg TV: http://www.bloomberg.com/video/silicon-savannah-kenya-billion-dollar-bet-on-tech-~nP8AsURSCSAbVZWrN~ufA.html

Boschma, R. (2005). Proximity and innovation: a critical assessment. *Regional studies, 39*(1), 61-74.

Boschma, R., & Frenken, K. (2010). The spatial evolution of innovation networks: a proximity perspective. In R. Boschma, & R. Martin, *The Handbook of Evolutionary Economic Geography* (pp. 120-135). Cheltenham: Edward Elgar Publishing Limited.

Bourdieu, P. (1986). *The forms of capital.*

Brass, D. J., Galaskiewicz, J., Greve, H. R., & Tsai, W. (2004). Taking stock of networks and organizations: A multilevel perspective. *Academy of management journal, 47*(6), 795-817.

Camagni, R. P. (1995). The concept of innovation milieu and its relevance for public policies in European lagging regions. *Papers in regional science, 74*(4), 317-340.

Camara, G., Foseca, F., Monteiro, A., & Onsrud, H. (2006). Networks of innovation and the establishment of a spatial data infrastructure in Brazil. *Information Technology for Development, 12*(4), 255-272.

Cao, M., & Zhang, Q. (2008). Supply chain collaborative advantage: A firm's perspective. *IEEE International Conference on Service Operations and Logistics, and Informatics* (pp. 1652-1657). Beijing: IEEE/SOLI .

Carayannis, E. G., Rogers, E. M., Kurihara, K., & Albritton, M. M. (1998). High-technology spin-offs from government R&D laboratories and research universities. *Technovation, 18*(1), 1-11.

Carlsson, B. (2007). Chapter 53: Innovation systems: a survey of the literature from a Schumpeterian perspective. In H. Hanusch, & A. Pyka, *Elgar Companion to Neo-Schumpeterian Economics* (pp. 857-871). Cheltenham, UK: Edward Elgar.

Chandra, A., & Chao, C.-A. (2011). Growth and Evolution of high-technology business incubation in China. *Human Systems Management, 30*, 55-69.

Chesbrough, H. W., West, J., & Vanhaverbeke, W. (2006). *Open Innovation: Researching a New Paradigm.* Oxford, UK: Oxford University Press.

Colombo, M. G., & Delmastro, M. (2002). How effective are technology incubators? Evidence from Italy. *Research policy, 31*(7), 1103-1122.

De Vreede, G.-J., Mgaya, R. J., & Qureshi, S. (2003). Field experiences with collaboration technology: A comparative study in Tanzania and South Africa. *Information Technology for Development, 10*(3), 201-219.

Dearden, A., & Rizvi, H. (2008). Participatory design and participatory development: a comparative review. *PDC 2008: Experiences and Challenges, Participatory Design Conference* (pp. 1-11). Bloomington: PDC.

DeBresson, C., & Amesse, F. (1991). Networks of innovators: a review and introduction to the issue. *Research policy, 20*(5), 363-379.

Dodgson, M., Mathews, J., Kastelle, T., & Hu, M. C. (2008). The evolving nature of Taiwan's national innovatio nsystem: The case of biotechnology innovation networks. *Research Policy, 37*(3), 430-445.

Ernst, D. (2002). Global production networks and the changing geography of innovation systems. Implications for developing countries. *Economics of innovation and new technology, 11*(6), 497-523.

Ernst, D. (2006). *Innovation offshoring: Asia's emerging role in global innovation networks.* Honolulu: East-Wester Center.

ESW, Enterprise for a Sustainable World. (2013). *BoP Global Network 2013 Annual Report.* Enterprise for a Sustainable World.

Etzkowitz, H. (2002). Incubation of incobators: innovation as a triple helix of university-industry-government networks. *Science and Public Policy, 29*(2), 115-128.

Etzkowitz, H. (2010). *The Triple Helix: University-Industry-Government Innovation in Action.* Routledge.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and "Mode 2" to Triple Helix of university-industry-government relations. *Research policy, 29*(2), 109-123.

Evangelista, R., & Mastrostefano, V. (2006). Firm size, sectors and countries as sources of variety in innovation. *Economics of Innovation and New Technology, 15*(3), 247-270.

