

NETWORKED ICTs AND INTERNATIONAL DEVELOPMENT: A CASE STUDY OF TECHNOLOGY
DIFFUSION IN KENYA

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ABSTRACT

As the information age matured from its beginnings in the mid-1990s, information and communication technology (ICT) increasingly became a recognized tool of development. Although use of ICTs in development projects continues to progress, the way in which these projects are organized is evolving. Much of the recent literature encourages bottom-up, or grassroots, development. However, given the complexity of ICTs, network technology diffusion for the purposes of development may require a new balance between change agents and local communities. Unlike stand-alone technologies, network technologies such as ICTs require interoperability and have high fixed costs. Coordinating these requirements may call for a centralized approach. Testing this hypothesis requires a conceptualization of the diffusion process, and the role that global change agents and local opinion leaders play in the diffusion process. In addition, consideration is given to how the nature of the technology — and the extent to which it is networked or not — affects the process. Finally, a case study of a World Bank technology diffusion development project in Kenya is examined to determine how the

design of the diffusion process and the nature of the technology combine to affect the outcome of the diffusion process.

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Chapter 1. Introduction

Since the advent of the information revolution in the mid-1990s, the world has embraced technology as a method of fostering development. In 1996, James Wolfensohn, then-president of the World Bank, said in a speech to its Board of Governors, "The revolution in information technology increases the potential value of [the bank's development] efforts by vastly extending their reach. We need to invest in systems that will enhance our ability to gather information, and experience and share it with our clients" (Watson, 2007). As a direct result, the World Bank created a new information technology group called Global Information and Communication Technology (GICT) on January 1, 2000. GICT is dedicated "to unleash(ing) the power of human capital and giv(ing) opportunities to the poor through easy access to information" (Watson, 2007). Likewise, the United Nations agency for information and technology, known as the International Telecommunication Union (ITU), was reorganized in 1992 to create a division called ITU-D. Dedicated solely to development, its mandate is to "connect all the world's inhabitants to telecommunications and spread the enormous benefits unleashed by the digital revolution" (ITU, 2007).

Although efforts toward using information and communication technology (ICT) in development have continued, the way in which development projects are organized is changing significantly. Whereas early initiatives were organized using a top-down structure, recent projects frequently rely on a bottom-up model. Even the World Bank has

put efforts into bottom-up development within the last decade, migrating from “what was a top-down, hierarchical Washington, D.C.-based” structure to a “decentralized, front-line, matrix organization that’s using information and communications technologies” to meet its mission goals (Watson, 2007).

One example of this bottom-up development model is the M. S. Swaminathan Research Foundation (MSSRF) South India telecenter project. Roman and Colle (2003) define a telecenter as a multi-purpose community entity that provides accessible and affordable ICT access to everyone (p. 89). In the MSSRF telecenter project, the challenge was to provide utility by meeting the need of community members and “one of the most important ways to meet this need is simply asking the community what information they consider useful” (Roman & Colle, 2003, 89). In the fishing village of Verampatinam, local fisherman, many of whom were illiterate, stated a need to have current weather information, which would effect their fishing. To meet the demand, MSSRF used two telecenters. In the larger town of Pondicherry, MSSRF used a “value-addition” telecenter to download weather information from the U.S. Navy’s website, translate it into Tamil and send it as an audio file to the telecenter in Verampatinam. Then, the telecenter in Verampatinam downloaded the audio file to local computers, and broadcast it over loudspeakers in front of the telecenter and along the waterfront.

In contrast to bottom-up development is the top-down model. This model was used by the Rwandan government in a 2003 project to modernize its ICT and

telecommunications infrastructure. President Paul Kagame discarded an existing \$50 million project that would have created Internet connections for 300 schools using satellite technology and instead funded a project to build out a nationwide fiber optic network after consulting with American entrepreneur Greg Wyler, who had no experience running an Internet service provider (ISP) (Nixon, 2007). At the time, the country's minister of telecommunications, Albert Butare, questioned the decision, "We've had to rebuild everything from nothing. So when people need shelter, water and energy, they ask, 'Do I really need a computer?'" (Rhoads, 2006). Notwithstanding comments such as these, Wyler created a new Rwandan ISP, naming it Terracom. Three years later he purchased the country's aging national telecommunications monopoly, Rwandatel (Rhoads, 2006).

In the Verampatinam project, foundation employees operated using a bottom up model, but in Rwanda the project continued in a top-down fashion. Wyler operated both companies with little input from people on the ground. In one case, for example, Christian Mulola, a 25 year-old Rwandatel employee emailed Wyler in 2006, saying "I do not feel confident enough to handle the (DSL) installation all alone" (Rhoads, 2006). Wyler ignored the email, telling a Wall Street Journal reporter that he had given Mulola a "pep talk months earlier" (Rhoads, 2006). By July 2007, one-third of the project was complete and one percent of Rwanda's population was connected to the Internet. The Rwandan government declared Wyler's top-down model a failure. In November 2006

Wylter resigned as chief executive, and in June 2007, Terracom was fined \$400,000. One might argue that the failure was due in part to Kagame's and Wylter's unwillingness to listen to the needs of the communities being connected.

The rationale for bottom-up approaches such as that employed in the Verampatinam case is related to models of diffusion. The most prominent of these is that proposed by Everett Rogers (2004). Early in his career, Rogers centered his research on agricultural diffusion. According to Rogers (2004), innovation diffusion is a "universal process of social change" in which subjectively-perceived information is communicated between individuals in a social system (p. xvi). He theorizes that diffusion is composed of four elements: the innovation itself; the communication channels through which it travels; the time it takes to travel; and the social system through which it progresses (p. 5).

One relevant pillar of Rogers' (2004) theory states that the implementation of technologies depends on actors both within and outside a social system to generate change. Within a social system or organization, such agents are called opinion leaders and they must be significantly involved in the process for successful diffusion to occur. Outside a social system are agents who set the agenda that opinion leaders follow. All too often, however, development models employ top-down strategies that focus solely on these outside change agents, who have little contact with the community. To effect

change, they often rely on the internal opinion leaders who act as “lieutenants,” within the social system. Many argue that such strategies are doomed to failure.

Rogers’ ideas of change agents and other aspects of his diffusion framework were first released in the early 1960s, approximately 30 years before ICTs began to take a significant role in international development projects. However, despite their general acceptance and longevity, Rogers’ ideas have yet to be comprehensively tested in the context of the role of ICTs in development. ICTs are a unique technology (see Figure 1) insofar as they require large scale investment; necessitate an existing knowledge base; are capable of rapid change; provide multiple implementation options; and require support personnel to quickly and frequently update skills.

ICTs May Be Considered a Unique Technology Because:
1. Require large scale investment
2. Requires an existing base of knowledge about the technology, as well as how to design and support it for specific development goals.
3. The technology changes quickly
4. Many more choices about appropriate technology can be made because the technology is flexible.
5. Because of the quick change, skills must be constantly and rapidly updated.

Figure 1. Why ICTs are a unique technology

Although Rogers’ ideas described diffusion of stand-alone technologies, several theorists argue that his conclusion may not be appropriate for the diffusion of large-scale networks. For example, Perez (2002), Freeman and Louçã (2001) and Hughes (1976) argue that networked large-scale systems, such as power stations, follow a different diffusion process than stand-alone technologies. In particular, these authors argue that

large-scale diffusion occurs in long waves. In proposing this alternative explanation, they contend that Rogers fails to address the fact that, in the case of networked technologies, a whole system needs to be in place before productivity gains can occur.

Given the complexity of large-scale systems, the diffusion of networked ICTs for development purposes may require a unique balance between outside change agents and local communities. Within this in mind, one must ask what an appropriate balance might be. This thesis seeks to answer this question. In particular, it considers how stand alone technologies and large scale systems might differ in the diffusion process and, having laid out the difference, it examines alternative diffusion processes and how they relate to the case of network diffusion in Kenya.

1.1 Research Model

Development is such a complex process that it is hard to identify how the numerous variables involved effect outcomes. Based on Rogers' (2004) theoretical framework, this paper hypothesizes that successful network diffusion requires both top-down and bottom-up approaches. That is to say, innovation diffusion must be generated by individuals both within and external to the social system. Moreover, the need for top-down directly is likely to be greater when technologies are networked rather than stand alone.

To answer this question and test the above hypothesis, subsequent chapters present and examine several variables. Chapter Two provides a theoretical framework that identifies the design of the development process (top-down or bottom-up) as the independent variable. Chapter Two also describes how the organization of development models evolved over time, in keeping with changing theories of development. The chapter examines top-down models of development based on modernization theory, and looks at how this type of theory drove the organizational structure. Likewise, it looks at the theories that led to the preference for grassroots-based models of development. In Chapter Three, the thesis looks at the intervening variable--how the nature of the technology affects the diffusion. This chapter argues that different types of technologies might require different organizational models of diffusion. Chapter Four examines the outcome of the diffusion process – the dependent variable. The outcome of the diffusion process will be examined in the context of a case study. Specifically, Chapter Four will present a World Bank-managed networked ICT-based development project that aims to provide high-speed data network access to the southeastern region of Africa. This section seeks to operationalize theories of technology, diffusion and development in a real-world setting. The conclusion, Chapter Five, addresses the research question and describes to which end the hypothesis is verified in the case study. In addition, it characterizes the implication of these findings for the organization of diffusion projects aimed at promoting development.

Chapter 2. International Development Frameworks

2.1 Introduction

As ICTs mature over time, they are becoming increasingly useful in the field of international development. Recent literature points to a transition in how the technology is being used in development, noting that historical top-down models of development are being replaced by those which are more grassroots-based, or bottom-up. However, ICTs are sufficiently complex and technologies are changing so rapidly that a third model specifically relating to ICTs may be required, one that goes beyond solely being bottom-up or top-down; specifically one that is a hybrid between the two models (see Figure 2). To test this hypothesis, a brief examination of international development frameworks is required.

International Development Frameworks			
	Top-Down Model	Bottom-Up Model	Hybrid Model
Where are the financial resources?	Top-level organizations (World Bank, UN, etc.).	Top-level organizations (World Bank, UN, etc.).	Top-level organizations (World Bank, UN, etc.).
Who maintains control?	Top-level organizations (World Bank, UN, etc.).	Organizations on the ground, operating out of the community.	Both top-level and community-level organizations, working together.
Where project operates?	In target community.	In target community.	In target community.
Necessary factors for success?	Cooperation from actors within the	Cooperation from top-level	Cooperation between top-level

	community	actors.	and ground-level actors.
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Figure 2. The three models of development

International development frameworks serve as the independent variable in the hypothesis presented in this thesis. This hypothesis contends that successful technological diffusion in large-scale networked technology development projects requires top-down as well as bottom-up approaches. To test this argument requires an understanding of the two types of development approaches, and the underlying theoretical rationale that pertains to each of them.

This chapter characterizes these development approaches and describes their origins and rationales. In summary, it notes that the top-down model sees development as a project undertaken by the developed countries to help the developing countries accelerate industrialization and development of modern infrastructure. Resources flow downward to the developing countries from the developed nations' resource pool, which may include large development banks such as the World Bank, or large intergovernmental organizations that have an aid mandate, such as the UN. In contrast, the bottom-up model conceives of development as originating from the communities in need. Although industrialized countries often provide resources to assist these grassroots-generated programs, the goal is not necessarily a specific level of industrialization, but rather providing tools and training appropriate to and supportive of the affected community.