Fagerberg, J., & Srholec, M. (2008). National innovation systems, capabilities and economic development. *Research policy, 37*, 1417-1435.

Fichman, R. G. (2004, August). Going Beyond the Dominant PAridigm for Information Technology Innovation Research: Emerging Concepts and Methods. *Journal of the Association for Information Systems, 5*(8), 314-355.

Florida, R. (1997). The globalization of R&D: Results of a survey of foreign-affiliated R&D laboratories in the USA. *Research policy, 26*(1), 85-103.

Fransman, M. (2010). *The New ICT Ecosystem: Implications for Policy Reguation.* Cambridge, UK: Cambridge University Press.

Freeman, C. (1995). The 'National System of Innovation' in historical perspective. *Cambridge Journal of Economics, 19*, 5-24.

Freeman, C. (2002). Continental, national and sub-national innovation systems -complementarity and economic growth. *Research Policy, 31*, 191-211.

Freund, C. L., & Weinhold, D. (2004). The effect of the internet on international trade. *Journal of International Economics, 62*, 171-189.

Furman, J., Porter, M. E., & Stern, S. (2002). The determinants of national innovation capacity. *Research Policy, 31*, 899-933.

Gardner, C. A., Acharya, T., & Yach, D. (2007). Technological and social innovation: a unifying new paradigm for global health. *Health Affairs, 26*(4), 1052-1061.

Gassman, O., Enkel, E., & Chesbrough, H. (2010). The future of open innovation. *R&D Management*, 1-9.

Gemunden, H. G., Ritter, T., & Heydebrech, P. (1996). Network configuration and innovation success: An empirical analysis in German igh-tech industries. *International Journal of Research in MArketing, 13*(5), 449-462.

Gichuru, S. (2013, August 1). Co-Founder, CEO, Nailab. (E. Marchant, Interviewer)

Goldstein, J. (2008, October 15). *BarCamp Africa*. Retrieved August 2, 2013, from Google Africa Blog: google-africa.blogspot.com/2008/10/barcamp-africa.html

Gorodnichenko, Y., Sveynar, J., & Terrell, K. (2010). Globalization and innovation in emerging markets. *American Economic Journal: Macroeconomics*, 194-226.

Grodal, S. (2004). Towards a Dynamic Model of Networks and Innovation. *DRUID Summer Conference 2004 on Industrial Dynamics, Innovation and Development* (pp. 1-30). Elsinor: DRUID.

Guiliani, E. (2007). The selective nature of knowledge networks in clusters: evidence from the wine industry. *Journal of economic geography, 7*(2), 139-168.

Guyer, J. I. (2004). *Marginal Gains: Monetary Transactions in Atlantic Africa.* Chicago: University of chicago Press.

Hagedoorn, J., & Duysters, G. (2002). Learning in dynamic inter-firm networks: the efficacy of multiple contacts. *Organization studies, 23*(4), 525-548.

Hall, R., Clark, J., Giordano, P., Johnson, P., & Van Roekel, M. (1977). Patterns of interorganizational relationships. *Administrative Science Quarterly, 22*(3), 457-474.

Harrison, B. (1994). The Italian industrial districts and the crisis of the cooperative form: Part 1. *European Planning Studies, 2*(1), 3-22.

Hickey, S., & Mohan, G. (2004). *Participation - from tyranny to transformation?: Exploring new approaches to participation in development.* Zed Books.

Holme, R., & Watts, P. (19999). Corporate social responsibility. *World Business council for Sustainable Development.* Geneva: World Business Council for Sustainable Development.

Holohan, A. (2003, Fall). Cooperation and Coordination in an International Intervention: The Use of Information and Communication Technologies in Kosovo. *ITID, 1*(1), 19-39.

Howells, J. (2002). Tacit knowledge, innovation and economic geography. *Urban studies, 39*(5-6), 871-884.

Hseih, T.-J., Yeh, R.-S., & Chen, Y.-J. (2010). Business goup characteristics and affiliated firm innovation: The case of Taiwan. *Industrial Marketing MAnagement, 39*(4), 560-570.

Huxham, C. (1996). *Creating collaborative advantage.* Sage.

infoDev. (2013, May 11). *About infoDev*. Retrieved from infoDev: Growing Innovation: http://www.infodev.org/infodev/about-infodev

Jaffe, A. B., & Trajtenberg, M. (2005). *Patents, Citations, and Innovations: A Window on the Knowledge Economy.* Boston: The MIT Press.

Kaplan, S. N., & Stromberg, P. E. (2004). Characteristics, contracts, and actions: Evidence from venture capitalist analyses. *The Journal of Finance, 59*(5), 2177-2210.

Keeble, D., & Wilkinson, F. (1999). Collective learning and knowledge development in the evolution of regional clusters of high technology SMEs in Europe. *Regional studies, 33*(4), 295-303.

Kelly, T. (2014, April 30). *Tech hubs across Africa: Which wil lbe the legacy-makers?* Retrieved from The World Bank: Information Communications for Development: http://blogs.worldbank.org/ic4d/tech-hubs-across-africa-which-will-be-legacy-makers

Kenya ICT Board. (2013). *Connected Kenya: Kenya ICT Board 2017 Master Plan.* Kenya ICT Board. Nairobi: Kenya ICT Board.

Kenya Institute for Public Policy Research and Analysis. (2013). *Kenya Economic Report 2013: Creating an Enabling environment for Stimulating Investment for competitive and Sustainable countries.* Nairobi: Kenya Institute for Public Policy Research and Analysis.

Khorsheed, M. S., Alhargan, A., & Qasim, S. M. (2012). A Three-Tier Service Model for National ICT Incubator in Saudi Arabia. *Process of IEEE International conference on Management and Service Science.* Shanghai, China.

Kilelu, C. W., Klerkx, L., Leeuwis, C., & Hall, A. (2011). Beyond knowledge brokering: an exploratory study of innovation intermediaries in an evolving smallholder agricultural system in Kenya. *Knowledge Management for Development Journal, 7*(1), 84-108.

Kim, D., Cavusgil, S. T., & Calatone, R. J. (2006). Information system innovations and supply chain amanagement: channel relationships and firm performance. *Journal of Academy of Marketing Science, 34*(1), 40-54.

Kimenyi, M. S. (2014, January 6). *Africa's Powerhouse*. Retrieved October 14, 2014, from Brookings: Foreign Policy: Opinion: www.brookings.edu/research/opinions/2013/12/30-kenya-economy-kimenyi

Lagendijk, A., & Oinas, P. (n.d.). Proximity, external relations, and local economic development. In A. Lagendijk, & P. Oinas, *Proximity, distance and diversity. Issues on economic interaction and local development* (pp. 3-22). Ashgate.

Lalkaka, R. (2002). Technology business incubators to help build an innovation-based economy. *Journal of Change Management, 3*(2), 167-176.

Lee, H. L., & Whang, S. (2000). Information sharing in a supply chain. *International Journal of Manufacturing Technology and Management, 1*(1), 79-93.

Lee, J., & Park, C. (2006). Research and development linkages i na national innovation system: Factors affecting success and failure in Korea. *Technovation, 26*(9), 1045-1054.

Letaifa, S. B., & Rabeau, Y. (2013). Too close to collaborate? How geographic proximity could impede entrepreneurship and innovation. *Journal of Business Research, 66*(10), 2071-2078.

Lewis, D. (2014, April 11). Africa must back entrepreneurs: Omidyar Network. *Reuters*.

Lindgreen, A., & Swaen, V. (2010). Corporate social responsibility. *International Journal of Management Reviews, 12*(1), 1-7.

Lundquist, K.-J., & Trippl, M. (2013). Distance, proximity and types of cross-border innovation systems: A conceptual analysis. *Regional Studies, 47*(3), 450-460.

Lundvall, B. (2007). National innovation systems - analytical concept and development tool. *Industry and Innovation, 14*, 95-119.

Lundvall, B.-A., Johnson, B., Anderson, E. S., & Dalum, B. (2002). National systems of production, innovation and competence building. *Research Policy, 31*, 213-231.

Mackintosh, M. (1992). Partnership: issues of policy and negotiation. *Local economy, 7*(3), 210-224.