2.2 Top-Down Models of International Development

The top-down model of development can be traced back to the end of the Second World War, specifically to the need for economic reconstruction and the post-War realization that colonialism was no longer a viable form of government. By 1944, the Allies realized they needed to help rebuild and re-establish the economies of worn-torn countries once World War II had ended. To meet this objective, American and British economists, acting on behalf of their governments, established the Bretton Woods financial system, which was designed to bring legally-binding obligations and multilateral decision-making together in an international organization (Cohen, 2001). Two international organizations—the International Monetary Fund and the International Bank for Reconstruction and Development (the World Bank)—constituted the core of this system. Because several of the signatories to the Bretton Woods agreements had colonies prior to the War, they were inclined to view the provision of aid as a top-down process, whereby resources flow downward from the most advanced countries. Thus, out of the need to find a substitute for colonialism as well as a need to rebuild the economies of Europe and Japan after World War II, modern development arose. As Kandiyoti (2002) has noted:

It was the formal dissolution of European colonial empires after World War II and the ‘national development’ agenda of newly independent states that prompted the

appearance of a new discourse about the modern trajectories of non-Western societies—that of development (p. 28).

Edward Said's idea of Orientalism perhaps best captures the essence of the asymmetrical colonial relationship that informed the Bretton Woods institutions. According to Said (Kohn, 2006), Orientalism was the European practice of defining themselves by identifying what was “outside” and the other, i.e. non-European. “Orientalism is a way of characterizing Europe by drawing a contrasting image or idea, based on a series of binary oppositions (rational/irrational, mind/body, order/chaos) that manage and displace European anxieties” (Kohn, 2006). Orientalism helps explain the mindset of the colonialist countries that sought, after World War II, to change their roles from that of colonizer to that of benefactor. In this way, the power dynamic remained firmly in the hands of the developed countries.

This top-down perspective, which came to be known as ‘modernization theory’ drove international development efforts following the War. The theory's most fervent proponents, such as W.W. Rostow, purported that successful development needed to follow a clear linear path from a state of underdevelopment, represented by a traditional society, to a modernized state, and hence a developed one, as signified by the presence of mass consumption. (Menzel, 2006, p. 213; Uitto, 2006, p. 80). The concept of modernization as development equated “development simply with industrialization and economic growth, which would lead to a trickle-down effect increasing the overall wealth

of the population” (Uitto, 2006, p. 80). Certain American theorists, such as Rostow, went even further with respect to top-down development, proposing that the US become the leader of a new global partnership for economic growth (Menzel, 2006, p. 215).

Although modernization theory became the most widely-adopted development approach, the theory had many vocal critics. Almost as soon as it began driving the Bretton Woods institutions, it came under fire from theorists with backgrounds ranging from economics to sociology. Some scholars, such as Blaut, argued that modernization theory assumed Europe was the holder of modernity, while lesser developed countries were the target of innovation flow, thus giving privilege to one group’s pool of knowledge over the other’s (Wisner, 2006, p. 42). Others questioned the value of modernization theory on the grounds that assuming “goodwill on the part of governments to really improve the lot of the invisible sectors [the poor] is naïve” (Max-Neef, as cited in Abrahamsen, 2006, p. 173). According to these critics, development represented the interests of the dominant class (Abrahamsen, 2006, p. 173).

The top-down model of development continues to undergo criticism today. According to Brohman (2006, p. 30), for example, modernism is flawed because it faults the developing country, rather than the process, when development projects fail. As he said “The failure of development efforts, especially those of external origin, is commonly attributed to the presence of some inescapable obstacles to development unfortunately present in Southern society” (Brohman, 2006, p. 130). Other critics went further, arguing

against the assumption that ‘tradition’ is necessarily a barrier to development. (Köbler & Schiel, 2006, p. 271).

Yet another reason why modernization theory and top-down development came under attack was that they were associated with blanket solutions, which critics deemed unlikely to meet with lasting success. As Escobar (2006, p. 225) pointed out, economic approaches that are suited to industrial economies are unlikely to be applicable in the context of developing countries. Likewise, Brohman (2006) noted:

Efforts to impose formal universal models and strategies, regardless of the historical and structural realities of specific development contexts, were a sure-fire recipe for disastrous development policies and programs, with many dire economic political and socio-cultural consequences (p. 129).

Therefore, according to these authors, what are needed instead are principles that take into account the wide variety of development experience in the southern, or developing, countries (Brohman, 2006, p. 130).

Given their strong negative reactions to modernization theory, many analysts sought to identify new frameworks. One new top-down framework was structuralism, which critiqued the way that modernization theory set the standard for international development in the 1940s. Structuralists defined core industrial countries as the “center” of the international economy, and developing, agrarian countries as the “periphery” (Love, 1996, p. 126). In their analyses, they emphasized the difference between the

economic, social and political structures of the core countries versus those in the periphery. Some argued that, while core countries' economic sectors had similar productivity levels, or an internally homogeneous structure, periphery countries had internally heterogeneous structures in which productivity fluctuated by economic sector, depending on the levels of technology present therein (Kay, 2006, p. 203). On this basis, they argued that international trade exacerbated the gap between periphery and core countries, by reinforcing developing countries' heterogeneous structure, as well as their unequal terms of exchange (Kay, 2006, p. 203).

The structuralists also had their critics, however. The scholar who designed the structuralist model, Prebisch (as cited in Kay, 2006), ultimately concluded that the structuralist model was flawed. In its place, he advocated for:

Changing the periphery's structure of production and developing an industrial sector which would lead to higher rates of productivity growth and to a greater ability to retain the 'fruits of technological progress,' leading thereby to high rates of growth and incomes which could reduce the gap between the core and periphery (p. 203).

Yet other theorists advanced the top-down model even further. For example, one model argued that economic development in the periphery countries was composed historically of four stages, and that these stages were universally applicable to all developing countries (see Figure 3) (Pitzl, 2004, p. 38). They contended that, in light of

the aforementioned core-periphery binary, the four stages of development “worked strongly on the regional scale, and brought space, power and society into unequal relationships” (Pitzl, 2004, p. 38).

Four Stages of Development			
Stage 1	Stage 2	Stage 3	Stage 4
Pre-industrial society	Core-periphery relationships	Dispersal of some economic activity (and a minimal level of control) to the periphery.	Spatial integration of the global economic system, resulting in greater interdependency between member countries in both the core and periphery.

Figure 3. Friedmann’s four stages of development

2.3 Bottom-Up Models of International Development

In response to such top-down models of development as modernization theory, new theories advocating a bottom-up or grassroots approach to development began to arise. Theorists, such as Altvater, observed that Western patterns of production and consumption are not necessarily universally applicable to all countries. Moreover, top down approaches, they said, may fail because all too often they equate underdevelopment with poverty. (Salih, 2006, p. 21). In addition, they contended that a development strategy based on capital accumulation and poverty was too focused on economic characteristics, when social and political characteristics were of equal importance in the development process. These critics defined underdevelopment as “a cumulative sum of

the whole history of capital expansion structurally constructed as a world system with centre and periphery. According to them, underdevelopment results from the cumulative problems of unequal exchange, unequal development and imperialism” (Salih, 2006, p. 21).

With these concerns in mind, a number of development theorists began to build bottom-up strategies for development. Common to such frameworks is the idea that successful development requires a multi-disciplinary approach, which allows for viewing development through a lens of diverse inter- and intra-disciplinary discussion and exchange. Multi-disciplinary approaches, they argued, are important because they can help build democracies, sustain economic growth and generate social equity (Sánchez-Rodríguez, 2006, p. 64). It is the separation along disciplinary lines of scholars that keeps them from being able to truly understand the many aspects of development (Brohman, 2006, p. 127). According to them, development is “complex, holistic and people-centered, in addition to encompassing economic as well as social, cultural, environmental, political and other forms of non-economic change and transformation” (Cline-Cole, 2006, p. 4).

Another characteristic of bottom-up development is the concept of empowerment. Noting the link between economic development and human development, bottom-up advocates call for development to remove “unfreedoms” that leave people without agency (Sen, as cited in Corbridge, 2006, p. 232). In addition, many of these scholars

note that a sense of ownership and having a voice in the process is key to successful bottom-up development projects (Cline-Cole, 2006 p. 4; Yapa, 2006, p. 28; Connell & Rugendyke, 2006, p. 57; Bebbington, 2006, p. 67; Gaile, 2006, p. 57). Placing “the poor, destitute, marginalized, excluded and powerless at the heart of development, this model incorporates the importance of decision making, policy formulation and implementation” (Parnwell, 2006, p. 73).

A third trait that defines bottom-up development models is the recognition of the importance of culture to the development process. Many theorists now recognize the importance of building on local knowledge and culture where a project or initiative takes place. (Melber, 2006, p. 17). Likewise, they emphasize that local knowledge and awareness of local culture, social relationships and environments impact participation, and thus are important for engaging the local population. They believe that local communities do not possess a vague idea of tradition, which is meaningless in the development process. Instead, these traditions comprise detailed social, economic and political structures that need to be integrated into any development strategy (Köbler & Schiel, 2006, p. 271).

2.4 Modern Definitions of International Development

These explanations of top-down and bottom-up models of international development inform today’s approach to the problem. For example, the World Bank now

defines international development in a large scale, societal light that does not highlight specific aims so much as a holistic concept of well-being. According to the World Bank (2008c), the purpose of development is “to help people become more productive and to improve the quality of life for individuals, families, communities and countries as a whole.” Further, the World Bank (2008c) notes that “a country must concurrently pay attention to social, economic, political, cultural and environmental issues to ensure that development is sustainable and beneficial to all.”

In contrast to the World Bank, the UN defines development more concretely, as a series of actual objectives, called the Millennium Development Goals (MDGs). According to the UN (2005), the eight MDGs include eradicating extreme poverty and hunger; achieving universal primary education; promoting gender equality and empowerment of women; reducing child mortality; improving maternal health; combating infectious disease and developing a global partnership for future development. But like the World Bank’s framework, the UN’s approach, when viewed as a whole, is far more holistic than earlier top-down models.

2.5 Conclusion

The independent variable of the hypothesis examined in this thesis, which is the focus of this chapter, is the type of international development framework. The hypothesis states that successful technological diffusion in international development projects

requires both top-down and bottom-up approaches. Testing this hypothesis requires comprehension of the dominant development approaches and the history and schools of thought that support each. In the top-down model, which is based on post-colonialist thought, resources flow from the northern, or developed countries, to the southern, or developing, countries with little input from the latter. In contrast, the bottom-up or grassroots model sees development as originating from the local community. In this model, resources from the northern countries may be of assistance, but the goal is not a specified state of industrialization, but rather a state which is appropriate and in support of the impacted community.

In comparison to the independent variable, which is international development frameworks, the dependent variable of this thesis is the outcome of the diffusion process. The relationship between the two is illustrated in Figure 4. The diffusion process that moves technology into an organization or system is nested within the international development model, which may be a top-down or bottom-up model. As discussed in subsequent chapters, the best type of diffusion model used within the international development framework may depend, in part, on the nature of the technology being diffused.