Mazouz, B., Facal, J., & Viola, J.-M. (2008). Public-private partnership: Elements for a project-based management typology. *Project Management Journal, 39*(2), 98-110.

Meagher, K. (2005). Social capital or analytical liability? Social networks and African informal economies. *Global Networks, 5*(3), 217-238.

Mian, S. (2011). University's involvement in technology business incubation: what theory and practice tell us? *International Journal of Entrepreneurship and Innovation Management, 13*(2), 113-121.

Mian, S. A. (1996). Assessing value-added contributions of university technology business incubators to tenant firms. *Research policy, 25*(3), 325-335.

Mian, S. A. (2011). University's involvementi n technology business incubation: what theory and practice tell us? *International Journal of entrepreneurship and Innovation Management, 13*(2), 113-121.

Mian, Sarfraz;. (2014). 15 business incubation and incubator mechanisms. In A. Fayolle, *Handbook of Research On Entreprepenurship: What We Know and What We Need to Know* (pp. 335-366). Cheltenham: Edward Elgar Publishing Limited.

Microsoft. (2014, October 21). *4africa*. Retrieved from Microsoft: http://www.microsoft.com/africa/4afrika/

Microsoft Research. (2014). *Dynamic Spectrum and TV White Spaces*. Retrieved October 21, 2014, from Microsoft Research: http://research.microsoft.com/en-us/projects/spectrum/

Molina, A., Aguirre, J. M., Breceda, M., & Cabero, C. (2011). Technology parks and knowledge-based development in Mexico: Tecnologico de Monterrey CIT2 experience. *International Journal of Entrepreneurship and Innovation Management, 13*(2), 199-224.

Moraa, H., & Gatheye, D. (2013). How ICT hubs models have impacted on the technology entrepreneurship development. *Proceedings of the Sixthy International Cofnerence on Information and Communication Technologies and Development: Notes-Volume 2*, (pp. 100-103). Cape Town.

Morara, m. H. (2014, July 7). *C-working vs Incubation spaces in Africa*. Retrieved October 10, 2014, from Venture Capital for Africa: vc4africa.biz/blog/2014/07/07/co-working-vs-incubation-spaces-in-africa/

Morgan, K. (2007). The learning region: institutions, innovation and regional renewal. *Regional studies, 41*(S1), S147-S159.

Mowery, D., & Oxley, J. E. (1995). Inward technology transfer and competitiveness: the role of national innovation systems. *Cambridge Journal of Economics, 19*, 67-93.

Moyo, D. (2009). *Dead aid: Why aid is not working and how there is a better way for Africa.* Vancouver: Macmillan.

Mulgan, G. (2006). The process of social innovation. *innovations, 1*(2), 145-162.

Mulgan, G., Tucker, S., Ali, R., & Sanders, B. (2007). *Working Paper: Social innovation: what it is, why it matters and how it can be accelerated.* Oxford: Skoll Centre for Social Entrepreneurship.

Munda, C. (2014, October 1). *Kenya: Now Kenya Joings the Ranks of Middle Income Countries*. Retrieved from the Star, republished in allAfrica.com: http://allafrica.com/stories/201410011159.html

Munford, M. (2013, March 26). Don't Call Africa' Tech Hub 'Silicon Savannah'. *Mashable*.

Murray, F. (2002). Innovation as co-evolution of scientific and technological networks: exploring tissue engineering. *Research Policy, 31*(8), 1389-1403.

Nachum, L., Zaheer, S., & Gross, S. (2008). Does it matter where countries are? proximity to knowledge, markets and resources and MNE location choice. *Management Science, 54*, 1252-1265.

Ndemo, B. (2005). Maasai Entrepreneurship and Change. *Journal of Small Business & Entrepreneurship, 18*(2), 207-219.

Ndemo, B., & Maina, F. W. (2007). Women entrepreneurs and stategic decision making. *Management Decision, 45*(1), 118-130.

Nelson, N., & Wright, S. (1995). *Power and participatory development: theory and practice.* Intermediate Technology Publications LTD.

Nieto, M. J., & Santamaria, L. (2007, June-July). The importance of diverse collaborative networks for the novelty of product innovation. *Technovation, 27*(6-7), 367-377.