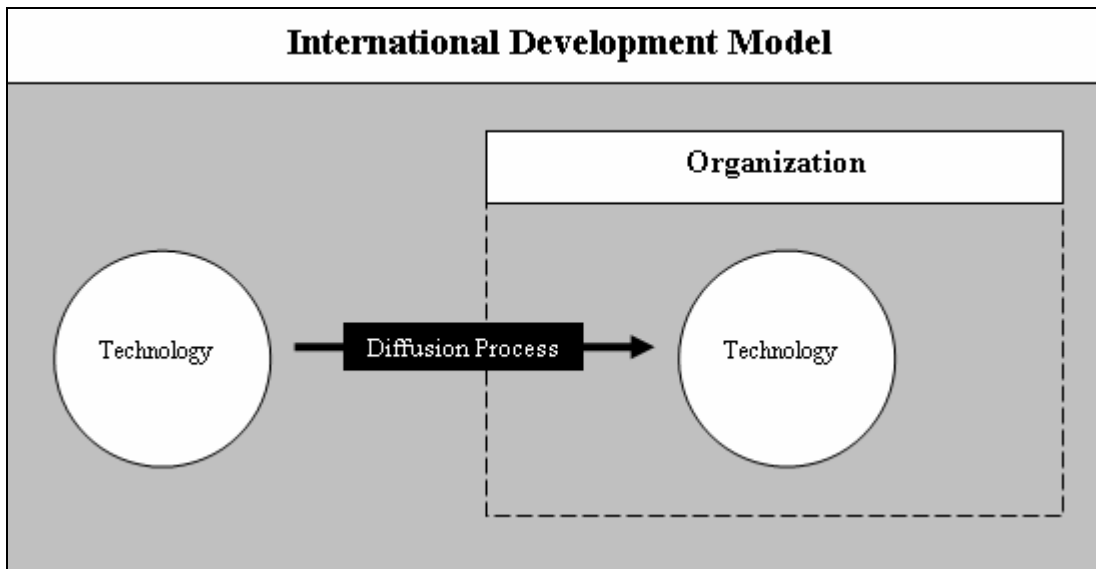


Figure 4. Diffusion models and international development frameworks

Chapter Three will examine the relationship between the nature of technology and frameworks for diffusion. Specifically, it first examines networked and stand-alone ICTs and the characteristics that differentiate the two. Second, it provides a study of current diffusion theory in relation to the nature of technology, in particular, how diffusion differs when referring to stand-alone ICTs versus networked ICTs.

Chapter 3. Conceptualizing the Nature of Technology and Diffusion

3.1 Introduction

As the information age matured from its beginnings in the mid-1990s, information and communication technology (ICT) increasingly became a recognized tool of development. Many of these projects have failed, however. This thesis hypothesizes that one reason for these failures might have to do with the nature of the technology. These projects entail the deployment and diffusion of networked information and communication technologies. These technologies differ from stand-alone ICTs in several ways. For example, in order to provide service, network technologies must be interoperable, a criteria that is very hard to achieve. Moreover, deploying networking technologies entails very high fixed costs, and thus the accumulation of significant financial capital (see Figure 5).

Characteristics of Technology		
	Network Technology	Stand-Alone Technology
Coordination Costs:	Low	High
Fixed Costs:	High	Low
Interoperability:	Required	Not required
Prerequisites for Growth:	Entire system must be in place.	None
Example:	The Internet	Early mainframe computers

Figure 5. Characteristics of technology

Meeting these criteria is especially difficult for developing countries. Most are not active in the standard setting process, so they typically must rely on foreign vendors to achieve interoperability. Nor do they have extensive financial resources, and those

that do have are used to meeting a wide range of special needs. Solving these problems may be especially difficult in light of the shift from top-down to bottom up development projects. While bottom up projects provide a more holistic approach, as well as greater citizen engagement, they may, as a result, be far more difficult to coordinate. Thus, in cases where networked technologies are involved, development projects may need to take a more centralized approach.

This argument provides the basis for the hypothesis tested in this thesis, in which the nature of technology serves as the intervening variable in accounting for diffusion outcomes. The hypothesis contends that successful technological diffusion in large-scale networked technology development projects requires a hybrid approach—that is a mixture of top-down as well as bottom-up practices. Testing this argument necessitates understanding the nature of technology and diffusion and the underlying theories relevant to each.

This chapter examines the relationship between the intervening and the dependent variables. First, the chapter characterizes stand alone and networked technologies, and the significant differences between them. Next it describes the diffusion process and the conditions under which it is said to be most successful. Then, it concludes by describing the implications for development.

3.2 Stand-alone versus large-scale networked technology

In this thesis, the focus is on information and communication technologies (ICTs). Two different types of such technologies are considered—stand alone, and networked technologies. They are differentiated based on their cost structure, their coordination costs, interoperability requirements and the presence of externalities.

3.2.1 Networked technologies

Many of the ICTs used for development are networked systems and development agencies employ a number of definitions to characterize them. According to the World Bank's ICT Glossary Guide, for example, ICTs consist of “the hardware, software, networks, and media for the collection, storage, processing, transmission and presentation of information (voice, data, text, images), as well as related services” (World Bank, 2008b). In contrast, the UN Department of Economic and Social Affairs does not define ICTs in a concrete sense so much as divide them into two classifications based on their usage: those related to manufacturing and those related to services. In turn, the OECD (2007) defines ICTs as being composed of three components: data, telephony, and television, with each component being made up of both infrastructure and services.

The World Bank definition, which conceives of ICT technology as the hardware, software, networks and services that all work toward the goal of information diffusion, is the most appropriate for this thesis, with its focus on development. Technologies

employed for development are those entailed, for the most part, in data exchange. In contrast to the World Bank definition, the UN definitions, which relate to specific business usage, are too narrow; whereas the OECD definition, which includes media technologies, is too broad.

To characterize data exchange networks in more detail, it is useful to consider the Internet, which dramatically expands the utility of local and national data networks by connecting them to backbone networks at the core of the global Internet. By examining the Internet's basic structure and technological requirements, the challenges facing ICT diffusion in development may be better understood. Perhaps the best way to understand the Internet is by looking at it as a series of layers, each one stacked on top of another (see figure 6). The Open Systems Interconnection Basic Reference (OSI) model, approved by the International Standards Organization (ISO) and the International Telecommunication Union (ITU), is the standard means by which to describe networked communication technologies, including those that power the Internet. The layers that are most germane to this thesis, and its focus on development, are the physical, transport and application layers.

OSI MODEL	
<u>Layer</u>	<u>Description</u>
Application	Network process to application
Presentation	Data representation and encryption
Session	Interhost communication
Transport	End-to-end connections and reliability
Network	Path determination and IP (logical addressing)
Data Link	MAC and LLC (physical addressing)
Physical	Media, signal and binary transmission

Figure 6. The OSI model

3.2.2 Differentiating between stand-alone and networked technologies

As noted above, two separate types of ICTs exist: stand-alone and networked technologies. The difference between the two lies in their respective interoperability requirements, fixed costs, coordination costs and the presence of externalities. One of the traits that separates stand-alone technologies from networked technologies is the latter's need for interoperability. As defined here, interoperability refers to "the interchange of information across different telecommunications infrastructures by their technologies" (Bailey, 1995). Note that interoperability is different from compatibility in that "while two systems may be compatible by sharing the same components, they are non-interoperable if they are unable to exchange information through a network" (Bailey, 1995). Networked technologies, such as those constituting the Internet, require interoperability so that their components can interact and pass information back and

forth. In contrast, stand-alone technologies, such as the first mainframe computers, lack interoperability, which prevents them from forwarding information to external computers without the help of technical intermediaries.

The presence of high fixed costs is another trait that differentiates stand-alone technologies from networked technologies. Networked technologies tend to have high fixed costs, while those of stand-alone technologies are low. High fixed costs are those required to begin production of a product or service. Networked technologies have high fixed costs because, in order to offer only one unit of a product or service, the entire system must be in place. Moreover, once expended, these initial costs can't be recouped. They are fixed for the life of the technology, and hence do not vary according to the amount produced (OECD 1993). In contrast, stand-alone technologies can be unbundled and purchased piece-meal. As a result, these technologies can be bought and deployed over time in direct response to demand. Therefore the cost of investing in these technologies is typically much lower than in the case of large-scale networked technologies.

The level of coordination costs also distinguishes stand-alone technologies from networked technologies. Coordination costs are low among networked technologies, but are high in stand-alone technologies. Coordination costs refer to “all of the information processing costs necessary to integrate the various economic activities of separate units of an organization and between separate organizations” (Shin, 1997). Because stand-alone

technologies need not be interoperable, assembling them together entails high coordination costs. On the other hand, the cost of coordinating networked systems is considerably lower. One reason for these lower costs is that networked systems allow increased amounts of information to be communicated throughout the system in the same amount of time.

3.3 Diffusion Models

Having examined the nature of technology used in development programs, we need to understand how successful diffusion of technologies takes place. This thesis argues that the type of technology—that is to say, whether it is stand-alone or networked, affects the process of diffusion.

Scholarly interest in the diffusion of innovations dates back to the early twentieth century. Schumpeter (as cited in Freeman & Louçã, 2001) was among the first to identify the role of the entrepreneur in promoting technology adoption. In the mid-to-late twentieth century, Everett Rogers developed a theory that sought to explain the entire diffusion process. His work became a benchmark for subsequent scholars writing about diffusion and, like Rogers, they focused on stand-alone technologies. More recently, a number of scholars, such as Hughes (1976), Freeman and Louçã (2001) and Perez (2002), have looked at some of the unique aspects of diffusion that are associated with large

scale, networked technologies (also called large-scale technology systems). These theories are described below.

3.3.1 Diffusion of stand-alone technology

Everett M. Rogers (2004) first examined innovation diffusion in the early 1960s, while studying the adoption of weed spray among Illinois farmers. He characterized the process in his classic work, *Diffusion of Innovations* (1962). Rogers (2004) defined innovation as an “idea, practice or object that is perceived as new by an individual or another unit of adoption.” Innovations, according to Rogers, present new alternatives and new methods of problem solving. In addition, he regarded diffusion as the “process in which an innovation is communicated through certain channels over time among members of a social system,” or an organization (2004, p. 5). Such communication might be either planned or spontaneous. Employing these terms, Rogers identified four key elements of the diffusion process.

The first element in Rogers’ (2004) model of innovation diffusion is the innovation itself. As he described it, innovation is any new idea where the newness is “expressed in terms of knowledge, persuasion or decision to adopt” (Rogers 2004). Disregarding the possibility of technological groups or innovations across an entire organization, Rogers said that potential adopters may decide for themselves where one innovation stops and another begins. He notes that the greater the relative advantage,

compatibility, trialability and observability associated with an innovation, the less complex it will be, and the faster its rate of adoption.

In the diffusion of stand-alone ICTs, a technological innovation is introduced into an organization such as a social system, which is composed of a social structure. Rogers (2004) defines a social system as a “set of interrelated units engaged in joint problem solving to accomplish a common goal” (p. 23). Such units may be composed of individuals, informal groups, organizations or subsystems within the system. Overlaying the social system is the social structure, defined as “patterned arrangements of units in a system,” which gives regularity and stability to human behavior, thus allowing prediction (Rogers, 2004, p. 24).

Innovations are introduced to organizations through several conduits; one of which is the change agent. Rogers (2004) defines a change agent as an individual who influences others’ innovation decisions to meet the desires of a change agency. Change agents generate change from outside the organization, in accordance with an external entity’s agenda. Change agents are often highly educated and have higher-than-average social status. Rogers concludes that they are thus heterophilous in relationship to the organizations upon which they are attempting to exert influence.

Opinion leaders operate within an organization such as a social system and frequently work with change agents to introduce innovation into the system. The role of opinion leader may be defined as an individual who frequently and informally influences

other individuals' attitudes or overt behavior in a desired way. Opinion leaders exist within the social system in which their influence is exerted, although they do not necessarily play a formal leadership role. Typically, opinion leaders are exposed to more forms of external communication, exist in a higher-than-average socioeconomic state, and are generally more innovative than other units in the organization. They are unique in that they are located at the nexus of multiple interpersonal communication networks. Rogers (2004) characterizes them as, "interconnected individuals who are linked by patterned flows of information."

Change agents often use aides in addition to opinion leaders to act as lieutenants in the diffusion process. Actors who play this role of operating at a level below that of the professional change agents work with opinion leaders to influence decision. Because aides are generally homophilous with the organization's average individual, they can better bridge the heterophilic gap between professional change agents and their target organization.

The three transformative roles of change agent, opinion leader and aide use communication channels to reach individuals within an organization. The three types of channels may be identified as mass media, interpersonal and interactive Rogers (2004). The mass media communication channel affords the transmission of messages from one or few individuals to many via a medium such as radio, television or newspapers. The interpersonal communication channel entails "face-to-face exchange between two or

more individuals,” (Rogers, 2004, p. 174) while an interactive communication channel is comprised of exchanges between individuals across the Internet. Rogers (2004) notes that communication channels may be homophilic or heterophilic to the organization’s population.

Time is the framework through which collective transformative agents contact members of a social system or organization via communication channels. In the innovation-decision process, time gauges an individual’s move from the first step of knowing about an innovation to the final step of making a decision either for or against the innovation. Rogers (2004) segments the innovation-decision process into five steps: knowledge, persuasion, decision, implementation and confirmation. The innovation-decision process eventually leads to adoption or rejection, also known as discontinuance.

Once an individual reaches the implementation stage of the innovation-decision process, time is again used as a measurement. Time may be used to measure “the relative earliness/lateness with which an innovation is adopted [by one individual as] compared with other members of a system” (Rogers, 2004). An individual’s innovativeness, or degree to which they adopt a new idea before another individual, may be measured using one of five time-based adopter categories: early adopters; early majority; late majority; and laggards.

On a more macroscopic level, time also affects technological diffusion via the rate of adoption within the larger organization. Rogers (2004) defines the rate of adoption as

the speed with which an innovation is accepted throughout the organization. As he observed, (2004) some innovations diffuse rapidly across an organization while others diffuse more slowly. Differences in rates of adoption are due to several reasons.

The rate of diffusion of stand-alone ICTs correlates to the rate of adoption of the innovation within an organization. With regard to stand-alone ICTs, five variables determine the rate of innovation adoption (Rogers, 2004). The first variable is composed of the collective perceived attributes of the innovation by individuals within the organization or social system. Statistically, these perceived attributes include relative advantage, compatibility, complexity, trialability and observability (Rogers, 2004).

The second variable to determine the rate of adoption of an innovation is the type of innovation-decision and this variable also originates from within the organization (Rogers, 2004). The first decision type, labeled “optional,” may define a situation in which the individual is the main unit of decision-making. The second type, “collective,” consists of decisions made by consensus among an organization’s units, or members. Third, the innovation decision is based on authority whereby relatively few individuals, possessing power, status or technical expertise, make the decision. The last type of innovation decision is called a “contingent decision” and it is made only after a prior innovation decision, usually by individuals possessing authority (Rogers, 2004).

Whereas the previous two variables that determine the rate of adoption of stand-alone ICTs derive from an individual unit within the organization or social system, the

subsequent three variables originate from external sources. The third variable that informs the rate of adoption of a stand-alone ICT innovation is the communication channel, which is determined externally by the change agent. The fourth variable is the nature of the social system itself, which is also defined by an outside change agency. The fifth and final variable is the extent of the change agents' efforts to promote diffusion of the innovation (Rogers, 2004).

While these five variables contribute toward the rate of adoption of stand-alone ICT innovations, it is also important to note that stand-alone ICT innovations can be perceived as happening in clusters. This perception, although held by individuals in an organization, is dictated by external change agents (Rogers, 2004, p. 249). In essence, while adoption of one stand-alone technology may trigger adoption of another, the view of multiple innovations as a cluster is driven by external change agents. How the change agent defines the technology is based on a sense of users' perceptions of the compatibility of the interrelated innovations (Rogers, 2004).

3.3.2 Diffusion of networked technology systems

While some theorists may disagree about how large-scale technologies are diffused, most concur that stand-alone technologies are a separate case. Noting that several historical innovation studies focus on stand-alone technologies, Freeman and Louçã (2001, p. 239) emphasize that the diffusion of a large-scale technology system is a

different process than that of stand-alone ICTs. In contrast to stand-alone ICT technologies, large-scale networked technology systems share three core characteristics, which are depicted in figure seven (Hughes, 1976). First, such systems are made up of different types of components, all of which serve a different function in order to meet the specific needs of the system. Second, these components are connected together in a network structure, thus forming a complex system in which changes to one component impact the others. Finally, each system is a control component, which exists to generate efficiencies within the system and also to drive the system toward completion of its goals. In essence, a technological innovation can't be viewed as a single object or as multiple disparate pieces; rather it must be seen as an interlocking system in which all components, ranging from material to political, are viewed in the context of each other (Owens, 1991).

Three Characteristics of Networked Technology Systems
1. Contains many components.
2. All components connected in a network architecture.
3. One component drives the others toward system goals.

Figure 7. Characteristics of networked technology systems

The differences between these technologies are reflected in their diffusion processes, and the rate of adoption. In the case of stand-alone technology innovations, for example, the rate of diffusion depends on the rate of adoption by the social system. In particular, it depends on five conditions: the perceived attributes of the innovation by

individual units in the organization; the type of innovation decision; the communication channels used to disseminate information about the innovation; the nature of the organization or social system itself; and the extent of the change agents' promotion efforts of the innovation.

The rate of diffusion of large-scale networked systems follows a different model, which some have described in terms of long waves. According to Kondratiev, for example, these long waves were the result of “infrastructural investments and their ‘echo’ replacement every half-century or so” (Freeman & Louçã, 2001, p. 139). In contrast, Freeman and Louçã (2001) dispute this notion, arguing that long waves are caused by a protracted process in which new technologies must emerge and diffuse throughout the economy (p. X). Kondratiev used his concept of long-wave theory to explain investment, technological deployment and economic growth at the national and global level.

Others writing about large-scale networked system diffusion propose a derivative of long wave theory, called punctuated equilibrium. In contrast to Kondratiev, this theory applies a similar idea, but on the small organizational scale. The theory highlights the fact that diffusion takes a long time to occur. In particular, it states that an organization will operate for long periods of time in a patterned state in which change is slow and apparently insignificant – referred to as an equilibrium period. Interspersed throughout this pattern are moments of radical shift, called revolutionary periods, in which rapid and major technological change occurs and disrupts the existing patterns, thereby creating a

basis for a new equilibrium period (Tushman & Anderson, 1986; Romanelli & Tushman, 1994).

Some scholars employ the notion of technological revolutions to characterize the diffusion of large-scale networked systems within an organization. According to them, growth is not driven by a single instance of innovation but rather by a revolution of clustered innovations (Perez, 2002). In this context, a technological revolution may be defined as “a powerful and highly visible cluster of new and dynamic technologies, products, and industries, capable of bringing about an upheaval in the whole fabric of the economy and of propelling a long-term upsurge of development” (Perez, 2002, p. 8). Technological revolutions are composed of four change phases: invention, innovation, commercialization and dissemination. (Perez, 2002). All four stages must occur because the organization that first brings a new technology to market does not necessarily realize significant return on investment.

Another characteristic of large-scale networked systems diffusion is the importance of socioeconomic factors that affect decisions relating to diffusion. Some authors emphasize that technological diffusion must take into account the context in which technologies are introduced. (MacKenzie & Wajcman, 1985). Indeed, they point out that, in looking at general factors of technological change, one should not limit oneself to scientific knowledge because other factors, such as politics and social values, also play a role (Hughes, 1976).

In explaining the failure of the diffusion of large scale networks, such as electric power generation systems, some analysts point to the discontinuities, as well as continuities, associated with families of interdependent innovations (Freeman & Louçã, 2001). These discontinuities need not be related solely to the technology. They can also stem from the social, economic, institutional and cultural factors that shape change. (Williams & Edge, 1996).

The study of large scale systems was inspired, in part, by what has come to be referred to as the productivity paradox. This paradox refers to the fact that, notwithstanding very large business investments in technology, the productivity gains were very low. Scholars (David, 1990; Brynjolfsson & Hitt, 1993) explained this outcome in terms of the high coordination costs entailed in developing a large scale system. He noted that the entire system must be in place before the benefits can be widely accrued. As importantly, even when productivity gains are made, they may not be recognized insofar as new technological systems can change the criteria for success (Brynjolfsson, 1993). Eventually productivity will increase, but not until the technology in question reaches a critical saturation point. (Kraemer & Dedrick, 2001). When a networked technology system is fully distributed within the society that surrounds it, the economic effects of that system will be greater and longer lasting. (Perez, 2002).

Many of the coordination problems associated with the deployment of large scale ICTs appear to be lessening. In fact, networked ICTs are now diffusing at a rate that is

faster than before. These findings are reported in the World Bank's 2008 report, *Global Economic Prospects: Technology Diffusion in the Developing World*, which provides evidence that technology diffusion is speeding up over time:

Technological diffusion appears to accelerate above a certain threshold. This pattern is consistent with the existence of significant economies of scale and barriers to entry among these technologies, such that once the barriers are overcome and the technology is in place, scaling up occurs relatively quickly.

3.3.3 Measuring technological diffusion

The primary method of measuring successful diffusion of large-scale networked systems in development projects is teledensity (Juma et al., 2005). In the case study presented in the following chapter, teledensity figures measuring how many people have Internet access is the primary measurement used to gauge successful diffusion of a large-scale networked system in the context of international development.

3.4 Implications of Diffusion in Development

What are the implications of these two types of ICTs for development projects that foster diffusion? We can see that for successful technological diffusion of networked systems to occur in international development projects, several conditions must be met. For example, there must be stability at the governmental level. If stability is lacking at the government level, there will be inadequate leadership and commitment, both financial

and otherwise, to sustain the long period before benefits and returns are experienced. Hence, successful and lasting diffusion requires stable government to assure consistent and reliable dedication of leadership, staffing, physical resources and funding. In addition, successful diffusion has several indirect requirements because stable governance requires governmental transparency to mitigate corruption, the presence of standards to create an operational business framework and the availability of financial resources to support these initiatives. Finally, checks and balances within the relevant government agencies are important to international development projects in which diffusion of networked ICTs occurs. Such government mechanisms help ensure that the salient groups and ministries or agencies remain focused on results and also meet the agreed-upon target deliverables (World Bank, 2007b, p.1).

Although governance is important to successful technological diffusion of networked systems in development projects, of equal importance is the presence of appropriate telecommunications policies. Indjikian and Siegel (2005) note that technological diffusion may “have a sustained, long-lasting impact on productivity and economic growth, provided that policymakers implement policies that facilitate a faster rate of diffusion and a better allocation of resources.” Appropriate telecommunications policies would encourage some level of public-private partnership (PPP), whether via privatization or other model, to provide affordable service to citizens. In addition, a successful PPP as encouraged by appropriate telecommunications policy would also

provide sustainable business models for private sector investors, such as through subsidies.