Peizer, J. (2003, Winter). Cross-Sector Information and Communications Technology Funding for Development: What Works, What Does Not, and Why. *ITID, 1*(2), 81-88.

Portney, P. R. (2005). Corporate Social Responsibility. In *Environmental Protections and the Social Responsibility of Firms - Perspectives from Law, Economcis and Business*.

Powell, W. W. (1998). Learning from collaboration. *California management review, 40*(3), 228-240.

Powell, W. W., & Grodal, S. (2005). Networks of innovators. In *The Oxford handbook of innovation* (pp. 56-85).

Powell, W., & Smith-Doerr, L. (1994). Netowkrs and economic life. In N. Smelser, & R. Swedberg, *The handbook of economc sociology* (pp. 368-402). Princeton, New Jersy: Princeton University Press.

Provan, K. G., Beyer, J., & Kruytenbosh, F. (1980). Environmental linkages and power in resource-dependence relations between organizations. *Administrative Science Quarterly, 25*(2), 200-225.

Ratinho, T., & Henriques, E. (2010). The role of science parks and business incubators inconverging countries: Evidence from Portugal. *technovation, 30*, 278-290.

Ritter, T., & Gemunden, H. G. (2004, May). The impact of a company's business strategy on its technological competence, network competence and innovation success. *Journal of Business Research, 57*(5), 548-556.

Rogers, M. (1998). *The definition and measurement of innovation.* Melbourne Institute of Applied Economic and Social Research. Parkville, VIC: Melbourne Institute of Applied Economic and Social Research.

Rothschild, L., & Darr, A. (2005). Technological incbuators and the social construction of innovation networks: an Israeli case study. *Technovation, 25*(1), 59-67.

Saxenian, A. (1996). *Regional Advantage: Culture and Competition in Silicon Valley and Route 128.* Cambridge, MA, US: Harvard University Press.

Sayer, A. (2001). For a critical cultural political economy. *Antipode, 33*, 687-708.

Siegwart, R. Y., & Hess, S. (2013). University Technology Incubator: Technology Transfer of Early Stage Technologies in Cross-Border Collaboration with Industry. *Business and Management Research, 2*(2), 22-36.

Smith, M., & Elder, L. (2010). Open ICT Ecosystem Transforming the Developing World. *Information Technologies and International Development, 6*(1), 65-71.

Soosay, C. A., Hyland, P. W., & Ferrer, M. (2008). Supply chain collaboration: capabilities for continuous innovation. *Supply Chain Management: An International Journal, 13*(2), 160-169.

Stewart, J. (1996). *Local government today.* London: Local Government Management Board.

Tapia, A. H., Ngamassi Tchouakeu, L.-M., Maldonado, E., & Maitland, C. F. (2013, Spring). Crossing Borders, organizations, Levels, and Technologies: IS Collaboration in Humanitarian Actions. *ITID, 9*(1), 1-17.

Teo, H.-H., Wei, K. K., & Benbasat, I. (2003). Predicting intention to adopt interorganizational linkaes: an institutional perspective. *Mis Quarterly*, 19-49.

Thoenig, M., & Verdier, T. (2003). A theory of defensive skill-biased innovation and globalization. *American Economic Review, 93*, 709-728.

Tiffen, M., & Mortimore, M. (1994). Malthus controverted: The role of capital and technology in growth and environment recovery in Kenya. *World Development, 22*(7), 997-1010.

Tignor, R. L. (1998). *Captialism and nationalism at the end of empire: state and business in decolonizing Egypt, Nigeria, and Kenya, 1945-1963.* Princeton: Princeton University Press.

Todtling, F., & Lehner, P. (2009). Do different types of innovation rely on specific kinds of knowledge interactions? *Technovation, 29*(1), 59-71.

Valverde, S., Sole, R. V., Bedau, M. A., & Packard, N. (2007). Topology and evolution of technology innovation networks. *Physical Review E, 76*(5).

Wang, P. (2008). Assimilating IT innovation: The longitudinal effects of institutionalization and resource dependence. *ICIS 2008* (p. 21). ICIS.