Another condition that must be met to ensure successful technological diffusion of networked technologies in international development projects is the presence of forward thinking. In networked systems, economic growth cannot occur until the entire system is in place. Therefore, considerable resources must be dedicated to the project before gains can be realized. These resources include not just dedicated leadership, but also financial, physical and staffing resources, as well as the participation of the users. By keeping an eye on the technological horizon and being aware of coming technological advances in networked systems technologies, such as WiMax as a replacement to WiFi, funding resources are not wasted on what might quickly become outmoded technology.

Conversely, once funding and resources are allocated for a large-scale networked systems project, dedication to the project should be maintained so it is completed in a timely fashion and economic gains are realized as rapidly as possible. This dedication is unique to large-scale networked systems because of the presence of high fixed costs, as well as the necessity of vision and commitment on the part of both external and internal change agents. In addition, in diffusion of a large-scale networked system, users also have a responsibility to participate in the diffusion process by generating acceptance of the technology on the local level and, above all, using the new technology.

Finally, a study of technological diffusion of networked technologies in international development projects requires recognition of the uniqueness of the development context. Diffusion of networked technologies into a developing country occurs when products or processes that are new to a country or to an individual enterprise are commercially introduced, whether or not they are new to the larger global community (UNCTAD, 2007). Diffusion in the developing world usually means the spread of existing technology from higher-income countries rather than the research and development of new technology within the developing country. As a 2007 UNCTAD report noted, “technological change occurs primarily through learning – that is the acquisition, diffusion and upgrading of technologies that already exist in more technologically advanced countries – and not by pushing the global knowledge frontier further” (p. ii).

3.5 Conclusion

The focus of this chapter was the nature of technology and diffusion, which was the intervening variable of the hypothesis examined in this thesis. The hypothesis puts forth the idea that successful diffusion in international development projects requires both top-down and bottom-up approaches. Testing this hypothesis requires a thorough understanding of the nature of technology, as well as diffusion. The technology studied in this thesis is limited to ICTs, the hardware and software that contribute to the collection,

processing and transmission of data. ICTs may be networked or stand-alone; the difference between the two being the presence of high-fixed costs, coordination costs and interoperability requirements in networked technologies. Whether or not a technology is considered networked impacts its diffusion, in that stand-alone technologies diffuse incrementally across a system and diffusion of networked technology occurs in a state of punctuated equilibrium.

Chapter Four examines a case study in the context of the variables presented in this chapter and Chapter Two, both of which support the hypothesis of this thesis. The case study is a multi-stakeholder, large-scale data network implementation project operated by the World Bank. First, Chapter Four identifies the development framework being used in the projects. Next, it studies the nature of the technology being diffused. Finally, it reviews the outcome and expected future outcomes of the process.

Chapter 4. Case Study: Kenya

4.1 Introduction

As information and communication technologies (ICTs) became increasingly flexible and affordable during the 1990s, the potential uses of ICTs in international development grew. However, many projects failed. This thesis argues that one reason for such failures relates to the development model used and the nature of the technology to be deployed. To explore these relationships, this thesis poses the question: How does the diffusion of networked systems technology differ from the diffusion of stand-alone technology in international development projects? As described in previous chapters, the thesis argues that successful diffusion in international development projects requires a hybrid development model, in which both top-down and bottom-up methods of development are used. The independent variable in this analysis is the development model, the dependent variable is the outcome of the diffusion process and the intervening variable is the nature of the technology and diffusion.

In this chapter, the above research model is applied to a real-world case study, a technology diffusion project that the World Bank undertook in East and Southern Africa, starting in 2007. The technology deployed in this case is a large scale network, as described in the previous chapter. This chapter examines the development model that the World Bank used, and shows how it functions as a hybrid of both top-down and bottom-up approaches. The analysis finds that the role of change agents is particularly important

in achieving this balance. In conclusion, Chapter Four examines the outcome of the diffusion process and identifies paths to success as well as potential problems.

4.2 Kenya: A Case Study

Kenya is participating in the World Bank's Regional Communication and Infrastructure Project (RCIP), a regional African telecommunications project whose goal is to provide users in Africa with high-speed terrestrial connections to global fiber optic backbone networks and the global Internet. RCIP is a multi-phase, decade-long project bringing telecommunications infrastructure, specifically data network access, to the countries in East and Southern Africa (E&SA). The focus of RCIP is to close the "terrestrial connectivity gap by supporting the build-out of terrestrial networks to connect the main towns of all participating countries with each other and the rest of the world" (World Bank, 2007e, p. 33). RCIP is composed of two sub-programs: investment in the physical infrastructure, and policy and regulatory support to insure universal and transparent access. As of March 2007, The World Bank's total estimated budget for RCIP is USD \$424 million.

Admission to RCIP is open to 25 countries in the E&SA region. This case study examines the program's implementation in Kenya, one of three countries selected for phase one. The Kenya portion of RCIP is also known as the Transparency and Communications Infrastructure Project (TCIP). The objectives of TCIP are similar to

RCIP's larger umbrella objectives. First, it aims to "contribute to lower prices for international broadband capacity and extend the geographic reach of broadband networks" (World Bank, 2007f, p. 10). Second, its goal is to "contribute to improved government efficiency and transparency through eGovernment applications" (World Bank, 2007f, p. 10). As of March 2007, The World Bank's estimated budget for TCIP is USD \$114.4 million.

Given the broad scope and significant cost of TCIP, and thus RCIP, it is important to understand why the development project was undertaken. One reason is that, at RCIP's inception, no terrestrial connection existed between the E&SA countries and the global fiber optic network infrastructure supporting the global Internet (see Figure 1). Even though Internet penetration rates rose by 41 percent in Sub-Saharan Africa from 1999 to 2005, Internet penetration in the region remains the lowest among developing regions (World Bank, 2007c, p. 74). At the time, the only data network access available was via satellite. This alternative was cost-prohibitive to all but the most affluent market segments. For example, in sub-Saharan Africa, the 2005 gross national income (GNI) per capita was USD \$745, yet "international wholesale bandwidth prices are 20 to 40 times higher than in the United States and international calls are on average 10 to 20 times more than in other developing countries" (World Bank, 2008b). According to the World Bank, such high pricing results from insufficient liberalization in the telecommunications sector.

Another reason for undertaking TCIP and RCIP was that lack of affordable data network access, specifically access to the Internet, limited regional economic growth (World Bank, 2007e; Indjikian & Siegel, 2005). Prohibitively expensive data network access harms trade at both the regional and international levels and also prohibits opportunities for employment (Bassanini & Scarpetta, 2002; Corea, 2007). In addition, the ability of ICTs to enhance education, social agency and good governance was also restricted by a lack of affordable data network access (World Bank, 2008b). As a 2005 UN report on science and technology in developing countries noted, the reduction of poverty is impaired by a lack of infrastructure (Juma & Yee-Cheong, 2005, p. 2). It argued that a basic level of infrastructure must be present in order for enhanced development of science, technology and innovation in development (p. 2).



Figure 8. African submarine data network, courtesy the World Bank

By leveraging a substantial budget distributed across multiple phases, the World Bank hopes to create and implement an effective diffusion strategy. According to RCIP project documents, (World Bank, 2007g, p. 2), the World Bank seeks to meet this goal in three ways: by accelerating the roll-out of backbone infrastructure; financing the pre-purchase of data network capacity for government use; and for financing eGovernment applications and ICTs in rural areas. The World Bank has two primary objectives (World Bank, 2007g, p. 2). First, it aims to provide quality and affordable telecommunications services for citizens and businesses in E&SA. Second, it seeks to use affordable capacity to improve efficiency and transparency of government through eGovernment applications. As part of the second objective, the World Bank also seeks greater financial accountability and governance in the public sector (World Bank, 2007g, p. 2).

4.3 Kenya: Design of the Diffusion Process

TCIP, and thus also RCIP, is a unique hybrid development project that uses both top-down and bottom-up models of development. The bottom-up aspect is reflected in the regional leadership's request to the World Bank for assistance in implementing the data network infrastructure. The top-down portion of the model is found in regional leaders' decision to prioritize the ICTs in the development agenda. This section explores both aspects of the hybrid model (see figure 2).

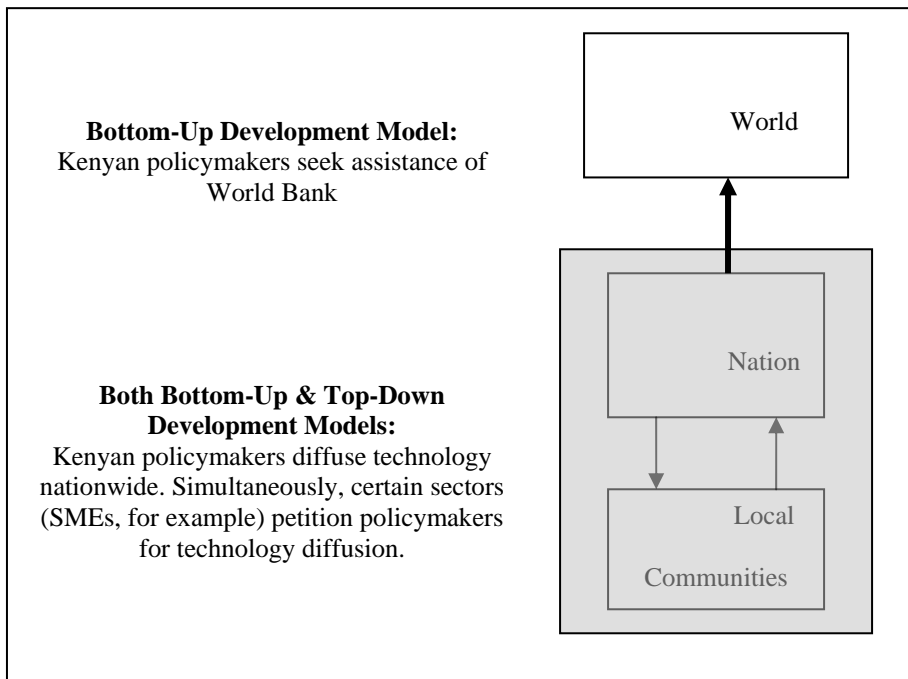


Figure 9. Development models used in TCIP

4.3.1 The Bottom-Up Model

TCIP, and its umbrella project, RCIP, incorporate a bottom-up development approach, in which the impetus for development originates at the community level. Community leaders determine which resources are required and work with other, larger organizations to secure those resources. In a bottom-up model, the goal of development is not necessarily industrialization or modernity but rather that of enhancing community services. Two principles pertaining to bottom-up development are relevant to this case study. The first relates to the existence of agency, which is seen as crucial to successful development (Corbridge 2006; Cline-Cole, 2006; Yapa 2006; Connell & Rugendyke,

2006). The second principle relevant to this case is that those in most need of assistance should be put at the heart of decision making, policy formulation and implementation processes (Parnwell 2006; Bebbington, 2006; Gaile, 2006).

One illustration of bottom-up development in the case of Kenya is the request for assistance from Kenyan and other regional leaders to the World Bank. The need for data network infrastructure development was first identified by multiple heads of state in the E&SA region, operating within a working group called the New Partnership for Africa's Development (NEPAD). To fund and manage such a large project, NEPAD chose a public-private partnership (PPP) model that would use the resources of NEPAD itself, private financiers and the World Bank Group, which includes the World Bank and the International Finance Corporation (IFC) (World Bank, 2007b, p. 2). NEPAD asked the World Bank to undertake RCIP for several reasons, including its significant experience in telecommunications reform; ability to generate open access and a hybrid project structure; and prior experience with multi-donor projects (World Bank, 2007g, p. 2).

In turn, the World Bank accepted NEPAD's request for assistance in designing and implementing RCIP, and thus TCIP. There were a number of reasons for their decision. First and foremost, RCIP met the World Bank's ICT mandate of improving communication infrastructure and providing cheaper ICT benefits (World Bank, 2007g, p. 12-15). These ICT benefits include higher growth and economic opportunities for the poor; increased efficiency in the public sector; improved health management; and the

provisioning of an enabling environment for economic growth and structural transformation. Second, the World Bank estimated that RCIP would strengthen infrastructure and institutional and regulatory reforms. Finally, the organization perceived RCIP as an engine for shared growth in the region (World Bank, 2007g, p. 12-15).

4.3.2 The Top-Down Model

This section examines another aspect of the development framework used in TCIP emblematic of the top-down model. This approach envisions resources flowing downward from developed countries to developing countries with the aim of bringing these countries upward to the same level of industrialization and modernity. As described in the previous chapter, this model stems from modernization theory (Menzel, 2006), which characterizes successful development as following a clear linear path from a state of underdevelopment, i.e. a traditional society, to a state of development, i.e. a modernized society.

In the Kenya project, TCIP, the top-down model of development is illustrated in the relationship between the national Kenyan government and local communities. In keeping with modernization theory, Kenya's leaders decided data network access was a priority in their economic development agenda. They agreed with the TCIP approach of building infrastructure to bring connectivity to rural communities through projects such as the government's Digital Villages initiative (World Bank, 2007f, p. 9). This approach

exemplifies top-down development insofar as the national government is taking development action in what it perceives to be the best interest of local Kenyan communities (see figure six). Moreover, it does not take into account whether local communities consider data network access to be the most important route to economic growth and poverty reduction.

4.3.3 The Hybrid Model

In the course of creating the development framework for RCIP, which ultimately informed the process of TCIP, the World Bank project staff recognized that each of the participant countries had diverse needs. To meet these needs, they developed a “menu” of project options, from which each country could choose. As the World Bank described it: “To maximize flexibility and client-responsiveness in a multi-country environment, RCIP has been designed as a menu of options which individual governments choose from in order to package their RCIP operation” (World Bank, 2007g, p. 3). The menu consisted of three core options: enabling environment; connectivity; and eGovernment applications.

Given this “menu” of options, TCIP had a set of four goals (see figure 3). As coordinated by the Kenyan government and World Bank, TCIP’s first component is affording an enabling environment in which the World Bank will provide technical assistance to Kenyan ministries and offices to create a legal and regulatory framework supporting the new data access network. The second component is connectivity, which

will provide physical data infrastructure to educational institutions and governmental organizations. The third component is transparency, which will migrate government services to software application processes. The final component is project management, which will provide training to Kenyan staff in areas ranging from governance to auditing.

Component One: Enabling Environment	<ol style="list-style-type: none"> 1. Legal and regulatory technical assistance. 2. Policy and regulatory capacity building. 3. Formulation of disbursement and governance mechanisms for capacity. 4. Transaction adviser to support eGovernment applications. 5. Monitoring and Evaluation system. 6. Establish website portal for government information.
Component Two: Connectivity	<ol style="list-style-type: none"> 1. Support competitive pre-purchase of capacity in regional and national networks. 2. Support for financing the government communications network. 3. Digital village transparency initiative and SMS/e-service initiative.
Component Three: Transparency	<ol style="list-style-type: none"> 1. Transition government processes such as immigration, driver licensing to eGovernment software applications. 2. Roll out eProcurement software applications in selected departments.
Component Four: Project Management	<ol style="list-style-type: none"> 1. Project management and implementation in the following areas: <ol style="list-style-type: none"> a. Capacity building in management. b. Procurement and financial management. c. Monitoring and evaluation, and governance. d. Office equipment. e. Incremental operating costs. f. Audits.

Figure 10. Summary of “menu” options chosen for TCIP

4.4 Kenya: The Nature of Technology

As the World Bank and its Kenyan counterparts, such as the Ministry of Information (MoIC), created a diffusion plan for TCIP, they conducted a study to lay out how the technology would be diffused, or built out. The technology selected was a large-scale network, as described in the previous chapter. Such networks have been shown to effectively spur economic growth (Indjikian & Siegel, 2005; Bassanini & Scarpetta, 2002; Corea, 2007; Roller & Waverman, 2001). According to World Bank RCIP documents, for example, lowering the cost of Internet access is expected to bring four key benefits (World Bank 2007e, p. 42). First, lower access costs will increase the opportunity for foreign and local private investment. Second, improved Internet access will decrease the cost of doing business in the region. Third, lowering the cost of Internet access will increase job prospects and the potential for wealth generation. Finally, high-speed data connections will help countries in the region glean the benefits of ICT as a method of delivering eGovernment services and improve transparency. As noted previous, the deployment and diffusion of such networks require large start up fixed investments, interoperability, and system-wide coordination.

The core physical component of the technology being diffused in TCIP and its parent project, RCIP, is a fiber optic data network. In the E&SA region, this data backbone will run from southern Kenya to Mozambique (see figure four). As part of the fiber optic build out, TCIP personnel will work with Kenyan internet service providers, such as Kenstream, Jambonet, Kenpac and Kensat, to switch over Kenya's Internet

access link from satellite and analog telephone connections to fiber optic connections. In addition, the fiber optic infrastructure will enable the improvement of Internet Exchange Points (IXPs) in Kenya. An IXP acts as a central routing mechanism between multiple ISPs within a country and permits faster and more efficient data routing (European Internet Exchange Association).

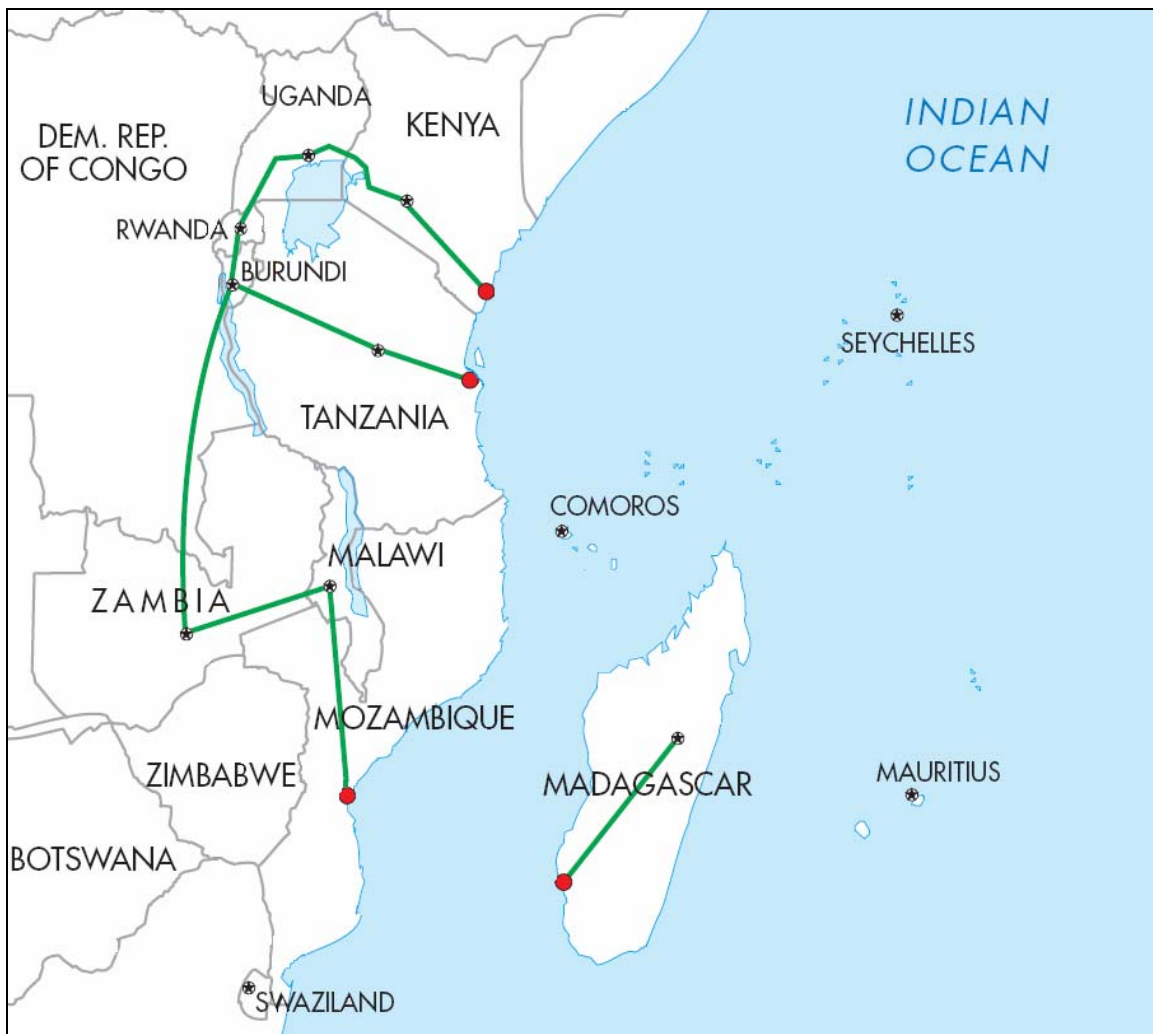


Figure 11. E&SA proposed infrastructure, courtesy the World Bank

Once the fiber optic data backbone is in place, the World Bank expects to work with the Kenyan government to generate several key outcomes from the process, as originally identified in figure two. One of the uses for the backbone is the Digital Village concept, which will be rolled out as a phase of TCIP. In the Digital Village concept, centers with networked computers or terminals will be set up to provide public access to eGovernment services (World Bank, 2007d, p. 2). Such services may include email, banking, government, business, education, agriculture and health. Digital Villages will be installed in many of the 1,000 post offices nationwide because “the country-wide network of post office branches provides a logical and feasible starting point to rapidly scale-up access points” (World Bank, 2007d, p. 2). To fund this concept, Digital Villages will be launched with support from the World Bank, the MoIC and private financiers.

Another use of the Kenya backhaul transmission link is a commodity pricing alert system via short message service (SMS), or text message to be used by farmers and traders. Farmers in rural Kenya who have access to timely and reliable market information on crop prices and other inputs can dramatically increase their profits. To meet this demand, TCIP aims to expand an existing SMS commodity messaging system, called SMS Sokoni, currently in use by the Kenya Agricultural Commodity Exchange. As part of TCIP, the expansion of SMS Sokoni would “scale up this service for a wider range of agricultural commodities including key export crops such as coffee and tea” (World Bank, 2007d, p. 2).

4.5 Kenya: The Nature of Diffusion

The discussion of diffusion, which appeared in chapter two, informs the review presented here of diffusion models used in Kenya's TCIP. As defined in Chapter Two, diffusion is a process in which innovations move through the communication channels of a social system over time (Rogers, 2004).

As described in Chapter Two, the theoretic perspective that is most relevant to the TCIP effort is that of punctuated equilibrium (Tushman & Anderson, 1986; Romanelli & Tushman, 1994). A system operating in a state of punctuated equilibrium exhibits slow and seemingly insignificant change for long periods of time. Amid these periods are moments of radical technological shift, called revolutionary periods, which disrupt existing patterns. In the period that follows a new level of technology and equilibrium is reached. Between 1999 and 2007, Kenya experienced such a technological shift, and the World Bank estimates a second shift will occur between 2010 and 2012.

Let us look at the case of Kenya in more detail. From 1999 to 2004, when Kenya's data network access service was a monopoly managed by Telkom Kenya, users grew from 100,000 to 400,000 (Communications Commission of Kenya, 2005). In 2004, the existing technology was mature enough so that when the Communications Commission of Kenya (CCK) liberalized the data network access sector, the number of users abruptly rose from 400,000 to one million (CCK, 2005). Although tariffs decreased

in 2004 with the advent of free-market competition, growth stalled and user access increased only by 111,000 between 2004 and 2006 (CCK, 2005). It is estimated that in seven years from the previous economic “revolutionary” period of 2004, a second technological shift will occur as TCIP investments begin to produce growth. In 2007, the World Bank estimates Internet user penetration will be 1.25 million, more than doubling to three million users by 2012 (World Bank, 2007e, p. 42). As can be seen in figure five, sector liberalization punctuated the growth equilibrium in 2004 and is estimated to do so again in 2011.

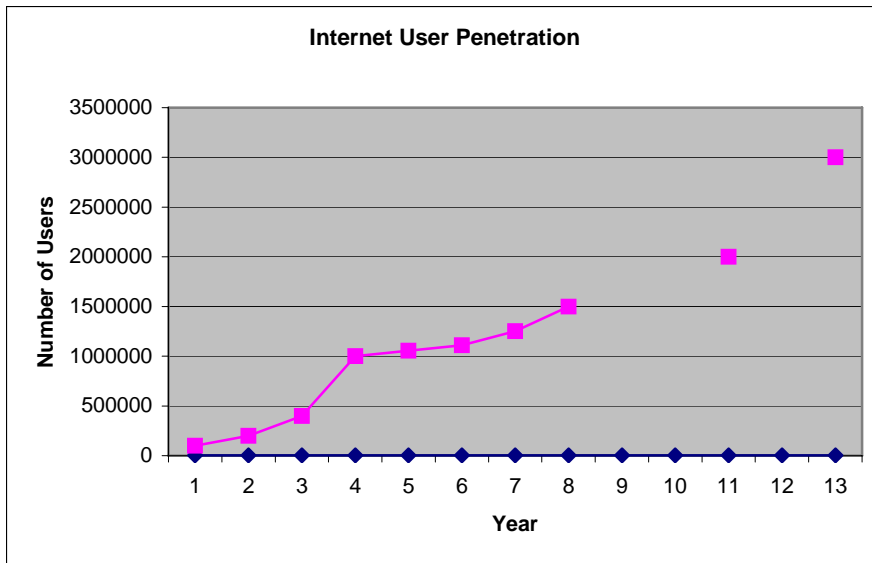


Figure 12. Kenyan Internet user penetration (CCK 2007; World Bank 2007)

A second theory that illuminates diffusion in TCIP is that of technological revolutions. A technological revolution may be defined as a strong and visible grouping of technologies, products and industries that are capable of generating an upheaval in an

economy that then boosts development (Perez, 2002, p. 8). She notes that technological revolutions have four central change phases: invention, innovation, commercialization and dissemination. However, while technological revolutions may proceed as indicated in established economies, technological revolutions in developing markets, such as the TCIP project in Kenya, may require a slightly different approach. Kenya may be perceived as a late adopter or laggard due to its relative lateness in seeking to newly adopt technology that is already mature in other countries. Therefore, in the case of Kenya and TCIP, the first two stages of Perez's technological revolution, invention and innovation, actually took place elsewhere. However, Perez's latter two stages, commercialization and dissemination, are taking place within Kenya's economy, as illustrated by the four components chosen for TCIP (see figure 2).

Another concept that provides context for technological diffusion within TCIP is that of Freeman and Louçã's (2001) six phases of technology system diffusion (see figure six). Phase one is a laboratory-invention phase in which many scientific discoveries may occur that are not necessarily related to one another. In phase two, demonstrations occur that illustrate the feasibility of the discoveries, from a technical and commercial perspective. Phase three is a time of explosive growth and economic upheaval caused by the arrival of new regulation. Phase four is a continuation of the growth begun in phase three, but the technology system is now an accepted and dominant presence. Phase five sees profitability wane as the existing system continues to mature and new technologies

appear and begin to challenge it. Finally, in phase six the technology system reaches maturity and as it interacts with newer technologies, it could either beneficially co-exist or begin to slowly disappear.

Six Phases of Technology System Diffusion	
Phase 1	Laboratory invention
Phase 2	Feasibility demonstrations
Phase 3	Explosive growth
Phase 4	Continuing growth
Phase 5	Slow down of profitability
Phase 6	Maturity of the technology system

Figure 13. Six phases of system diffusion

As with technological revolutions, the six phases of technology system diffusion require an adjusted perspective when applied to a developing economy, specifically Kenya. Initial research and development of a technology frequently occurs in industrialized countries and is then applied to developing countries over time (World Bank, 2007c; UNCTAD, 2007). The U.S. military invented the data network technology leveraged in TCIP in the late 1960s. Feasibility demonstrations of fiber-optic data network technology exist in other regions of Africa, notably in the presence of the South Atlantic 3/West Africa Submarine Cable (SAT-3/WASC) that runs from Europe down the western coast of Africa. SAT-3/WASC proved that large multi-stakeholder projects could successfully implement data network access service in previously unconnected regions of Africa. Freeman and Louçã's phases three through six are estimated to occur within the next five years as the technology implemented as part of TCIP begins to

positively affect the economy, given the strong impact technology systems have on economic development (World Bank, 2007e, p. 42; Indjikian & Siegel, 2005; Bassanini & Scarpetta, 2002; Corea, 2007).

4.5.1 Change Agents and Opinion Leaders

Still to be examined are the role of change agents and opinion leaders in Kenya's diffusion process. Hughes (1976) argues that while external scientific knowledge may propel diffusion, it is internal factors such as politics and social values that effectively cause change. Indeed, while the scientific knowledge behind fiber-optic data network installation existed for some time, TCIP began because Kenyan leadership made ICT a key pillar in the country's Economic Recovery Strategy for Employment and Wealth Creation plan (MoIC, 2006, p. 13, 45).

Another change agent that helps technological diffusion in TCIP is the public private partnership (PPP) model. Within the scope of the project, the PPP model is composed of the Kenyan government, the World Bank and private corporations. According to the World Bank (2007e), the aim of the private aspect of the partnership is to deploy backbone infrastructure and rural networks (p. 7); focus on missing links and avoid redundant infrastructure development (p. 19); and create a solid foundation for eGovernment applications (p. 19). The aim of the public aspect of the partnership is to award competitive subsidies because deployment of national backbones and rural

networks may not be commercially feasible on their own (World Bank, 2007e, p.20).

Therefore, they may require assistance to reach profitability and thus permit the leveraging of private investment (World Bank, 2007e, p. 33).

The other two change agents significantly impacting TCIP are Kenya's MoIC and the World Bank. First and foremost, the World Bank, an external change agent, partnered with MoIC, an internal change agent, to create and implement TCIP. In addition, MoIC is providing high-speed network access to educational institutions and hospitals as well as Digital Villages. The latter will be "established across the country and operated through PPPs and will increase the access of the rural and poor residents to government services" (World Bank, 2007e, p. 9). Finally, in addition to financial assistance, the World Bank is making available expert technical and management resources to the TCIP project staff members that are operating out of MoIC.

Of equal importance to the role of change agents in the diffusion process is that of opinion leaders. As discussed in Chapter Three, opinion leaders operate within the system and work with external change agents (Rogers, 2004). They frequently and informally influence individuals' attitudes or overt behavior in a desired way. In general, opinion leaders are unique in that they are located at the nexus of multiple interpersonal communication networks. In TCIP, these opinion leaders exist in two roles. The first role is that of "change champion," and the goal is to "help promote adoption from within government" (World Bank, 2007e, p. 20).

The second role of opinion leader in TCIP is a framework for the MoIC’s TCIP team to follow. The Communications Framework (World Bank, 2007f, p. 21) notes that the nexus of multiple interpersonal communication networks includes civil society, media, the citizenry and the Internet (see figure seven). The World Bank provides examples of potential opinion messages, including: “TCIP is more than just a telecom infrastructure project” (2007f, p. 21) and refers to it as a social project which will lower the cost of doing business and increase job prospects and wealth generation.

Civil Society	Very active civil society – good opportunity to engage and obtain feedback, reality-check.
Media	Diverse and relatively independent media voice.
Citizenry	Active citizenry keen to participate in decision making.
The Internet	Relative to other African countries, public has easy access to Internet through cyber-cafes – facilitates information dissemination.

Figure 14. Nexus of communication

4.6 Outcome of the Diffusion Process

In examining diffusion outcomes, one needs valid measurements. The most generally accepted and the most common measurement in TCIP is data network access teledensity. Data network access teledensity in Kenya was 7.5 million users in 2007, and the World Bank estimates it to be 15 million in 2012 (2007f, p. 42). Another measurement of diffusion is volume of international traffic in megabits per second (Mbit/s), simplex. In 2007, Kenya’s baseline was 4,000 Mbit/s and the World Bank estimates it will be 7,500 Mbit/s in 2012 once TCIP is fully implemented. A third measurement of diffusion is the price of Internet service for access at 128 kilobits per

second. In 2007, the cost of the service was \$500 per month, but it is estimated to drop to \$70 by 2012 (World Bank, 2007f, p. 43). If these estimates are met, the organization will consider TCIP to be a successful technological diffusion project.

According to the World Bank, one of the most important measurements of diffusion outcome in TCIP is economic growth. One indicator of economic growth in relation to technological diffusion is the propagation of Business Process Outsourcing jobs. In 2007, Kenya had 500 such jobs, but with the conclusion of TCIP, the World Bank (2007f, p. 43) estimates that the number will increase to 10,000 by 2012. Another important measurement of economic growth is gross domestic product (GDP). In 2007, Kenya's GDP growth was estimated to be six percent. The World Bank (2007e, p. 27) estimates that widespread Internet connectivity adds between 0.6 percent and 0.9 percent growth per year to a country's GDP. TCIP documents indicate that an increase in economic growth will be considered proof of the project's success.

4.7 Conclusion

This chapter focused on a case study of large-scale data network infrastructure diffusion in Kenya. To test the hypothesis of this thesis, this case study examines how the variables identified in technological diffusion played out in the context of this situation. The hypothesis states that successful technological diffusion in international development projects requires both top-down and bottom-up approaches. The type of international

development framework used in TCIP, that is to say, the independent variable, is a hybrid top-down/bottom-up model. The outcome of the diffusion process—the dependent variable—is measured via teledensity. Finally, the intervening variable—the nature of technology being diffused—is networked technology. The model of diffusion is a modified technological revolution.

Many conclusions may be drawn from the research conducted in this thesis. First and foremost is the idea that a hybrid model of development is the key to success. TCIP uses a bottom-up model in that it sought technical and financial support from the World Bank through NEPAD. TCIP uses a top-down model in that it is dictating the importance of data infrastructure and how, when and where it will be diffused to local Kenyan communities.

One idea that relates to the impact of the hybrid model on technological diffusion is “goodness of fit” (Carayannis & Sipp 2006). In essence, the technology utilized in the diffusion process as part of a development project must be the appropriate to the target community. For example, while TCIP may reduce the cost of doing business and increase the number of available jobs, Internet access may possess little utility to a community whose primary problem is lack of potable water. However, as Kenya’s development agenda advanced, it became clear to the country’s leadership that a high-speed networked ICT infrastructure was integral to the country’s economic growth. It should be noted that

goodness of fit may be dictated in top-down development, rather than sought out, as in the bottom-up model.

TCIP also illustrated that successful technological diffusion in development projects requires appropriate telecommunications policies. Indjikian and Siegel (2005) note that technological diffusion may “have a sustained, long-lasting impact on productivity and economic growth, provided that policymakers implement policies that facilitate a faster rate of diffusion and a better allocation of resources.” Fully one-quarter of the TCIP project plan is dedicated to policy and improving the institutional and regulatory environment, thus illustrating its importance to successful diffusion of networked ICTs.

Finally, a study of TCIP must address the current political situation in Kenya. Due to civil unrest, the future of TCIP remains uncertain. The unity government agreement brokered by Kofi Annan remains at a standstill as of March 2008. It is of significant concern that if a national government cannot cooperate internally, it will also struggle to cooperate externally. In addition, the two opposing factions are using Kenya’s telecommunications sector as a bargaining chip. It remains a bone of contention between the two factions largely because of its profit and growth potential.

Chapter 5. Conclusion

5.1 Introduction

Information and communication technologies (ICTs) exploded in the 1990s and subsequently, development organizations began adapting them to international development projects. One such organization, the World Bank, recognized the potential utility of ICTs and in 2000 created a group dedicated to implementing them globally in development projects. The group, called GICT, “serves as the World Bank Group’s core department for research, policy, investments and other programs related to ICTs in developing countries” (World Bank 2008a). The International Telecommunication Union, the information and technology branch of the UN, also recognized the importance of ICTs in development and in 1992 created ITU-D, which is dedicated to “using the power of latest generation technologies to spur social and economic development in the world’s poorest regions” (ITU, 2006, p. 3).

However, while the use of ICTs in development has grown in depth and scope since the 1990s, the implementation of development projects in general has evolved as well. In the mid-twentieth century, development projects were realized using a top-down model, in which resources flowed downward from the industrialized or “developed” countries. However, a migration of the development model began to occur and today many development projects follow a bottom-up or grassroots model, in which the needs of the local community are communicated upward to the organizations with resources

and the two groups work together to realize project goals. The reason that bottom-up models became more prevalent is related to models of diffusion.

This thesis hypothesized that successful diffusion of networked ICTs in international development projects requires both top-down and bottom-up approaches. In essence, technological diffusion must be generated by individuals both within and external to the social system. The question this thesis sought to answer was how the diffusion of networked systems technology differs from that of stand-alone technology in international development projects. Chapter Two examined international development frameworks, which was the independent variable of this hypothesis. Chapter Three studied the nature of the technology and models of its diffusion, which was the intervening variable. Chapter Four reviewed a case study of networked ICT diffusion in Kenya and looked at the outcome of the diffusion process, which was the dependent variable. This chapter reviews the research question and hypothesis in light of these discussions and characterizes their implications for diffusion projects in the arena of international development.

5.2 Review: International Development Frameworks

Chapter Two examined the traditional binary of top-down versus bottom-up development frameworks and proposed a third model that is a hybrid between the two. In a top-down development framework, resources and project goals originate in, and flow

downward from, top-level organizations to developing countries. The top-down development model, particularly modernization theory, was discussed in terms of a linear progression from “traditional” country to “industrialized” country (Rostow as cited in Menzel, 2006). In contrast to the top-down model, a bottom-up development framework sees project goals originate in local communities and resources are requested from top-level organizations by local actors. This model saw development through a lens of human agency, multidisciplinary study and culture (Sen, as cited in Corbridge, 2006, p. 232; Sánchez-Rodríguez, 2006, p. 64; Melber, 2006, p. 17). Given these two models of development, a third, or hybrid, model proposed cooperation between top-level and local organizations.

After an examination of development frameworks, it is clear that there exists a need to re-examine the top-down/bottom-up binary. The scope of this thesis was a study of diffusion in international development, in which there is interaction between northern or industrialized countries and developing countries. Future research needs to address the utility of this binary. It seems that a decentralized classification scheme might better serve a global community that is still struggling to overcome tones of post-colonialism.

5.3 Review: Technological Diffusion Frameworks

The rationale for the switch from practicing top-down development in the mid-twentieth century to the more modern practice of bottom-up development lies in models

of diffusion. The most renowned is that of Rogers (2004), who identifies diffusion as information traveling throughout a social system, across time. One of Rogers' (2004) tenets of diffusion is that the role of the change agent is important to the diffusion process. He argues that innovation is introduced into a social system via outside change agents, who then work in tandem with opinion leaders who exist locally within the system.

Several theorists argue that Rogers' ideas regarding diffusion are flawed, particularly in reference to networked ICTs. Networked large-scale systems differ from stand-alone technologies in that fixed costs, coordination costs and the need for interoperability are present in the former, but not the latter. Perez (2002), Freeman and Louçã (2001) and Hughes (1976) argue that the diffusion of networked large-scale systems differs from stand-alone technologies. These authors state that diffusion in such systems occurs in long waves. In addition, some theorists state that diffusion occurs via a process called punctuated equilibrium. This theory states that an organization will operate for long periods of time in state of slow or insignificant change and interspersed throughout this patterns are revolutionary periods in which rapid change occurs ((Tushman & Anderson, 1986; Romanelli & Tushman, 1994). Finally, some theorists (David, 1990; Brynjolfsson & Hitt, 1993) note that in networked systems diffusion, a unique productivity paradox exists wherein the entire system must be in place for benefits to accrue.

Given the differences between diffusion of large-scale networked technology and stand-alone technology, what are the implications? For successful technological diffusion of networked systems to occur in development, several conditions must be met. First, stability must exist at the governmental level. If stability is absent, inadequate leadership and commitment, financial and otherwise, will be unable to sustain the extensive period before benefits and returns may be accrued.

Additionally, successful technological diffusion of large-scale networked systems possesses several indirect requirements because stable government has several requirements. First, it requires governmental transparency, which mitigates corruption. Second, standards and policies must be in place to create an operational business framework for initiatives such as business process outsourcing (BPO). Next, financial resources must be available to support these requirements. Finally, a system of checks and balances within the salient government agencies must exist. The presence of such a system will help the relevant groups or organizations to remain results-focused and also meet target deliverables (World Bank, 2007b, p.1).

Although governance and supporting initiatives are important to successful technological diffusion of large-scale networked systems, appropriate telecommunications policies and standards are crucial. Such a framework may include some degree of public-private partnership (PPP), whether through privatization or other

concept, which would bring telecommunications services, such as broadband Internet access, down to affordable levels and also provide viable business models for investors.

Another important condition for technological diffusion of large-scale networked systems to occur is the idea of forward thinking. As mentioned earlier, economic growth in networked systems can occur only when the entire system is in place. Hence, significant resources, such as funding and staffing, must be provided to the project for gains to be realized. Keeping an eye on the technological horizon and thus being cognizant of up-and-coming technological advances, resources are conserved and not spent on what could potentially be outdated or inefficient technology.

Lastly, a study of large-scale networked technology diffusion requires recognition of the uniqueness of the development context. As UNCTAD notes, diffusion in development countries generally occurs when technologies are new to a country, regardless of whether or not they are new to the global community. In the development context, technological diffusion often occurs through learning and acquisition of existing technologies, not by conducting research and development at the local level.

5.4 Review: Kenya and TCIP

Using the framework identified in chapters two and three, chapter four examined a case study of a data backbone infrastructure implementation project undertaken by the World Bank. The project was called RCIP and contained a component called TCIP,

which focused on building out the data backbone in Kenya. RCIP, and thus TCIP, was created because as of March 2007, so terrestrial connection existed between the southeast Africa and the global fiber optic network infrastructure supporting the global Internet. In addition, Internet penetration in the region remains lowest among developing regions and what access is available is cost prohibitive.

TCIP, and thus also RCIP, is a unique hybrid development project that uses both top-down and bottom-up models of development. The bottom-up aspect is illustrated in the request of regional leaders to the World Bank for assistance. The top-down model is illustrated by regional leaders' decision to prioritize the ICTs in the development agenda. The hybrid model is also illustrated in TCIP's use of "menu options," which were used to decide which aspect of RCIP would be implemented in TCIP. The Kenyan TCIP menu consists of an enabling environment; connectivity; and eGovernment applications.

However, TCIP is an illustration that measurement of hybrid models of development should exist on a spectrum, ranging from models that are only moderately hybrid, in which top-models are still mostly in use, to extremely hybrid, in which participation between top-level actors and community-level actors is truly cooperative. On a hybrid measurement spectrum, TCIP would rate as only slightly bottom-up, as the impetus for the project did not come from local communities, but rather from Kenyan leadership at the national level.

Studying technological diffusion used in TCIP shows that punctuated equilibrium is the most apt model. This model is seen in the number of data network access subscribers in Kenya between 1999 and 2007, as well as the World Bank's estimates for 2012. Change was slow and generally insignificant from 1999 to 2004, when subscribers rose from by 300,000. In 2004, when the industry liberalized, subscribers rose by 600,000 in one year. The World Bank estimates a second period of technological revolution will as TCIP investments began to reach saturation and thus maturity. By 2012, the organization estimates 7.5 percent of Kenya's population, or approximately three million people, will have Internet connectivity.

Finally, in the study of TCIP, an examination of change agents was undertaken. Hughes (1976) argues that internal factors such as politics and social values cause change and indeed, TCIP began because Kenyan leadership made ICT development a national priority. In addition, the PPP model was also a successful change agent, in that it brought in external agents, such as the World Bank. In addition, the PPP model also brought in internal agents, such as the MoIC's ICT Board, which oversaw the Kenyan TCIP team. Opinion leaders are also an important part of the change agent model in technological diffusion (Rogers 2004) and the World Bank and Kenyan TCIP team used a Communications Framework to create positive opinion about TCIP.

A few lessons may be drawn from TCIP. One of which is the idea discussed earlier of "goodness of fit." While TCIP may reduce the cost of doing business, increase

employment and generate wealth (World Bank, 2007e), it is of little use to communities who most require malaria medication or potable water, for example. In identifying future initiatives, Kenyan leadership needs to work with local communities to determine what might best encourage growth. Another lesson that may be drawn from TCIP is that successful diffusion in development necessitates an appropriate telecommunication framework of standards and policies. Twenty-five percent of the TCIP project plan, one of its four “menu options,” is dedicated to improving the institutional and regulatory environment for ICTs in Kenya.

Finally, any study of Kenya cannot be complete without touching on its political situation. As of March 2008, civil unrest means that the time schedule of TCIP remains uncertain. Although a peace agreement between political factions was negotiated, it has yet to be successfully implemented. It is of concern that if a national government cannot cooperate with itself, how will it cooperate with external actors?

5.5 Future Research

This thesis sought to examine technological diffusion in international development projects, which is a large and complex topic. One problem with this thesis was the use of a single case study. To obtain a strong command of top-down and bottom-up diffusion models, comparing two case studies in which each model was used in one case would have provided a more comprehensive examination. In addition, no interviews

of relevant subjects were conducted in the course of this thesis due to time constraints and a lack of funding. Future researchers may find it useful to conduct interviews with World Bank personnel and personnel within the Kenyan government, such as those at the Ministry of Information and Communication. In addition, speaking with community-level actors would be of significant use to determine the placement of TCIP on the hybrid spectrum. Finally, this thesis relied only on publicly available information and had no access to World Bank or Kenyan documents, files or processes. Future research on this topic may find value in those resources.

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